

DEPARTMENT OF FOOD TECHNOLOGY
SCHOOL OF TECHNOLOGY

SYLLABUS

FOR

MASTER OF TECHNOLOGY IN
FOOD TECHNOLOGY



ISLAMIC UNIVERSITY OF SCIENCE AND TECHNOLOGY

AWANTIPORA, PULWAMA – 192122, J and K.

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

M. Tech. Food Technology
Course structure- at a Glance (Scheme)

S. NO	Course Code	Course Title	Credits	Semester	
Core Courses (Semester 1st)					
1	MFT-CC-901	Advances in Food Chemistry and Nutrition	3+1	Semester 1 st	
2	MFT-CC-902	Food Microbiology and Toxicology	3+1		
3	MFT-CC-903	Emerging Techniques in Food Processing	3+1		
4	MFT-CC-904	Research Methodology	1+1		
Elective Courses					
5	MFT- EC-914	Refrigeration Engineering and Cold Chain Management	2+1		
6	MFT- EC-915	Beverage Technology	2+1		
7	MFT- EC-918	Numerical Solutions	2+1		
Thesis					
8	MFT-TH-922	Thesis	2		
Open Elective					
9		Open Elective	2		
Core Courses (Semester 2nd)					
10	MFT- CC-905	Advanced Techniques in Food Analysis	2+2	Semester 2 nd	
11	MFT- CC-906	Credit seminar	1+0		
12	MFT-CC-907	Food standards & Regulation	2+1		
13	MFT-CC-908	Advanced in Food Engineering	3+0		
Elective Courses					
14	MFT-EC-916	Processing Techniques of Indigenous Foods in Kashmir	2+1		
15	MFT-EC-921	Industrial Bio Technology	2+1		
16	MFT-EC-913	Food Supply Chain Management	2+1		
Thesis					
17	MFT-TH-922	Thesis	4		
Open Elective					
18		Open Elective	2		
Core Courses (Semester 3rd)					
19	MFT-CC-909	Nutraceuticals and Functional Foods	2+1	Semester 3 rd	
20	MFT-CC-910	Product Design and Development	2+0		
21	MFTCC-911	Equipment design in Food Processing	2+0		
Elective Courses					
22	MFT-EC-912	Animal Product Technology	2+1		
23	MFT-EC-919	Technology of spices and Spice Products	2+1		
24	MFT-EC-920	Novel Techniques in Food Packaging	2+1		
25	MFT-EC-917	Snack Technology	2+1		
Thesis					
25	MFT-TH-922	Thesis	10		
Semester 4th					
26	MFT-TH-922	Thesis	17		

- Master's Degree in Food Technology requirement is 80 credit hours comprising of 42 credit hours for course work and 33 credit hours for research project
- Students have a choice to select any two courses in Elective Courses offered in the respective semester.
- Core courses are compulsory to all.

MFT –CC-901 ADVANCES IN FOOD CHEMISTRY AND NUTRITION

Objective

Credits (3+1)

To go beyond basic chemistry and nutrition into advances with the aim of developing healthy and nutritious foods for normal and special category of population groups.

Theory

UNIT- I

Interaction among food components and effect on sensory, nutritional/ processing quality Desirable/ undesirable changes during food processing- chemical changes in starch, cellulose, pectin, vitamins, plant pigments during processing. Water activity, concept, water sorption isotherms and mathematical models. Mobility and glass transition temperature. Glass transition of food components. Water activity measurement. Role of water activity in oxidative reactions, NEB and microbial growth. Free Radicals, natural antioxidants, mechanism of action of antioxidants, In-vitro methods of measuring antioxidant activity in foods. Source of antioxidants in foods and role in health (anthocyanidins, carotenoids, Resveratrol, Glucosinolates, terpenoids, phytoestrogens, phytosterols, dietary flavonoids, procyanidins).

UNIT- II

Functional properties of sugars in foods. Sweeteners/ sweetness theory. Functional properties of polysaccharides; poly-water interaction, viscosity, acidic polysaccharides. Starch composition and properties, modified starch, application of starches in food industry. Natural and synthetic gums. Dietary fiber, composition, physical/ physiological properties. Effect of cooking on dietary fiber. Fat oxidation, mechanism, effect of processing on functional properties of lipids. Functional properties of proteins (organoleptic, kinesthetic, hydration, surface properties, structural, rheological). Dough formation; (texturizability, fiber spinning). Protein structure and functionality, denaturation of proteins. NEB effect on Protein nutrition. Effect of processing on functional/ nutritional properties of protein.

UNIT- III

Flavor technology, Essential oils, and recovery methods for essential oils. composition of essential oils Spice extracts, oleoresins, Flavor generation in foods, flavor analysis. Flavor of meat, milk, butter, bread, coffee, tea. Flavor wheel, Synthetic flavors

UNIT-IV

Hunger scenario child malnutrition (National/ International), Nutrition programmers. Childhood obesity. Glycemic index, glycemic load. Geriatric nutrition. Changes associated with aging which require changed diet. Junk foods, Micronutrient deficiencies/ challenges in food fortification. Food fortification and its techniques. Nutrigenomics- role of nutrients in gene function. Genetic disorders and nutritional disorders. Pre, probiotics and concept of para-probiotics. The main methods used to inactivate probiotics to produce para-probiotics, their role as modifiers of biological responses as well as their potential application in food.

Practical's:

1. Preparation of nutritional requirements charts as per ICMR recommendations for various population groups.
2. Measurements of moisture content in cereals, pulses, oil seed. Vegetables, fruits, (3each)
3. Measurement of specific gravity and refractive index of foods.
4. Qualitative tests for carbohydrates, proteins and fats.
5. Estimation of Carbohydrate protein and fat in food samples
6. Demonstration of effect of varying relative humidity on texture, and visual sensory quality of various food products.
7. Preparation of o/w/ w/o emulsions
8. Comparison of foaming properties of proteins.
9. To study factors that affect rancidity of fats.
10. Microscope examination of starch.
11. Separation of pigments from green leafy vegetables/ fruits.
12. Study effect of heat and pH on plant pigments.
13. Test for adequacy of blanching in fruits/ vegetables
14. Effect of various treatments on discoloration of banana/apple.
15. Study of gel formation from alginate gums.
16. Preparation of leaf protein concentrate
17. Estimation of essential oil of spices.
18. Preparation of chilly oleoresin

Suggested Readings

1. Belitz, H.D, Grosch, W Schieberle. P. Food Chemistry 4th ed. Springer.
2. Fennema, Owen, R. Food Chemistry, Marcel dekker
3. Richardson, T and finely, J.W (Ed) Chemical changes in Food during Process. CBS Publishers & distributors.
4. Health Hewry B, Remecub Gary flavor Chemistry and Technology CBS Publishers & distributors.
5. Reineccius Gary. source Book of Flavours CBS Publishers & Distributors.
6. Wong, Dominic, W.S Mechanism and theory in Food Chemistry. CBS Publishers & Distributors.

Objective

To acquaint the students with the recent advances and applications in the area of Food Microbiology.

Unit I:

History, scope and importance of food microbiology. Microorganisms and food: Their primary sources of microorganisms in foods: Microorganisms found in Air, soil and water

Unit II

Microbiological examination-Methods of Isolation and detection of microorganisms or their products in food. -Conventional methods - Rapid methods (Newer techniques) – Immunological methods: Fluorescent, antibody, Radio immunoassay, ELISA etc. - Chemical methods PCR (Polymers chain reactions), RT PCR, Microchip based techniques. Predictive microbiology and modeling for microbial safety of foods.

Unit III

Food borne infections and diseases: Significance to public health, Food hazards and risk factors, Bacterial, and viral food-borne disorders, Food-borne important animal pathogens, - *Bacillus*, *Campylobacter*, *Brucella*, *Staphylococcus*, *Clostridium*, *E. coli*, *Aeromonas*, *Vibrio cholerae*, *Listeria*, *Mycobacterium*, *Salmonella*, *Shigella*, Microbiological criteria of foods and their significance, Mycotoxins, Aflatoxins – Patulin, RDA, Detection Methods.

UNIT -IV

Toxicants and allergens in foods derived from plants, animals, marine, algae and mushrooms. Common food causing allergy, Toxins generated during processing, nitroso amines, acrylamide, dioxins, benzene etc. Radiation hazards of food safety problem of pesticide residue in fruits/ vegetables.

Practical's:

1. Preparation of common laboratory media and special media for cultivation of bacteria, yeast
2. & molds
3. Staining of Bacteria: Gram's staining, acid -fast, spore, capsule, Motility of bacteria, Staining
4. of yeast and molds.
5. Isolation of microorganisms: Different methods and maintenance of cultures of microorganisms.
6. Bacteriological analysis of Foods using conventional methods.
7. Coli forms analysis of milk and water samples using MPN, Direct and membrane filter techniques.
8. To perform various biochemical tests used in identification of commonly found bacteria in
9. foods IMVIC urease, H₂S Catalase, coagulase, gelatin and fermentation (Acid/gas)
10. Determination of thermal death characteristics of bacteria.
11. Visits (at least two) to food processing unit or any other institution dealing with advanced
12. methods in food microbiology and visit to pesticide residue Laboratory (SKUAST K)

Suggested Readings

1. Pelzer, M.I. and Reid, R.D. (1993) Microbiology McGraw Hill Book Company, New York, 5thEdition.
2. Atlas, M. Ronald (1995) Principles of Microbiology, 1st Edition, Mosby-Year Book, Inc, Missouri, U.S.A.
3. Topley and Wilson's (1983) Principles of Bacteriology, Virology and Immunity, Edited by S.G.
4. Wilson, A. Miles and M.T. Parkar, Vol. I: General Microbiology and Immunity, II: Systematic Bacteriology. 7th Edition. Edward Arnold Publisher.
5. Frazier, W.C. (1988) Food Microbiology, McGraw Hill Inc. 4th Edition,
6. Jay, James, M. (2000) Modern Food Microbiology, 6th Edition. Aspen publishers, Inc., Maryland.
7. Banwart, G. (1989) Basic Food Microbiology, 2nd Edition. CBS Publisher.
8. Doyle, P. Benehat, L.R. and Mantville, T.J. (1997): Food Microbiology, Fundamentals and Frontiers, ASM Press, Washington DC.
1. Adams, M.R and M.G. Moss (1995): Food Microbiology, 1st Edition, New Age International (P) Ltd.

MFT-CC-903 EMERGING TECHNIQUES IN FOOD PROCESSING Credits (3+0)

Objective

To develop an insight among the students about the existing modern techniques so as to aware them about their methodology and applications in food processing.

Theory

UNIT-I

Introduction to heat, mass and momentum transfer and their analogues behavior, unsteady state condition equation, unsteady state heat conduction in rectangular solids, cylinder and spheres. Models of heat transfer through convection and radiations. Molecular diffusion in gases, liquids and solids; unsteady state mass transfer and mass transfer coefficient. Overall momentum balance, differential equation of momentum transfer. Membrane Technology: Introduction to pressure activated membrane processes: micro- filtration, UF, NF and RO and their industrial application. Supercritical fluid extraction: Concept, property of near critical fluids (NCF) and extraction methods.

UNIT- II

Microwave and Radio Frequency Processing: Definition, Advantages, mechanism of heat generation, application in food processing: microwave blanching, sterilization and finish drying. Hurdle technology: Types of preservation techniques and their principles, concept of hurdle technology and its application minimal Processing.

UNIT - III

High Pressure Processing: Concept, equipment's for HPP treatment, mechanism of microbial inactivation and its application in food processing. Ultrasonic processing: Properties of ultrasonic, application of ultrasonic as processing techniques.

UNIT -IV

Newer Techniques in Food Processing: Application of technologies of high intensity light, pulse electric field, ohmic heating, IR heating, inductive heating and pulsed X-rays in food processing and preservation irradiation, Nanotechnology: Principles and applications in foods. Electron Beam processing, Encapsulation Technology

Suggested Readings

1. Barbosa-Canovas 2002. Novel Food Processing Technologies. CRC.
2. Dutta AK & Anantheswaran RC. 1999. Hand Book of Microwave Technology for Food Applications.
3. Frame ND. (Ed.). 1994. The Technology of Extrusion Cooking.
4. Blackie, Gould GW. 2000. New Methods of Food Preservation. CRC.
5. Shi J. (Ed) 2006. Functional Food Ingredients and Nutraceuticals Processing Technologies. CRC

MFT-CC-904 Research Methodology Credits Hours 1+1

Unit: I

Definition and Meaning of research, Characteristics of Research, Objectives and Types of Research, Attributes of Good Research, Research Method and Research Methodology, Scientific Method and Research, Steps of research process, Developing of Theories, Significance of Research, Research Problems and Preparing Research Proposal, Criteria of Good Research Problem, Sources, Selection, and Definition of Problem, Research Proposal, Types, Contents of Research proposal, Research Design Meaning Characteristics and Importance of Research Design, Concepts relating to research Design, Types of Research Design.

Unit: II

Data types, Sources of measurement Error, Goodness of Measures, Scaling: Meaning, Scale Classification, Response methods, Scale Construction Techniques, Sampling Fundamentals, Objectives of a Sample, Sampling Definitions, Sampling and Non-Sampling Errors, Theoretical Basis of Sampling, Sampling Distribution, Standard Errors, Size of the Sample, Estimation, Sampling Designs, Census survey and Sample Survey, Characteristics of a good Sample, Sampling Design Process, Types of Sampling Techniques, Probability Sampling Designs , Non Probability Sampling.

Secondary Data Vs Primary Data, Literature Review, Sources of Secondary Data and Its Collection and Organization, Use of Library, Evaluating Secondary Data, Primary Data, Interview, Mail Survey/ Questionnaire, Schedules, Observation, Case Study Method, types Documentary Method, content analysis, Experimental Method, Data Processing, Editing, Coding, Tabulation, Pictorial and Graphical Presentation of Data, Problems of Processing, Transcribing, Data Analysis, Factors Influencing Data Analysis strategy,

Unit: III

Measures of Central Tendency, Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean, Measures of Dispersion, Range, Mean Deviation, Measures of Shape, Skewness, Kurtosis, Measures of Relationship, Co-relation Analysis , regression analysis

Important terms and definition of Probability, Additive, Multiplicative Theorem, Conditional Probability, Binomial Probability, Testing of Hypothesis-Parametric TestI, Meaning Characteristics of Hypothesis, Basic Concepts of related to Hypothesis Testing, and Procedure, Types of Hypothesis Tests, Hypothesis Testing of Means and Proportions, Limitations of Hypothesis Tests, Parametric Tests-II(F-Test and ANOVA), F-Test for Testing variance of Two Normal Populations, Analysis of Variance – ANOVA Technique, one and two way ANOVA in Latin Square, Analysis of Covariance Chi-Square Test, X^2

Unit: IV

Classification of Computers, Computers Architecture, Characteristics of a Computer, Data Representation, Application of Computers, Computer in Research, Windows processes, Windows Processes, Commonly Used statistical Package How to Use SPSS. Interpretation and Report writing Interpretation and Implementation, Pitfalls in Interpretation, Qualities of Good Research Report, Types of Report, Steps in Writing the Report, layout of Report, Procedure for Writing Bibliography, Procedure for Writing references, Guidelines for Writing a report, Evaluation of the Research Report.

Reference

1. Ranjit Kumar, Research Methodology A step- by- step Guide for Beginners
2. Kothai, C.R, Garg Gaurav. Research Methodology, Methods and Techniques New, Age International Publishers
3. Kalyani Publishers Research Methodology, methods, Tools and Techniques
4. Upgagade , Vijay, Shenda Arvind. Research Methodology, S. chand & company
5. Napoleon, D and Narayanan, B. BalajiSatha Research Methodology (A theoretical Approach) University science Press

Unit -1

Introduction to Rheology of Foods: Definition of texture, rheology and psychophysics – their of structural basis; physical considerations in study of foods; salient definitions- stress tensor and different kinds of stresses.

Unit -II

Examining food microstructures: history of food microstructure studies, light microscopy, transmission electron microscopy, scanning electron microscopy, other instrumentation and techniques, Image analysis: image acquisition, image processing, measurement analysis, Food structure: traditional food structure and texture improvement, approaches to food structure, extrusion and spinning, structured fat products, structure and stability, gels, gelation mechanisms, mixed gels, the microstructure of gels, structure-property relations in gels.

Unit III

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

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.

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

Practical's:

1. To calculate the moisture content of the given food sample using Vacuum oven, MW oven, IR Drying
2. To calculate the protein of the given food sample using automatic nitrogen estimation system.
3. To calculate the fat content of the given food sample using automatic fat estimation system.
4. To calculate the fiber content of the given food samples using automatic crude fiber estimation system.
5. Estimation of total sugars in the given food's samples by Dubois method, Anthrone Method, Lane and Eynon,
6. Estimation of Ascorbic Acid content in given food samples by HPLC/ Dye Method
7. To find ash content of simple (soluble, in soluble ash)
8. Mineral profile analysis of food samples by Atomic Absorption Spectroscopy and Titrimetric Method.
9. Qualitative and quantitative analysis of amino acids by paper chromatography (ascending / descending / circular)
10. To measure refractive index of oil by using Abbe's Refractometer.
11. Estimate of hydrolytic, oxidative and microbiological rancidity of given oil samples.
12. Determination of food adulterants in given food samples.
13. Estimation of browning in foods/ enzymatic/ non enzymatic
14. Estimation of color of different food products using Hunter color Lab/ Tintometer.
15. To study the water activity of given a food product.
16. Texture profile analysis of foods samples.
17. Determination of antioxidant activity of given food sample using HPLC.
18. Extraction and estimation of plant phenolic substances by colorimetric and spectrophotometric techniques.
19. Rheology of Dough using rheometer
20. SEM/TEM of Food Samples
21. Differential Scanning calorimetry of Food Samples

MFT-CC-906

Credit Seminar

1+0

Unit -1

Concepts of quality management: Objectives, importance and functions of quality control; Quality management systems in India; Quality assurance, Total Quality Management; GMP/GHP; GLP, GAP; Sanitary and hygienic practices. NABL accreditation and NABL accredited Laboratories in India Euro GAP

Unit -II

Regulatory Approaches to Food safety-present scenario, food safety and standards Act, 2006, Food Licensing & Registration System (FLRS). The Food Safety and Standards Regulations 2011: Licensing and Registration of Food businesses, Sampling procedures and plans. Food product standards and Food Additives Part I and Part II, Prohibition and Restriction on sales of contaminants, toxins and residues.

Unit-III

Food categorization System, Product/ Ingredient Approval, Export & Import Laws and Regulations, FTDR Act, 1992 and Foreign Trade Policy, Food Import Clearance System (FICS). Introduction to OIE and IPPC, other International Food Standards (e.g. European Commission , USFDA etc) WTO: Introduction to WTO agreement: SPS and Agreement, Export and Import Laws and regulation Export (Quality control and Inspection) Act, 1963.

Unit-IV

Codex Alimentations Commission (CAC), CAC Implications on trade in light of SPS and TBT, Other International Standards Setting Bodies Harmonisation of India's Food Standards with Codex Standards and other International Best Practices. Food Commodity Geographical identification bar coding. Certification of organic labelling procedures, Food editing in commercial Food factories, safety in Food label design requirements, Bar coding requirements, Nutrition information expire date and best before etc. (COOL) centre of origin labelling

Practical

1. Testing and evaluation of quality attributes of raw and processed foods.
2. Detection and estimation of food additives and adulterants.
3. Quality assurance procedure, GMP, GAP documentation.
4. Preparation of quality policy & documentation.
5. Application of HACCP to products.
6. Preparation of HACCP chart.
7. Preparation of documentation & records, Visit to Units with ISO systems; Visit to Units with HACCP certification; Visit to Units implementing GMP, GAP; Mini-project on preparation of a model and laboratory manual.

Suggested Reading:

1. Singal RS. 1992. Handbook of Indices of Food Quality and Authenticity; Woodhead Publ Cambridge, UK.
2. Shapton DA. 1991. Principles and practices Safe Processing of Foods; Butterwor Publication, London.
3. Resources at FSSAI Website.
4. ISO Standards and Documents from NIFTEM Knowledge Centre.
5. Early R. 1995. Guide to Quality Management Systems for Food Industries. Blackie Academia.
6. Furia TE. 1980. Regulatory Status of Direct Food Additives, CRC Press.
7. Export and Import Policy of GOI.

MFT- CC-908 ADVANCES IN FOOD ENGINEERING Credits (3+0)

Objective

To acquaint with recent advances of Food Engineering and its Processes.

Theory

UNIT-I

Introduction to modes of heat mass and momentum transfer and their analogues behavior, convection radiation unsteady state condition equation, unsteady state heat conduction in rectangular solids, cylinder and spheres. Molecular diffusion in gases, liquids and solids; unsteady state mass transfer and mass transfer coefficient. Overall momentum balance, differential equation of momentum transfer.

UNIT-II

Theory of microfiltration/ ultra-filtration, Nano-Filtration and reverse osmosis. Selection and types of membranes and their properties. Mathematical description of flow through membrane. Application and use in food industry.

UNIT-III

Biomaterials and their properties in relation to processing, their role in the development of new products and processes. Physico-Chemical Characteristics, Physical Characteristics: shape, sphericity, size, volume, density, porosity, surface area, coefficients of friction, and angle of repose and influence of constituents on processing design of equipment's.

UNIT- IV

Psychometry, WBT, DBT, Psychometry charts, humidification and dehumidification. Application of Psychometry in drying of foods.

Suggested Readings

1. Charm SE. 1971. Fundamental of Food Engineering. AVI Publ.
2. Cheryan M. 1998. Ultra-filtration and Micro-filtration Handbook.
3. Technomic Publ. Duckworth R. 1975. Water Relations in Foods. Academic Press.
4. Heldman DR & Singh RP.1984. Food Process Engineering. AVI Publ. Hendrickx and Knorr.
5. Rockland LB & Stewart GF. 1991. UHP Treatments of Foods.
6. KA/PP Publ. Mohsenin NN. 1986. Physical Properties of Plant and Animal Materials.

Gordon & Breach Science Publ.

7. Rao MA & Rizvi SS.1986. Engineering Properties of Foods.

8. Marcel Dekker. Robertson GL. 1992. Food Packaging (Principles and Practices).
Marcel Dekker.

9. Watson EL & Harper JC.1989. Elements of Food Engineering. AVI Publ. Figura, L.O and
Teixeira, A.A. 2007. Food Physics. Springer.

1. Sahin S. and Sumun S.G (2006) Physical Properties of Food . Springer

2. Steffe J. 1996. Rheological Methods in Food Process Engineering. Freeman Press. East
Lansing, MI USA. Available Online www.egr.msu.edu/~steffe/

3. Rao M.A.; Rizvi, S.S H.; Datta, Ashim K.2005, Engineering properties of Foods. Taylor &
Francis

MFT- CC-909 NUTRACEUTICALS AND FUNCTIONAL FOODS Credits (2+1)

Objective

To cater to the newly emerging area of nutraceuticals with respect to the types, mechanisms of action, manufacture of selected nutraceuticals, product development, clinical testing and toxicity aspects.

Theory

UNIT- I

Introduction to nutraceuticals: definitions, Nature, type and scope of nutraceutical and functional foods.

UNIT -II

Nutraceutical and functional food applications and their health benefits, Nutraceutical compounds and their classification based on chemical and biochemical nature with suitable and relevant descriptions. Functional foods and nutraceuticals as anti-cancerous, hypo-lipidemic, anti-stress, osteoarthritis, hypotensive, hypoglycemic, hypoallergenic food, neuro-protective food.

UNIT- III

Nutraceuticals from fruits, vegetables and spices. Antioxidants and other phytochemicals, dietary fibre and complex carbohydrates from oats, wheat bran, rice bran. Probiotics and prebiotics and their functional role. Coffee, tea and other beverages as functional foods/drinks. Whey proteins, soy proteins and Spirulina, fish proteins as functional foods .

UNIT -IV

Stabilities of nutraceuticals, nutraceuticals and Food interactions, Bio-availability of nutraceuticals; Safety, marketing and regulatory issues for functional foods and nutraceuticals, Future of functional foods and nutraceuticals, recent developments and advances in functional foods and nutraceuticals. Drug- nutraceuticals interactions.

Practical's

1. Market survey of existing health Foods and their health claims
2. Identification of Nutraceuticals from fruits/ vegetables/ spices. (I) Carotenoids (II) Ascorbic Acid (III) Poly phenols (IV) Tannins
3. Estimation of dietary fibre from locally consumed food stuffs. (Rice, Wheat, maize. Local

fruits/ vegetables.

4. Preparation and quality evaluation of functional foods. From locally available materials and their quality evaluation.
5. Preparation of pro biotic milk products.
6. Development of labels for health foods.
7. Visit to relevant processing units.

Suggested Readings

1. Brigelius-Flohé, J & Joost HG. 2006. Nutritional Genomics: Impact on Health and Disease.
2. Wiley VCH. Cupp J & Tracy TS. 2003. Dietary Supplements: Toxicology and Clinical Pharmacology. Humana Press.
3. Gibson GR & William CM. 2000. Functional Foods - Concept to Product.
4. Goldberg I. 1994. Functional Foods: Designer Foods, Pharma Foods.
5. Losso JN. 2007. Anti-angiogenic Functional and Medicinal Foods. CRC Press.
6. Manson P. 2001. Dietary Supplements. 2nd Ed. Pharmaceutical Press.
7. Campbell JE & Summers JL. 2004. Dietary Supplement Labeling Compliance.
8. Neeser JR & German BJ. 2004. Bioprocesses and Biotechnology for Nutraceuticals.
9. Chapman & Hall. Robert EC. 2006. Handbook of Nutraceuticals and Functional Foods.
10. 2nd Ed. Wildman. Shi J. (Ed) 2006. Functional Food Ingredients and Nutraceuticals: Processing technologies. CRC. Webb
11. GP. 2006. Dietary Supplements and Functional Foods. Blackwell Publ.

MFT- CC-910 PRODUCT DESIGN AND DEVELOPMENT Credits (3+0)

Objective

To enable the student to plan and prepare a project report for food processing unit and to provide capability to execute and evaluate the same.

Theory

UNIT- I

Concept of product development - product success and failure, factors for success, process of product development, managing for product's success. Innovation strategy - possibilities for innovation, building up strategy, product development programme.

UNIT- II

The product development process - product strategy, product design and process development, product commercialization, product launch and evaluation. The knowledge base for product development technology - knowledge and the food system, knowledge management, knowledge for conversion of product concept to new product, technological knowledge (product qualities, raw material properties, processing, packaging requirement, distribution and marketing. Role of consumers in product development - consumer behavior, food preferences, avoiding acceptance, integration of consumer needs in product development and sensory needs.

UNIT -III

Managing the product development process, - principles of product Development management, people in product development management, designing the product development process, key decision points, establishing outcomes, budgets and constraints, managing and organizing product development process.

UNIT- IV

Improving the product development process - key message, evaluating product development, innovative matrices, striving for continuous improvement, Improving success potential of new products, market exploration and acquisition, Legal aspects of new product launch.

- (i) Green processing
- (ii) Life scale assessment

(iii) Carbon Credit Analysis

(iv) Zero Discharge Wastage

Suggested Readings

1. Clarke and Wright W.1999. Managing New Product and Process Development. Free Press.
2. Earle and Earle 2001. Creating New Foods. Chadwick House Group. Earle R, Earle R Anderson A. 2001.
3. Food Product Development. Woodhead Publ. Fuller 2004. New Food Product Development – from Concept to Market Place. CRC.

MFT- CC-911 EQUIPMENT DESIGN IN FOOD PROCESSING Credits (2+0)

Objective

To introduce basic equipment design and various process control mechanisms and related engineering aspects

Theory

UNIT- I

Process design of piping, Fluid moving devices and Flow meters: Introduction, process design of piping, NPSHA & NPSHR, losses in fluid flowing in pipes. Power required by pump, evaluation of centrifugal pump performance when handling viscous liquids, flow meters, process design of flow meters.

UNIT- II

Process design of heat exchangers: shell and tube heat exchangers, Functions of various parts of Shell and Tube heat exchangers, General design method of shell & Tube heat exchangers, criteria of selection among Fixed Tube sheets, U tube & Floating Head heat exchangers, Process design of heat exchanger without phase change.

UNIT- III

Design of evaporator: Introduction, types of evaporators, methods of feeding of evaporators, General design consideration of evaporator. Design of driers: Introduction, type of driers, design consideration of driers.

UNIT- IV

Basic data for design of pressure vessels, classification of pressure vessels, stresses in thin cylindrical shell, Strength of materials, circumferential (hoop) stresses and longitudinal stresses. Reinforcement of cylinder for high pressure vessels.

Suggested Readings

1. Considine DM. 1974. Process Instruments and Controls. Mc-Graw-Hill.
2. Considine DM. 1964. Handbook of Applied Instrumentation.
3. Mc-Graw-Hill. Eackman DP. 1972. Automatic Process Control.
4. Wiley Eastern. Evans FL. 1974. Equipment Design Hand Book. Vol. II. Gulf Publ.
5. Foust AS et al. 1960. Principle of Unit Operations.
6. John Wiley & Sons. Hesse ND, C.R. & Ruston JH. 1964. Process Equipment's

Design. Affiliated East-West Press.

7. Kempe's Engineers Year Book 1996. Miller Information Services, UK. Kern DQ. 1965.

8. Process Heat Transfer. McGraw-Hill. Liptak BG. 1995.

9. Process Measurement and Analysis. Butterworth-Heinmann. McCabe WL, Smith JC & Harriott P. 1993. McGraw Hill.

MFT-EC-913 Food Supply Chain Management Credits (2+1)

Unit- 1

Introduction and overview of Food Supply Chain Management, present status of Food Supply Chains in India and challenges thereof, System view of logistics, Co-ordination and management of transportation Characteristics of different transportation services, Carrier selection, contracting and evaluation methods,

Unit- II

Inventory strategies and management, Transportation infrastructure and management, Facility location, Materials handling. Logistics/Supply Chain (SC) Strategy and Planning: Corporate Strategy, Logistics/SC Strategy, Logistics/SC Planning, Levels of Planning, Major Planning Areas, Conceptualizing the logistics/SC Planning Problems, Guidelines for Strategy Formulation, Selecting the Proper Channel Strategy, Measuring Strategy Performance. The Logistics/ Supply Chain Product: Nature and Classification of products, The Product Life Cycle, Product Characteristics Tracing and Traceable Techniques

Unit- III

Order Processing and Information Systems: Defining Order Processing, Order Preparation, Order Transmittal, Order Entry, Order Filling, Order Status Reporting, Order-Processing Examples, Industrial Order Processing, Retail Order Processing, Customer Order Processing, Web-Based Channel Order Planning, Other Factors Affecting Order-Processing Time, Processing Priorities, Parallel versus Sequential Processing, Order-Filling Accuracy, Order Batching.

Unit-IV

Strategic considerations for supply chain, Porter's industry analysis and value-chain models, Concept of total cost of ownership, Supply stream strategies, Classification and development guidelines, Measuring effectiveness of supply management, Logistics engineering. Operations Research Models for operational and strategic issues in supply chain management. The Bullwhip Effect and supply-chain management game. Food traceability issues.

Suggested Readings:

1. Chopra, S and Meindi P (2004). "Supply chain management-Strategy, Planning and Operation", Pearson Education.
2. Raghuram, G and Rangaraj N (2000). "Logistics and Supply Chain Management: Cases and Concepts", Macmillan, New Delhi.
3. Simchi-Levi, D., Kaminski, P and Simch-Levi (2003). Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies". 2nd Edition, Irwin, McGraw-Hill.
4. Shapiro, J (2001). "Modeling the Supply Chain" Duxbury Thomson Learning.

**MFT-EC-914 REFRIGERATION ENGINEERING AND COLD CHAIN
MANAGEMENT Credits (2+0)**

Objective

To acquaint the students with technology and operational systems of cold chain management in the retail, whole sale and over all supply chain in the food industry.

Theory

UNIT- I

Present scenario of post-harvest loss of perishables in India and in developed countries. Factors affecting post-harvest loss of perishables. Factors affecting metabolic process of respiration, transpiration, ripening, ethylene production, and senesce in perishables. Artificial ripening of banana/ mango. Quality assessment of fresh horticulture fruits and vegetables Q10 concept Principles of mechanical refrigeration system, refrigeration cycle, classification of refrigerants design of cold storage unit, heat of respiration, calculation of refrigeration load, Commodity storage requirements, solar power refrigeration and green refrigeration, principles of CA Storage and its application. Zero energy storage of fruits and vegetables.

UNIT II

Introduction, scope and importance of cold chain in food processing industry and retail chain, components of cold chain and integration. National center for cold chain development. Products going in cold chain, their temperature and humidity requirements, packaging needs and their compatibility in cold chain.

UNIT- III

Stages and points of control in cold storages and structures, functions in cold storages, pallet layout and stacking options, flexibility storage systems cold chain transportation in land and export, retail & supermarket cold chain and display systems.

UNIT- IV

Temperature recording devices used during transport, documentation and traceability, Risk management problem diagnosis, cost benefit studies for type of transport, loading and unloading, storage duration. REFID Technology in cold chain management.

Suggested Readings

There are no books on cold chain management but there are chapters in supply chain management books shown in next course.

1. Visit to CA storage units at Lassipora
2. Visit to Banana / Mango ripening chambers
3. Visit to local fruit/ vegetable markets/ Mandies

Objective

To provide a technical view of beverages and a full discussion of Manufacturing processes in the context of technology and its related chemistry as well as a more fundamental appraisal of the underlying science.

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 fermented 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, Equipment's used for brewing and distillation, wine and related beverages, distilled spirits. And beer original Gravity.

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, flavored water, carbonated water.

Practical's:

- 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. Hardwick WA. 1995. Handbook of Brewing. Marcel Dekker.
2. Hui YH et al 2004. Handbook of Food and Beverage Fermentation Technology.

3. Marcel Dekker. Priest FG & Stewart GG. 2006. Handbook of Brewing. 2nd Ed. CRC.
4. Richard PV. 1981. Commercial Wine Making - Processing and Controls. AVI Publ.
5. Varnam AH & Sutherland JP. 1994. Beverages: Technology, Chemistry and Microbiology.
6. Chapman & Hall. Woodroof JG & Phillips GF. 1974. Beverages: Carbonated and Non-Carbonated. AVI Publ.

**MFT- EC-916 PROCESSING TECHNIQUES OF INDIGENOUS FOODS IN
KASHMIR Credits (2+1)**

Objective

Unit I

Tree Nuts:

Almonds: Cultivation & harvesting, indigenous varieties. Post-harvest processing steps- dehulling, drying, cracking, packaging, storage. Quality attributes.

Walnuts: Harvesting, processing steps for whole nuts/ kernels- dehulling, washing, bleaching, drying, cracking, color sorting, vacuum packaging, marketing. Quality aspects- physical, chemical & microbiological.

Unit II

Fruits:

Apple: Maturity indices, processing steps- harvesting, washing, grading, waxing, packaging & storage- cold chain management, CAS. Quality attributes,

Apricot: Processing steps- harvesting, sorting, washing, preservation by drying, storage. Apricot products.

Unit III

Saffron: Harvesting, separation of stigma, drying, grading, packaging, marketing. Changes during storage, quality attributes.

Unit IV

Honey: Harvesting from beehive & local structures, processing, dewaxing, clarification, packaging. Quality aspects, Quality control.

Unit V

Meat & dairy products:

Meat preparations (Wazwan)- Kabab, Goshtaba, Rista, Rogan Josh, Tabakh Maaz, etc. Packaging (canning) & storage. Quality & Health attributes.

Harrisa- Preparation, Quality, marketing.

Indigenous fish products: dried (Hoakhgard) & smoked (phari). Preparation & quality attributes.

Dairy Products: Kalari- production process, physiochemical & quality attributes, use in local preparations.

List of Practical's:

1. Visit to walnut/almond processing plants.
2. Visit of apple CA plant.
3. Visit to processing plant.
4. Visit to local wazwan canning units.
5. Visit to Kalari processing units.

Objective

To provide knowledge of principles and characteristics of extruders and support systems for effective selection and operation, to review current practices for preparation of fried chips and other extruded snacks and also to demonstrate equipment in operation and familiarize students with practical aspects of snack foods processing technology.

Theory**UNIT -I**

Technology for grain-based snacks: whole grains - roasted, toasted, puffed, popped and flakes, coated grains-salted, spiced and sweetened; flour based - batter and dough-based products; savory and farsans; formulated chips and wafers, papads, instant premixes of traditional Indian snack foods.

UNIT -II

Technology for fruit and vegetable-based snacks: Chips, wafers; Technology for coated nuts - salted, spiced and sweetened; chikkis.

UNIT- III

Extruded snack foods: Formulation and processing technology, coloring, flavoring and packaging.

UNIT- IV

Equipment's for frying, Baking and drying, toasting, roasting and flaking, popping, blending, Coating, chipping. Corn flacks (scones, crozans) cheeses balls Baked snakes

Practical

1. Preparation of various snack foods based on cereals, legumes, nuts, fruits, vegetables and extrusion cooking their quality evaluation.
2. Development of instant food premixes.
3. Determination of shelf-life and packaging requirements; Visits to industries manufacturing snack foods.

Suggested Readings

1. Edmund WL. Snack Foods Processing.
2. Frame ND. 1994. The Technology of Extrusion Cooking. Blackie Academic. Gordon 3.
- BR.1997. Snack Food.AVI Publ
4. Samuel AM.1976. Snack Food Technology. AVI Publ.

Objectives

In practical applications, an engineer finally obtains results in a numerical form. The aim of numerical analysis is to provide efficient answers to any problems. The course will enable students to use numerical techniques to tackle problems that are not analytically soluble. case study, Dummy data

UNIT-I

Difference operators, divided differences, interpolating polynomials using finite differences, Hermite interpolation, Spline interpolation, Interpolation. Numerical solution of algebraic and transcendental equations by bisection, secant and Newton-Raphson's Methods.

UNIT-II

Numerical differentiation, maxima and minima of a tabulated function Numerical differentiation based on interpolation, finite differences and undetermined coefficients. Numerical integration using methods based on interpolation and undetermined coefficients.

UNIT-III

Numerical integration; Numerical integration by Trapezoidal, Simpson's and Weddle's rules, difference equations, solution of linear difference equations, numerical solution of ordinary differential equations by Picard's, Taylor's series, Euler's, modified Euler's and Runge-Kutta methods, Food Potation data.

UNIT-IV

Numerical solution of ordinary differential equations of first order and first degree by Runge-Kutta method and predictor-corrector methods. Iterative techniques

Practical's:**Suggested Readings**

MFT- EC-919 TECHNOLOGY SPICES AND SPICE PRODUCTS Credits (2+1)

Unit-I

Introduction: Status and scope of spice and flavour processing industries in India; Spices, Herbs and seasonings: sources, production, selection criteria; flavours: commercially available materials, classification on the basis of origin, physical characteristic.

Unit-II

Processing technology of Spices: Chemical composition of spices; processing methods: equipment's used in the processing of spices; spice encapsulation; recent developments in production, retention and recovery of spices; effect of processing on spice quality: contamination of spices with micro-organisms and insects.

Spice Essential Oils: Definition, methods of extraction, isolation, separation equipment's.

Unit-III

Flavour Technology: Essence(flavour) recovery techniques from fruits, spices and herbs along with the equipment used: liquid and Solid flavour production; Flavouring remixing: flavour intensifiers: synthetic flavours; effect of processing on flavour quality.

Unit-IV

Spice Oleoresins: Definition, method of extraction, isolation, separation equipment.

Spices and flavour quality evaluation: Criteria for assessment of flavour quality; identification of natural food flavours; methods of flavour evaluation (chemical, instrumental, sensory); PFA standards for flavouring materials and flavours.

Practical's:

Books Recommended:

1. Handbook of Spices by Peter K.V.2001, Woodhead Publishers, UK.
2. Spices and Condiments by Pruthi, J.S.,1976, NBT India.
3. Spice Statistics by Spices Board 2007, GOI, Cochin.
4. Source book of flavor by Reineccius, G, CBS
5. Food Flavours by Morton, I.D., Macleod, A.J, AVI Publishers

MFT-EC-920 NOVEL TECHNIQUES IN FOOD PACKAGING Credit (2+1)

Objective

To provide knowledge about selected trends and development in food packaging technologies and materials aiming at assuring the safety and quality of foodstuffs in order to design an optimized package which satisfies all legislative, marketing and functional requirements sufficiently, and fulfils environmental, cost and consumer demands as well as possible.

Unit-1

Active and intelligent packaging systems, 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

Unit-2

Oxygen and ethylene, scavenging technology, concept and its food applications Carbon dioxide, odor and flavor absorber and other scavengers, ethanol emitters and preservative releaser, and their food packaging uses Antimicrobial food packaging: concept and mechanism, Factors affecting the effectiveness of antimicrobial packaging

Unit-3

Non-migratory bioactive polymers (NMBP) in food packaging, Advantages and limitations Inherently bioactive synthetic polymers: types and applications, Polymers with immobilized bioactive compound Time-temperature indicators (TTIs), Definition and classification of TTIs, Requirement, development and current TTI systems, effectiveness of TTIs, Application of TTIs- to monitor shelf-life, and optimization of distribution and stock rotation

Unit-4

Packaging-flavor interactions, Factors affecting flavor absorption, Role of the food matrix and different packaging materials. Case studies: Packaging and lipid oxidation. The problem of plastic packaging waste, the range of biopolymers, developing novel biodegradable materials, Legislative issues, Current applications, integrating intelligent packaging, role

of packaging in the supply chain, Creating integrated packaging, storage and distribution: alarm systems and TTIs, Traceability: radio frequency identification,

List of Practical's

1. Application of MAP packaging in selected foods
2. Study of time temperature indicators
3. Determination of oxidative changes in packaged foods
4. Comparative evaluation of flexible and rigid packages for fragile foods
5. To study textural characteristics of selected fruit/ vegetable under MAP storage
6. Shelf-life evaluation of packaged food product under accelerated and refrigerated conditions
7. Study of aseptic packaging system
8. Determination of oil and grease resistant test for packaging films
9. Visit to food packaging material manufacturing industry and packaging laboratory
10. Equipment's used in packaging material digital bursting strength meter, compression tester. Internal play Bond Tester, Film permeable Tester.

Suggested Readings

- Ahvenainen R. 2001. Novel Food Packaging Techniques. CRC.
- Crosby NT. 1981. Food Packaging Materials. App. Sci. Publ.
- Mahadeviah M & Gowramma RV. 1996. Food Packaging Materials. Tata McGraw Hill.
- Painy FA. 1992. A Handbook of Food Packaging. Blackie.
- Palling SJ. 1980. Developments in Food Packaging. App. Sci. Publ
- Rooney ML. 1988. Active Food Packaging. Chapman & Hall.
- Sacharow S & Griffin RC. 1980. Principles of Food Packaging. AVI Publ.
- Painy FA. 1992. A Handbook of Food Packaging.
- Blackie. Palling SJ. 1980. Developments in Food Packaging. App. Sci. Publ.

Rooney ML. 1988. Active Food Packaging. Chapman & Hall. Sacharow S & Griffin RC.1980.
Principles of Food Packaging. AVI Publ. Stanley S & Roger CG. 1998. Food Packaging

Objective

To develop an understanding of enzymes useful in food product technology and food processing with respect to production and purification protocols, applications in commodity technologies, and their impact on sensory and nutritional quality.

Unit-1

Introduction: Interaction of chemical engineering, biochemistry and microbiology, Chemical Reaction kinetics, kinetics of batch and continuous cultures, process variables, Biocatalysts in food processing: scope and present status in India in relation to food industry. Sources of enzymes, advantages of microbial enzymes, mechanism of enzyme function, Production and purification of enzymes, immobilization and applications of biocatalysts in food processing, enzyme biosensors.

Unit II

Fermenter and bioreactors: Transport phenomenon in microbial systems, types of reactor, working principles, aeration and agitation, sterilization and sanitation, advances in continuous fermentation, developments in solid-state fermentation for food applications. Production of alcoholic beverages: Introduction, classification of alcoholic beverage, Production of alcoholic beverages: raw materials, culture, fermentation technology of non-distilled Beverages (beer and wine) and distilled alcoholic beverages (brandy, whiskey, vodka, rum, gin)

Unit-III

Production of organic acids/acidulants and Single Cell Proteins: Raw materials, Starters and fermentation conditions, recovery and applications, Case studies production of acetic acid (vinegar), citric acid, lactic acid and gluconic acid. Production of Bio-colors, Bio-Flavours: Factors affecting pigment production, Uses in food, color laws and regulations. Flavor biosynthesis, Enzymatic flavor synthesis, Fragrances via Yeast Fermentation, Challenges and Opportunities. Single cell proteins production: substrates, Factors effecting SCP production, composition, uses, economic parameters and constrains including safety aspects.

Unit IV

Product recovery operations and waste utilization: Handling of materials in microbial systems, filtration, centrifugation, sedimentation, chromatography, membrane separation (UF and NF) and electrophoresis, separation and disintegration of cells for product recovery operations. Biological waste treatment and in plant sanitation.

List of Practical's:

- 1 Study of fermenter and fermentation process
- 3 Study of bioprocess instrumentation and control system
- 4 Production and maintenance of starter culture
- 6 Production of enzyme, extraction and purification
- 7 Production of SCP
- 8 Production of amino acids
- 9 Production of alcohol and alcoholic beverages
- 10 Production of bio-color's and Flavours
11. Visit to brewery
- 12 Visit to effluent treatment plant

Suggested Readings

1. Schimid. *Advances in Biochemical Engineering*.
2. Olson, J. E. Bailey and David F. Ollis. *Biochemical Engineering Fundamentals*. McGraw-Hill Book Co. Inc., New York
3. Pauline, M. Doran. *Bioprocess Engineering Principles*. Academic Press.
4. Perry R.H. *Chemical Engineering Handbook*. McGraw-Hill
5. Stumbo. *Thermobacteriology in Food Processing*. Academic Press, New York
6. Stanbury. *Principles of Fermentation Technology*.