Maulana Abul Kalam Azad University of Technology, West Bengal

Department of Food Science

M. Sc (Food Science & Technology) Syllabus

M. Sc in Food Science and Technology
(SYLLABUS)

Duration: 2 Years (Four Semesters)
Level: Post Graduate
Type: Degree
Admission Requirements:
B.Sc. in Food and Nutrition /B.Sc.in Food Science/ Bachelor's degree in any other branch of Science and Technology having Hons/Minimum 140 Credit Points.

M.Sc. or Master of Food Science and Technology is a post graduate course. Food Science & Technology is the application of science and technology to the sorting, grading, processing, storage or preserving, refining , mixing, blending, heating, drying, manufacturing, handling, packaging, quality control, and distribution food materials , and also use of good quality, safe, nutritious, healthy, and wholesome food. Increasing technology for value addition of plant , animal, and agricultural resources has made food production extremely complex thus causing a need for a very specialised knowledge based and trained Food Science & Technology professional who can grasp and apply such expertise effectively.
In addition the course also includes a significant quantum of industrial learning giving students the opportunities to boost their specialist professional skills facilitate independent learning and implement a reflective and practical approach to practice.
Under this program students gain a close perspective of real-world problems to food science and technology. Students interested in more detailed learning of the subject can apply for higher education in national or international forum.
The Master degree course in Food Science & Technology is an important and careers oriented nature that opens a lot of job opportunities for the candidate in the position of Food technologist, Nutritional therapist, Product or Process development scientist, Quality control manager, Regulatory affairs officers or Food safety officers, Scientific laboratory technician, Production manager, Technical brewer, etc.

PROGRAM OUTCOMES (POs):

PO1- Science and technical knowledge: Apply the knowledge of mathematics, science, and a technological specialization to the solution of complex processing.
PO2- Problem solving: Identify, formulate, design and development of solutions for processing problems that meet the specified needs with appropriate consideration for the safety, and sustainable development.
PO3- Research and analysis: Use research-based knowledge, literature review and research methods including design of experiments, analysis and interpretation of data, for synthesis of products to provide valid usage of modern tools and techniques.
PO4- Environmental sustainability and ethics: Understand the impact of the professional scientific solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development and commit to professional ethics and responsibilities.
PO5- Communication and team work: Communicate effectively on complex technical activities with the science and technological community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions as a member or leader in diverse teams, and in multidisciplinary settings.

PO6- Entrepreneurship development: Demonstrate knowledge and understanding of the technological and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO7- Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

At the end of the program, the student

PSO1: should acquire fundamental theoretical as well as practical knowledge in the field of Food Science and Technology.

PSO2: should apply the concepts of Food Science and Technology, Food Microbiology, Food Chemistry, Food Safety Laws during food processing, food analysis, food preservation, and food packaging in the food sector after successful completion of the program.

PSO3: should develop accuman, skills, and temperament to work in the food processing industries, food research & development, and academia. In addition, the student will boost their specialized professional skills which facilitate independent learning and implement to practical approach as an Entrepreneur to meet the growing demand for processed foods.

M.Sc. (Food Science & Technology) Syllabus

Department of Food Science, MAKAUT, W.B

Semester –I:

Code	Course Title	Contact Hrs./Wk	Credit
A	**Theory**	**L-T-P**	
MSUFT-101	**Food Microbiology**	**3-0-0**	**3**
MSUFT-102	**Nutritional Biochemistry**	**3-0-0**	**3**
MSUFT-103	**Principles of Food Processing Technology**	**3-0-0**	**3**
MSUFT-104	**Fermentation Technology**	**3-0-0**	**3**
MSUFT-105	**Mathematical Techniques for Food Science**	**3-0-0**	**3**
MSUFT-106	**Analytical Techniques and research methodology**	**3-0-0**	**3**
MSUFT-107	**English communication skill(non-credit compulsory course**	**0-0-0**	**0**
B	**Practical**		
MSUFT-191	**Microbiology**	**0-0-6**	**3**
MSUFT-192	**Biochemistry and Analytical Techniques Lab**	**0-0-6**	**3**
Semester Total			**24**

Semester –II:

Code	Course Title	Contact Hrs./Wk.	Credit
A	**Theory**	**L-T-P**	
MSUFT-201	**Food Chemistry**	**3-0-0**	**3**
MSUFT-202	**Technology of fruits and vegetables**	**3-0-0**	**3**
MSUFT-203	**Technology of cereals, pulses and oilseeds**	**3-0-0**	**3**
MSUFT-204	**Technology of milk and milk products**	**3-0-0**	**3**
MSUFT-205	**Waste Management of Food Industries**	**3-0-0**	3
MSUFT-206	**Statistical Techniques for Food Science**	**3-0-0**	**3**
B	**Practical**		
MSUFT-291	**Pickles and Fermented Food Lab**	**0-0-6**	**3**
MSUFT-292	**Food Process Technology Lab**	**3-0-0**	**3**
Semester Total			**24**

Semester – III:

Code	Course Title	Contact Hrs./Wk	Credit
A	**Theory**	**L-T-P**	
MSUFT-301	**Technology of meat, poultry and fish**	**3-0-0**	**3**
MSUFT-302	**Food Packaging Technology**	**3-0-0**	**3**
MSUFT-303	**Food safety and quality control**	**3-0-0**	**3**
MSUFT-304	**Process control and Instrumentation**	**3-0-0**	**3**
MSUFT-305	**Choice Based course (From Elective Basket-I)***	**2-0-0**	**2**
MSUFT-306	**Choice Based course (From Elective Basket-II)****	**2-0-0**	**2**
B	**Practical**		
MSUFT-391	**Milk and Milk product processing Lab**	**0-0-6**	**3**
MSUFT-392	**Meat and Fish Processing Lab**	**0-0-6**	**3**
C			
MSUFT-381	**Seminar**		**2**
Semester Total			**24**

***Elective Subjects Basket-I:**

Code	Subject
MSUFT-305A	**Food Biotechnology**
MSUFT-305B	**Speciality Food and Beverages**
MSUFT-305C	**Enzyme Technology**

****Elective Subjects Basket-II:**

Code	Subject
MSUFT-306A	**Entrepreneurship and Business Management**
MSUFT-306B	**Supply Chain and Retail Management**
MSUFT-306C	**IPR, Biosafety & Bioethics**

Semester –IV:

Code	Course Title	Contact Hrs./Wk	Credit
	Theory	**L-T-P**	
MSUFT-481	**Project Work**		**20**
MSUFT-482	**Industry / Lab visit**		**1**
MSUFT-483	**Journal club and seminar presentation**		**1**
MSUFT-491	**Grand Viva**		2
Total			**24**
Total Course Credit			**96**

SEMESTER I

MSUFT-101: Food Microbiology

Credit: 3 Marks: 100

Course Outcomes (COs):

CO1: Recalling of microbes and their importance, application in day to day life with special reference to food.

CO2: Illustrate various types of food contamination and spoilage by different microorganisms and their preservation techniques.

CO3: Analyze the physical as well as biochemical changes of spoiled food, food intoxication and food borne pathogens

CO4: Determine the rapid methods in detection of microorganisms along with conventional methodologies.

Theory

MODULE I: Microbial nutrition, macronutrients, micronutrients and growth factors; nutritional types of microorganisms based on sources of carbon, energy, and electron; uptake of nutrients by cell (passive and facilitated diffusion, active transport, group translocation, iron uptake); Culture media and culture techniques; Microbial growth curve, growth rate and generation time; measurement of cell number and cell mass; Continuous culture (chemostat, turbidostat); different environmental factors influencing microbial growth (water activity, pH, temperature, oxygen concentration, pressure, radiation); Biofilms.

MODULE II: Pattern of microbial death, General Microbial control methods (physical agents, chemical agents, mechanical removal); basic approaches to food preservation (mechanical removal, low temperature, high temperature, water availability, chemical based preservation, radiation, microbial product based inhibition).

MODULE III: Intrinsic factors (pH, moisture content, water availability, oxidation-reduction potential, physical structure of the food, available nutrients, possible presence of antimicrobial agents) and extrinsic factors (storage conditions, temperature, relative humidity, modified atmosphere packaging) influencing microbial growth in foods, microbial growth and food spoilage (Milk and milk products, Meat and poultry, fruits and vegetables, Ready-to-serve food products) ;

MODULE IV: Microbes in food fermentation, putrefaction, lipolysis; Antagonism and synergism in microorganisms; Microbiology of fermented foods (Fermented milk, Cheese production, Meat and Fish, production of alcoholic beverages –Wines and Champagnes, Beer and Ales, Bread production, etc), Microorganisms as food (Prebiotics, probiotics and symbiotic-system) and food amendments.

MODULE V: Food borne diseases (Botulism, Salmonellosis, Listeriosis, Campylobacteriosis, Shigellosis, E.coli diarrhea and colitis, Cholera, Giardiasis, toxoplasmosis, viral gastroenterititis, cryptosporidiosis) and intoxication (botulinum toxin, aflatoxins, fumonisins, ergotism, major genera involved in food-borne intoxication), Food hygiene and sanitation: Contamination during handling and processing and its control; indicator organisms Detection of food-borne pathogens (selective culture media, antigen detection by ELISA, radioimmunoassay technique; molecular techniques using labelled

probes linked to variety of enzymatic, isotopic, chromogenic or luminescent/fluorescent markers, serotype specific probes and PCR techniques, food-borne pathogen fingerprinting)

Suggested Readings:

1. Microbiology. Prescott, Harley, and Klein`s, 7th edition. McGraw-Hill publication. 2008

2. Fundamental Principles of Bacteriology. A.J. Salle, Tata McGraw-Hill Education. 1974

3. Banawart GJ. 1989. Basic Food Microbiology. 2nd Ed. AVI Publ. Frazier J & Westhoff DC. 1988.

4. Food Microbiology. 4th Ed. McGraw Hill. Garbutt J. 1997.

5. Essentials of Food Microbiology. Arnold Heinemann. Jay JM, Loessner MJ & Golden DA. 2005.

6. Modern Food Microbiology. 7th Ed. Springer. Ray B. 2004.

7. Fundamentals of Food Microbiology.3rd Ed. CRC. Robinson RK. (Ed.). 1983. Dairy Microbiology. Applied Science. Steinkraus KS. 1996.

MSUFT-102 : Nutritional Biochemistry
Credit: 3 Marks: 100
Course Outcome (COs):

CO1: To build the knowledge of students about biomolecules, their structures, relevant biochemical reactions and nutrition.

CO2: To develop an insight on metabolism of different biomolecules and enzymatic pathways leading to end products.

CO3: To discover the basic concepts of vitamins, hormones and water metabolism.

CO4: To create food products using the basic concepts of nutrition, different nutritional demands and dietary requirements.

Theory

MODULE I: Definition, Introduction to biomolecules, Introduction to biochemical and metabolic pathways. Functional aspects of dietary fibre, amino acids & peptides, lactic acid bacteria, antioxidants, vitamins, fatty acids etc. Assessment of nutritional quality of food. Importance of nutrition to health and growth; Relation of food and diseases; Nutritional requirement of human body & RDA.

MODULE II: Carbohydrate metabolism, Pathway of glycolysis & its regulation, Energetics & Role of hormone, Pathway of TCA cycle & its regulation, Energetics & Role of hormone, Glycogen metabolism & its regulation, Energetics & Role of hormones, HMP Shunt pathway & its regulation, Protein sparing action of carbohydrate, Inborn error of carbohydrate metabolism (galactosemia), Glycoprotein & Proteoglycan.

MODULE III: Lipid metabolism: digestion, absorption and functions. Oxidation of fatty acids. Biosynthesis of fatty acids and fats. Food emulsions. Lipid Metabolism Fatty acid

synthesis, Lipoprotein synthesis, β-oxidation & ω-oxidation Forward cholesterol, transportation (LDL & VLDL), Reverse cholesterol transportation (HDL), Disorders of lipid metabolism, Dyslipidemia & Lipid storage disease, Ketosis & Ketone body metabolism.

MODULE IV: Protein Metabolism, Deamination, Transamination & Transmethylation Urea cycle, Protein structure, Inborn error of amino acid metabolism, Nucleic acid Metabolism, Metabolism of Purine and Pyrimidine, Diseases due to abnormal nitrogen base metabolism, DNA replication, mutation, repair & recombination, Gene Expression, Gene expression in eukaryotes & its regulation (Normal), Translation & post translational modification, Inhibitors of protein biology, Gene expression in mitochondria.

MODULE V: Enzymes, Enzyme kinetics including inhibition in enzyme kinetics, Co-enzyme & Co-factors, Enzyme in clinical diagnosis, Vitamins, Free radical, ROS & Oxidation, Xenobiotics & its Metabolism.Food components and nutrients affecting immune systems, behaviour and performance.

Suggested Readings

1. Principles of biochemistry Lehninger

2. Principles of Biochemistry Voet

3. Bamji MS, Rao NP & Reddy V. 2003. Textbook of Human Nutrition. Oxford & IBH. Joshi SA.1999.

4. Nutrition and Dietetics. Tata McGraw Hill. Khanna K, Gupta S,Passi SJ, Seth R & Mahna R. 1997.

5. Nutrition and Dietetics. Phoenix Publ. Swaminathan M. 1974.

6. Essentials of Foods and Nutrition. Vol. II. Ganesh & Co.

7. Osner hawk's Practical Physiological Chemistry Hawk

8. Practical Biochemistry Thamiah

MSUFT-103: Principles of Food Processing Technology

Credit: 3 Marks: 100

Course Outcomes (COs):

CO1: Relate the basic knowledge of food science to understand the need and importance of food processing.

CO2: Identify the causes of spoilage and how they affect the shelf life of food.

CO3: Determine the principles, working mechanism, advantages and disadvantages of different methods and techniques of food processing.

CO4: Evaluate preservation principles in product design and value addition of food products.

CO5: Formulate the appropriate application of different types of processes in specific foods ensuring maximum retention of nutritional and orgnoleptic quality of food products.

Theory:

MODULE I: Scope of food processing; historical developments; principles of food processing and preservation.

MODULE II: Processing and preservation by heat – blanching, pasteurization, sterilization and UHT processing, canning, extrusion cooking, dielectric heating, microwave heating, baking, roasting and frying, etc.

MODULE III: Processing and preservation by low-temperature- refrigeration, freezing, CA, MA, and dehydro-freezing.

MODULE IV: Processing and preservation by drying, concentration and evaporation-types of dryers and evaporators and their suitability for different food products; ultra- filtration, reverse osmosis.

MODULE V: Processing and preservation by non-thermal methods, irradiation, high pressure, pulsed electric field, hurdle technology.

MODULE VI: Use and application of enzymes and microorganisms in processing and preservation of foods; food fermentations, pickling, smoking etc; Food additives: definition, types and functions, permissible limits and safety aspects.

Suggested Readings:

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

MSUFT-104: Fermentation Technology

Credit: 3 Marks: 100

Course outcomes (COs):

CO1: To define biological and biochemical technology, with a focus on biological products by fermentation.

CO2: Summarize the knowledge of the fermentative processes used in the industrial production of primary and secondary metabolites, biomasses and recombinant proteins.

CO3: Identify the types of fermentation and the design and construction of fermenter and parameters to be monitored and controlled in fermentation process in laboratory scale and industrial processes.

CO4: Compile the production of various fermented food.

Theory

MODULE I: Introduction to fermentation: Isolation, screening and maintenance of industrially important microbes; microbial growth kinetics, strain improvement for increased yield and other desirable characteristics. microbes and food fermentations, measurement and control in fermentation, Substrate utilization and product formation. Fermentation Kinetics.

MODULE II: Methods in fermentation- Batch, fed-batch and continuous operations; immobilized cell systems; media formulation and optimization; sterilization of media and air;

oxygen transfer and kLa in fermentation. Fermenter design, instruments and operation; Aeration and agitation in fermentation: Types of fermentation, sub-merged and solid state. Types of fermenters, Batch and continuous fermentation, scale up in fermentation,

MODULE III: Downstream processing for microbial products- Separation of insoluble products: filtration, centrifugation, sedimentation, flocculation; cell disruption; Separation of soluble products: liquid- liquid extraction, precipitation, chromatography, reverse osmosis, crystallization, ultra and micro filtration; drying and packaging.

MODULE IV: Fermented foods and beverages- Food ingredients and additives by fermentation; fermentation as a method of preparing and preserving foods; microbes and their use in pickling, producing colours, flavours and alcoholic beverages; process wastes- whey, molasses, starch substrates and other food wastes for bioconversion to useful products; bacteriocins from lactic acid bacteria. Food Fermentations; Traditional fermented foods of India and other Asian countries; saurkraut, youghurt, miso, tempeh, idli, dosa.

MODULE V: Biological waste treatment, plant sanitation, application of enzymes in food industry, production of food flavour, colour, enzymes, Immobilised enzymes. Regulatory and social aspects of biotechnology of foods.

Suggested Reading:

1. S.M. Reddy, Basic Fermentation Technology, New Age Internationals Publisher
2. Peter F Stanbury Allan Whitaker Stephen J Hall. Principles of Fermentation Technology.
3. Syed Sajeed Ali, FERMENTATION AND INDUSTRIAL MICROBIOLOGY
4. Fermentation Microbiology and Biotechnology, E. M. T. El-Mansi, C. F. A. Bryce , Arnold L. Demain , A.R. Allman , CRC Press.
5. Casida L.E.J.R. Industrial Microbiology, Wiley Eastern Limited, New Delhi.
6. Indigenous Fermented Foods of South Asia. Marcel Dekker, edited by V. K. Joshi, CRC press-Taylor and Francis group, 2016.
7. S. John Pirt, Principles of Microbes and Cell Cultivation, Blackwell Scientific Publications, Oxford, London.
8. Mittal G.S., Food Biotechnology: Techniques and Applications, Technomic, Lancaster, PA.
9. Prescott S.C. & Dunn C.G, Industrial Microbiology, McGraw hill Book Company, INC, New York.
10. Shular, M L and Kargi, F. Bioprocess Engineering, Basic Concepts, Prentice-Hall, Englewood Cliffs, NJ.
11. Aiba, Shuichi, Humphrey Arthur E. and Millis, Nancy. F. Biochemical Engineering, Academic Press INC, , New York.
12. Maiti, B.R. Principles of Bioreactor Design, Viva Books Pvt. Ltd., New Delhi.

MSUFT-105: Mathematical Techniques for Food Science
Credit: 3 Marks:100

Course outcomes (COs):

CO1: Recall different types of matrices, their eigen values, eigen vectors, rank and also their orthogonal transformations essential for physical and engineering problems.

CO2: Outline the domain of applications of mean value theorems to engineering problems.

CO3: Experiment with the tools of power series and Fourier series, infinite series for solving engineering problems related to food industry.

CO4: Analyze the concept and techniques of differential and integral calculus to determine curvature and evaluation of different types of improper integrals.

CO5: Design real life problems which comprise of several variables or attributes and identify extreme points of different surfaces of higher dimensions.

Theory

MODULE I: Linear Algebra: Basics, Vectors, matrices, determinants; Matrix addition and multiplication.

MODULE II: Differential Calculus: Basic concept of functions, limits & continuity with simple applications. Concepts of derivatives of functions and its Simple applications. Fundamental Concepts of Maxima and Minima; Basics of Partial Derivatives; Gradient and Directional derivatives.

MODULE III: Integral calculus: Basic concept of integral calculus with respect to Differential Calculus, integration techniques of some simple basic derivatives, Simple applications of integration for calculation of area & volume. Simpson Rule for graphical integration.

MODULE IV: Differential Equations: Examples of 1st & 2nd order differential equations and their techniques of solutions. Partial derivatives and simple applications.

MODULE V: Numerical techniques for solutions of Mathematical problems.
(To be embedded in Module II through Module IV)

Suggested Readings:

1. G. B. Thomas and R. L. Finney, Calculus and Analytic Geometry, 9th Edition, ISE Reprint, Addison-Wesley, 1998.

2. E. Kreyszig, Advanced engineering mathematics,8th Edition, JohnWiley, 1999. 3. W. E. Boyce and R. DiPrima, Elementary Differential Equations, 8th Edition, JohnWiley

MSUFT-106: Analytical techniques and Research methodology

Credit: 3 Marks:100

Course outcomes (COs):

CO1: Recall previous and basic concepts regarding the working principle of various instruments used in food analysis.

CO2: Illustrate the advantages and reason for using various instruments in the food sector.

CO3: Identify the various knowledge of instruments to analyze different types of food matrices.

CO4: Analyze the sensitivity and reproducibility of analytical results by the various

instruments.

CO5: Design and develop different methods of food analysis using various instruments.

Theory:

MODULE I: Sampling techniques; Water activity, its measurements and significance in food quality; Calibration and standardization of different instruments.

MODULE II: Spectroscopic techniques using UV/Vis, fluorescence, IR, FTIR, NIR, NMR, atomic absorption, ICP, polarimetry, refractometry, microscopic techniques in food analysis (light microscopy, SEM, TEM, XRD, particle size analysis, image analysis etc.).

MODULE III: Chromatographic techniques: Adsorption, column, partition, affinity, ion exchange, size exclusion, GC, GLC, HPLC, HPTLC, GCMS, LCMS.

MODULE IV: Separation techniques: Gel filtration, dialysis, electrophoresis, sedimentation, ultrafiltration and ultracentrifugation, solid phase extraction, supercritical fluid extraction, isoelectric focusing, isotopic techniques, manometric techniques.

MODULE V: Special techniques: Immunoassay techniques; Isotopic, non-isotopic and enzyme immunoassays; surface tension; enzymatic methods of food analysis; thermal methods in food analysis (Differential scanning colorimetry and others).

Suggested Readings:

1. AOAC International. 2003. Official methods of analysis of AOAC International. 17th Ed. Gaithersburg, MD, USA, Association of Analytical Communities. Kirk RS & Sawyer R. 1991.
2. Pearson's Chemical Analysis of Foods. 9th Ed. Longman Scientific & Technical. Leo ML. 2004.
3. Handbook of Food Analysis. 2nd Ed. Vols. I-III. Linden G. 1996.
4. Analytical Techniques for Foods and Agricultural Products. VCH. Macleod AJ. 1973.
5. Instrumental Methods of Food Analysis. Elek Sci. Marcel Dekker. 24 Nielsen S. (Eds.). 1994. Introduction to Chemical Analysis of Foods. Jones & Bartlett. Pomrenz Y & Meloan CE. 1996.
6. Food Analysis – Theory and Practice. 3rd Ed. CBS. Ranganna S. 2001.
7. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. 2nd Ed. Tata-McGraw-Hill. Robinson JW. 1970.
8. Undergraduate Instrumental Analysis. Marcel Dekker.

MSUFT-191: Microbiology Lab
Credit 3; Full Marks: 100

Course Outcomes (COs):

CO1: Experiment with microbiological instruments used in Food Microbiology laboratory

CO2: Examine methods to isolate of microorganisms from different foods and water sample

CO3: Determine microbiological techniques to standardize quality tosolve practical problems

CO4: Design appropriate SOPs for microbiological analysis of food in real-time situation

List of Experiments:

1. Microscope and its operation, Microscopic examination of bacteria, yeast and molds; Staining
2. Media Preparation, Autoclave operation , Aseptic transfer
3. Standard plate count; Yeast and mould count; Spore count;
4. Detection and enumeration of pathogenic and indicator organisms in food; MPN of coli forms;
5. Enumeration of physiological groups- psychrophilic, thermoduric, osmophiles and halophiles.Evaluation of microbiological quality of commonly consumed street foods. Production of Ethanol and vinegar by Fermentation.

MSUFT-192: Biochemistry and Analytical Techniques Lab
(Credit: 3, Mark: 100)

Course Outcomes (COs):

CO1: Build the biochemical composition of food.

CO2: Analyze the different methods of separation and isolation of biochemical components of food.

CO3: Determine effective methodology to identify the common adulterants in food.

CO4: Design appropriate methods for biochemical assays in real situation.

List of Experiments:

1. Proximate analysis of content of protein and fat in foods;
2. Nitrogen value determination and calculation of calorific value of foods;
3. TSS; pH; acidity in foods and Food Products;
4. Estimation of browning intensity;

5. Determination of vitamin C and beta-carotene, sugars;
6. Estimation of calcium, phosphorus and iron; anti-nutritional factors in foods.
7. Detection of common adulterants in food.

MSUFT 107: English Communication Skill (non-credit compulsory course)

Course Outcomes (COs):

CO1: Recall the English skills by reading and listening comprehension, writing and speaking.

CO2: Show their vocabulary and use them effectively and appropriately.

CO3: Develop and discover the speaking skills to communicate with each other.

CO4: Assess and improve confidence in the group discussions, seminar presentations, viva-voce, job interview etc.

Theory:

MODULE I:Grammar

Sentence Structure, Voice, Narration

MODULE II:Writing Skills: Nature and style of sensible writing

Report Writing (Structure, Types of report), Article/ Blog writing

MODULE III: Business Correspondence

Formal letter, Job Application, CV/ Resume, Email

MODULE IV: Reading Comprehension (Seen & unseen)

Selected pieces from literature (1 Prose & 1 Poetry), Skill of answering questions by understanding a given text

MODULE V:Communication Skills

Video & Audio Conferencing, Group Discussion, non-verbal skills, etc.

MODULE VI:Writing Practices

Essentials for different purposes

MODULE VII:Speaking Skills

Mock Interview sessions, Group Discussion Practice, Extempore, Debate etc.

Suggested Readings:

1. Business Communication, by UrmilaRai& S. M. Rai. Himalaya Pub.

2. Communication Skill for Effective Management by Dr. Anjali Ghanekar. Everest Pub. House.

3. Developing Communication Skill by Krishna Mohan, MeeraBanerji. McMillan

SEMESTER II

MSUFT-201: Food Chemistry

Credit:3 Marks:100

Course outcomes (COs):

CO1: Outline and identify the various food groups, the nutrient components (macro and micro), and proximate composition of food components.

CO2: List the chemistry underlying the properties and reactions of various food components.

CO3: Decide the functional role of food components and their interaction in food products in terms of colour, flavour, texture and nutrient composition.

CO4: Formulate diet chart from the knowledge of different nutrients calorific value and other health benefits.

Theory:

MODULE I: Definition and importance; major food constituents and their physicochemical properties; role of water in food. Minerals of Foods: Calcium, phosphorus, iron, copper, lead, zinc & arsenic.

MODULE II: Carbohydrates, proteins and lipids: classification, physical, chemical, nutritional, and functional properties and their structural correlations; auto-oxidation of lipids and rancidity.

Carbohydrates: Structural, analytical, physicochemical, nutritional and functional aspects of small mol. Wt. carbohydrates, mono, di and polysaccharides, oligosaccharides and prebiotics of plant and microbial origin.

Lipids: Occurrence, composition classification, and use of lipids in foods, physical and chemical properties, effects of processing on functional properties and nutritive value. Rancidity and flavor, inversion processing of oil bearing materials, refining of oils and fats, splitting & esterification hydrogenation, shortenings and low fat spreads. Essential Oils: Occurrence, structure, biosynthesis, monoterpene sesquiterpenes, oxygenated terpeans, extraction of essential oils, terpeanless oils, and uses in foods.

Protein and amino acids: Physical and chemical properties, distribution, amount and functions of proteins in foods, functional properties, effect of processing.-Losses of vitamins and minerals due to processing.

MODULE III: Properties of minerals, vitamins, pigments, anti-oxidants, flavour components, allergens, toxins and anti-nutritional factors in foods; Interaction of constituents in food systems; Changes during storage and processing; Browning reactions in foods.

Pectic Substances its occurrence, structure, properties and uses in foods. Enzymes in foods, and food industry, bio-deterioration of foods, food contaminants, additives and toxicants.

MODULE IV: Food groups and their typical composition; essential nutrients- sources, functions, deficiency diseases; requirements and recommended dietary allowances; digestion, absorption, transport and metabolism of nutrients in human system; protein quality evaluation.

Suggested Readings:

1. Principles of Food Chemistry. John M. deMan, Springer Publ., 3rd edition, 1999.
2. Food Chemistry. Fennema Owen R., Food Science & Technology series, CRC press, New York, 4th edition, 2007.
3. Food Chemistry. Lillian Hoagland Meyer, CBS publication, New Delhi, 2nd edition, 2006.
4. Food Science Chemistry & Experimental Foods. M. Swaminathan, Bappco publ., 2nd edition, 2001.
5. Food Chemistry. S. Yadav, Anmol Publications, 1st edition, 1997.

MSUFT-202 Technology of fruits and vegetables
Credit: 3 Marks: 100

Course Outcomes (COs)

CO1: Recall and outline the concept of processing and products manufactured from various fruits and vegetables.

CO2: Build the technology of physiological and physicochemical characteristics of fruits and vegetables.

CO3: Examine the methods to prevent the fruit and vegetable loss after production or during storage.

CO4: Evaluate scientific principles and technologies for product development out of fruits and vegetables

CO5: Develop various new processing technologies for preservation of fruit and vegetables.

Theory:

MODULE I: Importance & scope of post-harvest management of fruits and vegetables in Indian economy. 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.

MODULE II: 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 pre-treatments - chemicals, wax coating, pre-packaging, VHT and irradiation.

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

from mango, tomato, guava, papaya, apple, pineapple, pomegranate, grapes etc. using aseptic packaging, canning, RTS fruit beverages, IQF and frozen fruits and vegetables; for peas, mango pulps etc.

MODULE IV: Technology for processed products like pickles, chutneys, sauces particularly from raw mango, lime and other regional fruits and vegetables of importance.

MODULE V: Dehydration of fruits and vegetables using various drying technologies like sun drying, solar drying (natural and forced convection), osmotic, tunnel drying, fluidized fed drying, freeze drying, convectional and adiabatic drying; applications to raisins, dried figs, vegetables, intermediate moisture fruits and vegetables. Fruit powders using spray drying. Processing of fruits for candies, bars, toffees, jams and jellies, squashes and syrups using locally available fruits like papaya, mango, aonla and other under-utilized fruits.

Suggested Readings

1. Barret DM, Somogyi LP &Ramaswamy H. 2005. Processing of Fruits. CRC Press FAO. 2007.

2. Handling and Preservation of Fruits and Vegetables by Combined Methods for Rural Areas- Technical Manual. FAO Agr. Ser. Bull., 149. Fellows P. 2007.

3. Guidelines for Small-Scale Fruit and Vegetables Processors. FAO Agr. Ser. Bull., 127. Lal G, Siddappa GS & Tandon GL. 1998.

4. Preservation of Fruits and Vegetables. ICAR. Salunkhe DK & Kadam SS.1995. Handbook of Fruit Science & Technology: Production, Composition and Processing. Marcel Dekker. Salunkhe DK & Kadam SS. 1995.

5. Handbook of Vegetables Science & Technology: Production, Composition, Storage and Processing. Marcel Dekker. Somogyi LP. et al. 1996.

6. Processing Fruits - Science and Technology. Vols I, II. Technomic Publ. Srivastava RP & Kumar S. 2003.

7. Fruit and Vegetable Preservation - Principles and Practices. International Book Distributors. Verma LR & Joshi VK. 2000.

8. Post-Harvest Technology of Fruits and Vegetables. Indus Publ.

MSUFT-203: Technology of cereals, pulses and oilseeds

Credit: 3 Marks:100

Course outcomes (COs):

CO1: Recall and outline the concept of processing and products manufactured from cereals, pulses and oilseeds.

CO2: Build the technology of physiological and physicochemical characteristics of cereals, pulses and oilseeds.

CO3: Examine the methods to prevent the loss of cereals, pulses and oilseeds after production or during storage.

CO4: Evaluate scientific principles and technologies for product development out of cereals, pulses and oilseeds.

CO5: Develop various new processing technologies for preservation of cereals, pulses and oilseeds.

Theory:

MODULE I: General introduction and production and utilization trends; Structure and composition of common cereals, pulses and oilseeds.

MODULE II: Wheat: Types and physicochemical characteristics; wheat milling - products and by-products; factors affecting quality parameters; physical, chemical and rheological tests on wheat flour; additives used in bakery products; flour improvers and bleaching agents; manufacture of bakery products, pasta products and various processed cereal-based foods; manufacture of whole wheat atta, blended flour and fortified flour. Bakery and confectionary industry; raw materials and quality parameters; dough development; methods of dough mixing; dough chemistry; rheological testing of dough-Farinograph, Mixograph, Extensograph, Amylograph / Rapid Visco Analyzer, Falling number, interpretation of the data.

Technology for the manufacture of bakery products-bread, biscuits, cakes and the effect of variations in formulation and process parameters on the quality of the finished product; quality consideration and parameters; Staling and losses in baking; machineries used in bakery industry.

MODULE 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.

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

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

Suggested Readings:

1. Chakrabarty MM. 2003. Chemistry and Technology of Oils and Fats. Prentice Hall. Dendy DAV & Dobraszczyk BJ. 2001.

2. Cereal and Cereal Products. Aspen. Hamilton RJ & Bhati A. 1980.

3. Fats and Oils - Chemistry and Technology. App. Sci. Publ. Hoseney RS. 1994.

4. Principles of Cereal Science and Technology. 2nd Ed. AACC. Kay DE. 1979.

5. Food Legumes. Tropical Products Institute. Kent NL. 1983. Technology of Cereals.

6. 4th Ed. Pergamon Press. Kulp K & Ponte GJ. 2000.

7. Handbook of Cereal Science and Technology. 2nd Ed. Marcel Dekker. Lorenz KL.1991.

8. Handbook of Cereal Science and Technology. Marcel Dekker. Marshall WE & Wadsworth JI. 1994.

9. Rice Science and Technology. Marcel Dekker. Mathews RH. 1989.

10. Legumes Chemistry, Technology and Human Nutrition. Marcel Dekker. Matz SA. 1969. Cereal Science. AVI Publ. Paquot C. 1979.

11. Standard Methods of Analysis of Oils, Fats and Derivatives. Pergamon Press. Pomeranz Y. 1987.
12. Modern Cereal Science & Technology. VCH Publ. Salunkhe DK.1992.
13. World Oilseeds: Chemistry, Technology and Utilization. VNR. Swern D. 1964.
14. Bailey's Industrial Oil and Fat Products. InnterSci. Publ. 28 Watson SA & Ramstad PE.1987. Corn; Chemistry and Technology. AACC.

MSUFT-204 Technology of milk and milk products
Credit: 3 Marks: 100

Course outcomes (COs):

CO1: Recall and outline the various properties and composition of milk.

CO2: Build the technology of manufacturing of various milk products.

CO3: Analyze and assessthe safety and quality methods to determine the acceptability of the dairy products by consumers including cleaning and sanitation in dairy industry.

CO4: Design various techniques to address practical problems of milk processing and preservation in the industry.

CO5: Develop methods to utilize various by-products of dairy industry.

Theory

MODULE I: Present status of milk & milk products in India and Abroad; market milk Composition of milk of various species, quality evaluation and testing of milk, procurement, transportation and processing of market milk, cleaning 30 & sanitization of dairy equipments. Special milks such as flavoured, sterilized, recombined & reconstituted toned & double toned.

MODULE II: Condensed milk- Definition, methods of manufacture, evaluation of condensed & evaporated milk; dried milk- Definition, methods of manufacture of skim & whole milk powder, instantiation, physiochemical properties, evaluation, defects in dried milk powder. Cream- Definition, classification, composition, cream separation, sampling, neutralization, sterilization, pasteurization & cooling of cream, evaluation, defects in cream; Butter- Definition, composition, classification, methods of manufacture, theories of churning, evaluation, defects in butter.

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

MODULE IV: Cheese: Definition, composition, classification, methods of manufacture, cheddar, Gouda, cottage and processed cheese, evaluation, defects in cheese.

MODULE V: Indigenous milk products - Present status, method of manufacture of yoghurt, dahi, khoa, burfi, kalakand, gulabjamun, rosogolla, srikhand, chhana, paneer, ghee, lassi etc; probiotic milk products

MSUFT-205 Waste Management of Food Industries
(CREDITS: 3 Marks: 100)

Course outcomes (COs):

CO1: Interpret the characteristics and classification of wastewater generated from various food industries.

CO2: Identify the various disposal techniques of food industry waste with special attention to their economical aspects.

CO3: Examine the physical, chemical and biological waste treatment and in plant sanitation.

CO4: Choose the treatment methodologies of solid wastes generated from food industry.

CO5: Discuss the recovery of useful materials from effluents by different methods and environmental legislations to discharge the waste into the environment.

Theory

MODULE I:

Introduction: Classification and characterization of food industrial wastes from Fruit and Vegetable processing industry, Beverage industry; Fish, Meat & Poultry industry, Sugar industry and Dairy industry; Waste disposal methods – Physical, Chemical & Biological; Economical aspects of waste treatment and disposal.

MODULE II:

Treatment methods for liquid wastes from food process industries; Design of Activated Sludge Process, Rotating Biological Contactors, Trickling Filters, UASB, Biogas Plant.

MODULE III:

Treatment methods of solid wastes: Biological composting, drying and incineration; Design of Solid Waste Management System: Landfill Digester, Vermicomposting Pit.

MODULE IV:

Biofilters and Bioclarifiers, Ion exchange treatment of waste water, Drinking-Water treatment, Recovery of useful materials from effluents by different methods.

Suggested Readings:

1. Food Industry Wastes: Disposal and Recovery; Herzka A & Booth RG; 1981, Applied Science Pub Ltd.
2. Water & Wastewater Engineering; Fair GM, Geyer JC & Okun DA; 1986, John Wiley & Sons, Inc.
3. Wastewater Treatment; Bartlett RE; Applied Science Pub Ltd.
4. Symposium: Processing Agricultural & Municipal Wastes; Inglett GE; 1973, AVI.
5. Food Processing Waste Management; Green JH & Kramer A; 1979, AVI.
6. Environmental Biotechnology: Principles and Applications; Rittmann BE & McCarty PL; 2001, Mc-Grow-Hill International editions.

7. Environmental Biotechnology; Bhattacharyya B C & Banerjee R; Oxford University Press.

MSUFT-206: Statistical Techniques for Food Science
Credits: 3; Marks: 100

Course outcomes (COs):

CO1: Construct the interpolating polynomial for both equispaced and un-equispaced arguments.

CO2: Discover graphical displays of science/engineering data and interpret the role of such displays in data analysis.

CO3: Choose basic statistical inference techniques, including confidence intervals, hypothesis testing and analysis of variance, to science/engineering problems.

CO4: Choose appropriate regression models to determine statistical relationships.

CO5: Design numerical techniques to solve food engineering problems.

Theory

MODULE I: Statistical Techniques - Definition of Probability, Relative frequency, Probability distribution with simple examples.

MODULE II: Statistics - Measure of central tendency – Mean (for grouped & ungroupeddata); Measure of dispersion- Standard Deviation (for grouped & Ungrouped data);

MODULE III: Sampling theory –Statistical population, Sample from population, Randomsample; Statistical Hypothesis - Test of significance, Test for proportion, means & standarddeviations, Chi-square test of goodness of fit, t-test, F-test. Correlation & Regression (linear)- Associated test of significance, simple problems.

MODULE IV: Fundamental concepts in applied probability - Exploratory data analysis and statistical inference; Probability and analysis of one and two way samples; discrete and continuous probability models;

MODULE V: Hypothesis; Critical region and error probabilities; Tests for proportion; Equality of proportions; equality of means of normal populations (variance known, variance unknown); P-value of the statistic; Confidence limits; Introduction to one way and two-way analysis of variance; Data transformation Corrector methods;

Module VI: Exposure to software packages like Matlab or Scilab, R, Python, Statistica, SPSS. Solving real life application problem related to food science and technology field (data analytic concept with the help of some language like R, Python).

Suggested Readings:

1. Fundamentals of Statistics 7th Edition, S. C. Gupta, Publisher: Himalaya Publishing House Pvt. Ltd
2. Statistical Methods 43rd Edition, S. P. Gupta, Publisher: Sultan Chand and Sons.
3. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Trevor Hastie (Author), Robert Tibshirani (Author), Jerome Friedman (Author) Publisher : Springer

Series in Statistics .
4. Cambridge International AS & A Level Mathematics: Probability & Statistics 1 Course book , Dean Chalmers (Author), Julian Gilbey (Editor), Publisher Cambridge Assessment International Education .

MSUFT-291: Pickles and Fermented Food Lab
(Credit: 3, Mark: 100)

Course outcomes (COs):

CO1: Apply and analyze the principles of food fermentation technology

CO2: Determine the quality of fermented foods

CO3: Develop various fermented food

List of Experiments

1. Evaluation of pectin grade; canning of mango/guava/papaya;
2. Preparation and quality evaluation of fruit jam: apple/ mango/ guava /papaya / strawberry and fruits of regional importance; fruit jelly, wood apple, sweet orange/mandarin/guava,/tamarind; fruit marmalade: ginner marmalade;
3. Fruit preserve and candy; fruit RTS, squash, syrup and candy;
4. Preparation of grape raisin, dried fig and dried banana;
5. Processing of tomato products; preparation of anardana;
6. Preparation of papain /guava jam, jelly and marmalade;
7. Preparation of pickle, mixed pickle;
8. Preparation of dried ginger; preparation of amchur;
9. Preparation of dried onion and garlic;
10. Preparation of banana and potato wafers
11. Preparation of dehydrated vegetables.

MSUFT-292 Food Process Technology Lab

Credits: 3 Marks: 100

Course outcomes (COs):

CO1: Construct different methods applied to processing of foods and preservation.

CO2: Construct process flow diagrams and compare various process technologies.

CO3: Analyze the changes of raw food materials during postharvest storage and transformation into food products and classify them

CO4: Develop innovative methods for process and preservation technologies.

List of Experiments

1. Determination of thermal inactivation time of enzymes;
2. Thermal processing of foods; Dehydration of foods;
3. Refrigeration Freezing of foods; Concentration of foods;
4. Use of chemicals in preservation of foods;

5. Extrusion cooking of foods:

SEMESTER III

MSUFT-301: Technology of meat, poultry and fish
Credit: 3 Marks: 100

Course outcomes (COs):

CO1: Recalling the basic concepts of biology, define the basic structure and biochemical composition of muscle foods and eggs and how these may undergo changes during ante & post mortem handling, processing and storage.

CO2: Explain the spoilage mechanisms in freshly harvested fish, meat and egg and estimate their quality using apposite qualitative and quantitative biochemical, physical or organoleptic parameters.

CO3: Explain the principle and applicability of different preservation technologies and apply this knowledge to prescribe suitable preservation methods for freshly harvested fish, animal and eggs.

CO4: Analyze ante mortem handling techniques and stunning methods to minimize pain and struggle of animals and frame a hygienic slaughtering process to yield high quality muscle food.

CO5: Evaluate the possibilities of value addition of fish; meat, poultry to design processing and manufacture of value added products and specialty foods

CO6: Identify potential in the by-products originating from fish, meat and poultry industries and propose the manufacture of various food, feed and non-food products.

Theory

MODULE I: Meat composition from different sources; muscle structure and compositions; post-mortem muscle chemistry; meat colour and flavours; meat microbiology and safety, Effect of processing on meat tenderisation, fish harvest, freezing and processing techniques.

MODULE II: Chilling and freezing of carcass fish and meat; canning, cooking, drying, pickling, curing and smoking; prepared fish and meat products like salami, kebabs, sausages, sliced, minced, corned; intermediate moisture and dried meat products; meat plant hygiene – GMP and HACCP; Packaging of meat products.

MODULE III: Poultry industry in India, microbiology of poultry meat, spoilage factors; Lay-out and design of poultry processing plants, Plant sanitation; Poultry meat processing operations, equipment used. Packaging of poultry products, refrigerated storage of poultry meat, by products – eggs, egg products, Whole egg powder, Egg yolk products, their manufacture, packaging and storage.

MODULE IV: Commercially important marine products from India; product export and its sustenance; basic biochemistry and microbiology; preservation of postharvest fish freshness; cold chain transportation in refrigerated vehicles; preservation of shell fish; pickling and preparation of fish protein concentrate, fish oil and other by products. Handling of fish and meat waste by-products.

Suggested Readings

1. Forrest JC. 1975. Principles of Meat Science. Freeman. Govindan TK. 1985.

2. Fish Processing Technology. Oxford & IBH. Hui YH. 2001.

3. Meat Science and Applications. Marcel Dekker. 32 Kerry J. et al. 2002.

4. Meat Processing. Woodhead Publ. CRC Press. Levie A. 1984.

5. Meat Hand Book. 4th Ed. AVI Publ. Mead M. 2004.

6. Poultry Meat Processing and Quality. Woodhead Publ. Mead GC. 1989. Processing of Poultry. Elsevier. Pearson AM & Gillett TA. 1996.

7. Processed Meat. 3rd Ed. Chapman & Hall. Stadelman WJ & Cotterill OJ. 2002. Egg Science and Technology. 4th Ed. CBS.

MSUFT-302: Food Packaging Technology

(Credit: 3 Marks: 100)

Course outcomes (COs):

CO1: Define, recall, and relate basic packaging technologies with respect to manufacturing methodologies, potential material development to address substantiated solution to practical food preservation and transportation problems.

CO2: Interpret the need, and to have the preparation for independent, life-long learning in the emerging areas of packaging technology in synergy with other technological applications.

CO3: Interpret and demonstrate as a professional, who has comprehensive knowledge on regulatory requirements for food packaging and allied areas to meet societal needs within realistic constraints such as economic, environmental, ethical, legal, cultural, health and safety, feasibility, and sustainability.

CO4: Examine and analyze problems associated with difficulties related to packaging material, methodologies and food components to be packaged.

CO5: Create, develop and formulate appropriate packaging technologies with the aid of various tools with a view to work in real life situations and as independent entrepreneurs.

Theory

MODULE I : Definitions, objectives and functions of packaging and packaging materials; Packaging requirements and selection of packaging materials; Types of packaging materials: Paper: pulping, fibrillation and beating, types of papers and their testing methods; Glass:

composition, properties, types of closures, methods of bottle making; Metals: Tinplate containers, tinning process, components of tinplate, tin free steel (TFS), types of cans, aluminum containers, lacquers; Plastics: types of plastic films, laminated plastic materials, co-extrusion, edible films, biodegradable plastics.

MODULE 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.

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

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

MODULE V: 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.

Suggested Readings:

1. Crosby NT.1981. Food Packaging: Aspects of Analysis and Migration Contaminants. App. Sci. Publ. Kadoya T. (Ed). 1990.

2. Food Packaging. Academic Press. Mahadeviah M & Gowramma RV. 1996.

3. Food Packaging Materials. Tata McGraw Hill. Palling SJ. (Ed). 1980. Developments in Food Packaging. App. Sci. Publ. Painy FA. 1992.

4. A Handbook of Food Packaging. Blackie Academic. Sacharow S & Griffin RC. 1980.

5. Principles of Food Packaging. AVI Publ. Stanley S & Roger CG.1970.

6. Food Packaging. AVI Publ. 22 FST 506

MSUFT-303 Food safety and quality control

Credit: 3 Marks: 100

Course outcomes (COs):

CO1: Recall principles and basics ofbiological, chemical and physical hazardsin food industry

CO2: Compare the problems arising in quality control and quality assurance policies and regulations in food processing industry.

CO3: Choose and analyze existing food laws and quality management techniques in relation to follow legal limits and supply safe food to consumers.

CO4: Examine or interpret data and apply various tools to reach a sustainable solution in food safety and quality management system in industries.

CO5: Decide and apply methods to meet specific needs of food safety and maintain the

quality of food during processing, storage, distribution taking public health and safety, cultural, societal and environmental issues into consideration following the standard regulations.

Theory:

MODULE 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.

MODULE 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.

MODULE III: Quality assurance, Total Quality Management; GMP/GHP; GLP, GAP; Sanitary and hygienic practices; HACCP; Quality manuals, documentation and audits; Indian & International quality systems and standards like ISO and Food Codex;

MODULE IV: Export import policy, export documentation; Laboratory quality procedures and assessment of laboratory performance; Applications in different food industries; Food adulteration and food safety. IPR and Patent.

Suggested Readings:

1. Amerine MA, Pangborn RM & Rosslos EB. 1965. Principles of Sensory Evaluation of Food. Academic Press. Early R.1995.

2. Guide to Quality Management Systems for Food Industries. Blackie Academic. Furia TE.1980.

3. Regulatory status of Direct Food Additives. CRC Press. Jellinek G. 1985.

4. Sensory Evaluation of Food - Theory and Practice. Ellis Horwoood. Krammer A & Twigg BA.1973.

5. Quality Control in Food Industry. Vol. I, II. AVI Publ. Macrae R, Roloson R & Sadlu MJ. 1994.

6. Encyclopedia of Food Science & Technology & Nutrition. Vol. XVI. Academic Press. Piggot J.R. 1984.

7. 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.

8. Export/Import policy by Govt. of India.

MSUFT-304: Process Control and Instrumentation

Credit: 3 Marks: 100

Course outcomes (COs):

CO1: Explain of the basic concepts of process control and its application in food technology.

CO2: Make use of the sensors and transducers for food processing.

CO3: Analyze the stability of a food processing system.

CO4: Make use of the controller and actuators.

CO5: Elaborate Computerized control, Intelligent control, ANN, Fuzzy logic, Genetic Algorithm, PLC and SCADA for food processing systems

Theory:

MODULE I: Process variables: Need for their measurement and control pressure measurement by mechanical and electrical transducers. Low pressure measurement by Mcleod Gauge and Pirani gauge. Temperature measurement by bi-metal thermometers, resistance thermometer thermistors, thermocouples. Radiation and optial pyrometers.

MODULE II: Flow measurement by Hot – Wire ammo meter and magnetic flow meters. Visualization by shadow-graph and interferometer. Liquid feel measurement in open vessels and in pressure vessels.

MODULE III: Thermal conductivity measurement of solids, liquids and gases. Measurement of diffusivity in gases. Block diagrams. Transfer function closed-loop and open-loop control systems. Response of first order systems and first order systems. Response of time constant.

MODULE IV: Different types of controllers. Final control elements. Closed loop transfer functions. Stability Root locus method. Frequency response. Level control. Flow control. Dynamics and control of heat exchangers and distillation columns.

MODULE V: case study

Suggested Readings:

1. Process Dynamics and Control, By Dale E Seborg, Duncan A. Mellichamp and Thomas F, Edgar, John Wiley & Sons, 2006.
2. Process Control: A Practical Approach by Myke King, John Wiley & Sons, 2010.
3. Process Control Instrumentation Technology, by Curtis D Johnson, Prentice Hall, 1997.
4. Instrumentation and Process Control, by Thomas A.Weedon, American Technical Publishers, 2014.
5. Fundamentals of Automatic Process Control, By RayChaudhuri, CRC Press.

MSUFT-305A : Food Biotechnology(Elective)
(Credit: 3 Marks: 100)

Course outcomes (COs):

CO1: Recall the biotechnology used in the production of food constituents; flavors, aroma, food additives and an array of other high valued-enhanced products.

CO2: Identify the principles of food fermentation and enzyme technology.

CO3: Examine the processes related to food raw materials and food bio-processing.

CO4: Importance of functional foods and neutraceutricals.

CO5: Develop value added products from foods.

Theory:

MODULE I: Biotechnology- definition, scope and applications, Application of Biotechnology in food (Food industries), pharmaceuticals and agriculture, Application of biotechnology for food plant waste utilization, biogas plants.

MODULE II: Introduction to nutraceuticals and functional foods, definitions, basis of claims for a compound as a nutraceutical, regulatory issues for nutraceuticals including CODEX. Nutraceuticals for different human metabolic disorders, dosage levels, contraindications if any etc.

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

MODULE IV: Prebiotics, Probiotics, preparation and their mechanism of action . Enzymes– classification, properties, characterization, kinetics and immobilization; fermentative production of enzymes (amylases, proteases, cellulases, pectinases, xylanases, lipases) used in food industry and their downstream processing.

MODULE V: GMO, genetic recombination mechanisms and technique used for improvement in microbial strains, Recombinant-DNA technology (plasmids and cloning), Expression of foreign genes, Promoters (Enzyme), Biomass production by using various microorganisms.

MODULE VI: 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. Enzymes as processing aids: 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; xylanses 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.

Suggested Readings:

1. Flickinger MC & Drew SW. 1999. Encyclopedia of Bioprocess Technology. A Wiley- Inter Science Publ. Kruger JE. et al. 1987.

2. Enzymes and their Role in Cereal Technology. American Association of Cereal Chemists Inc. Nagodawithana T & Reed G. 1993.

3. Enzymes in Food Processing. Academic Press. Tucker GA & Woods LFJ. 1991. Enzymes in Food Processing. Whitehurst R & Law B. 2002; Brigelius-Flohé, J & Joost HG. 2006.

4. Nutritional Genomics: Impact on Health and Disease. Wiley VCH. Cupp J & Tracy TS. 2003.

5. Dietary Supplements: Toxicology and Clinical Pharmacology. Humana Press. Gibson GR & William CM. 2000.

6. Functional Foods - Concept to Product. Goldberg I. 1994.

7. Functional Foods: Designer Foods, Pharma Foods. Losso JN. 2007.

8. Angi-angiogenic Functional and Medicinal Foods. CRC Press. Manson P.2001. Dietary Supplements. 2nd Ed. Pharmaceutical Press. Campbell JE & Summers JL. 2004.

9. Dietary Supplement Labeling Compliance. Neeser JR & German BJ. 2004. Bioprocesses and Biotechnology for Nutraceuticals. Chapman & Hall. Robert EC. 2006.

10. Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman. Shi J. (Ed.). 2006.

11. Functional Food Ingredients and Nutraceuticals: Processing Technologies. CRC Press. Webb GP. 2006.

12. Dietary Supplements and Functional Foods. Blackwell Publ. Enzymes in Food Technology. Blackwell Publ. FST.

MSUFT-305B: Speciality Food and Beverages (Elective)
(Credit: 3 Marks: 100)
Course outcomes (COs):

CO1: Recall the concept of processing and physiological characteristics of products manufactured from various cereal grains, fruits and vegetables.

CO2: Outline the characteristics and processing of various raw materials used for beverage manufacturing.

CO3: Analyze and assess quality of raw material/ingredients in the food and beverage industry industries

Theory:

MODULE 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; savoury and farsans; formulated chips and wafers, papads, instant premixes of traditional Indian snack foods.

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

MODULE III: Extruded snack foods: Formulation and processing technology, colouring, flavouring and packaging. Specialty beverages based on tea, coffee, cocoa, spices, plant extracts, herbs, nuts, dairy and imitation dairy-based beverages.

MODULE IV : 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.

MODULE V: Equipment for frying, Baking and drying, toasting, roasting and flaking, popping, blending, Coating, chipping.

Suggested Readings:

1. Edmund WL. Snack Foods Processing. AVI Publ. Frame ND .1994.
2. The Technology of Extrusion Cooking. Blackie Academic. Gordon BR.1997
3. Snack Food.AVI Publ Samuel AM.1976. Snack.
4. Handbook of Brewing. Marcel Dekker. Hui YH. et al 2004.

MSUFT-305C: Enzyme Technology (Elective)

Credit: 2: Marks: 100

Course outcomes (COs):

CO1: Define and relate basic principles of enzyme functioning and its relevance to food processing, biochemical and allied sector.

CO2: Outline and review research literature in relation to enzyme production and downstream techniques considering techno-economic feasibility.

CO3: Determine modern techniques like immobilizations, recombinant technologies to formulate high value bio-chemicals for food and allied industries in compliance to legal, ethical and environmental guideline.

Theory:

Module I: Enzymes: Classification, mode of action, activation, specificity, Source of enzymes; production, isolation and purification of enzymes; Characterization in terms of pH, temperature, ionic strength, substrate and product tolerance, effects of metal ions; Coenzymes and cofactors: Coenzymes, classification of vitamins, role and mechanism of action of some important coenzyme (NAD+/NADP+, FAD, lipoic acid, tetrahydrofolate, B12-coenzyme), role of cofactors with specific examples.

Module II: Enzyme kinetics

Enzyme as biological catalysts; Enzyme action, active site, functional group, enzyme substrate complex, cofactors, Michaelis-Menten equation, Km and Vmax, enzyme inhibition;

order of reaction, methods of plotting enzyme kinetics data; Enzyme turnover number. competitive, non-competitive, uncompetitive, irreversible; order of reaction, methods of plotting enzyme kinetics data; determination of Kcat, Km, Vmax, Ki, Half life, activation and deactivation energy etc, Cross-linked enzyme aggregates, Cross linked enzymes, enzyme crystals, their use and preparation; Solution of numerical problems; Energy yielding and energy-requiring reactions; Calculation of equilibrium constants; Activation energy etc.; Multi-substrate enzymes and kinetics mechanisms; Enzyme induction, repression, covalent modification, Isoenzymes, allosteric effects.

Module III: Applications of enzyme technology

Immobilized enzyme technology: Different techniques of immobilization of enzymes and whole cells; Advantages and disadvantages of immobilization; Kinetics of immobilized enzymes, design and operation of immobilized enzymes reactors; Type of reactors, classification, retention of enzymes in a reactor, kinetics of enzyme reactors; Reactor performance with inhibition, operation of enzyme reactors; case studies; starch conversion; APA production, bio-transformations using soluble as well as immobilized enzymes; Calculation of diffusional resistances and Thiele's modulus, multi-step immobilized enzyme systems; Solution of numerical problems; Application and future of immobilized enzyme technology; Enzyme in organic solvents and ionic liquids: Various organic solvents and ionic liquids used in biocatalysis; Potential in organic solvents and ionic liquids; Applications of enzymes in analysis.

Text/References

1. Stryer, L. (2002). Biochemistry. Freeman. New York.
2. Lehninger, A. L. (2004). Principles of Biochemistry (4th ed.). Worth. New York, NY
3. Voet, D., & Voet, J. G. (2004). Biochemistry (4th ed.). Wiley & Sons. Hoboken, NJ: J
4. Rehm, H. & J. Reed, G., (1986). Enzyme Technology. Volume 7a. John Wiley & Sons.
5. Irwin H. Segel, (1976). Biochemical Calculations: How to Solve Mathematical Problems in General Biochemistry, 2nd revised Ed. John Wiley & Sons.
6. Biotol, (1992). Bioreactor Design & Product Yield. Butterworth-Heinemann
7. Wang, D. I. C. (1979). Fermentation and Enzyme Technology. Wiley. New York.

****Elective Subjects Basket-II:**
MSUFT-306A: Entrepreneurship and Business Management (Elective)
(Credit: 3 Marks: 100)
Course outcomes (COs):

CO1: Demonstrate various forms of Entrepreneurship Models.

CO2: Make use of a Business Plan using the tools of Entrepreneurship Management.

CO3: Examine the financial calculations required to validate a Business Plan.

CO4: Importance of Government initiatives and legal processes in Entrepreneurship Management.

CO5: Design the techniques of Business Management for starting an Entrepreneurship Project in the food sector.

Theory:

Introduction to Entrepreneurship: Meaning and concept of entrepreneurship, the history of entrepreneurship development, role of entrepreneurship in economic development, agencies in entrepreneurship management and future of entrepreneurship. The Entrepreneur: Meaning of entrepreneur, the skills required to be an entrepreneur, the entrepreneurial decision process, and role models, mentors and support system. Business Opportunity Identification: Business ideas, methods of generating ideas, and opportunity recognition. Preparing a Business Plan: Meaning and significance of a business plan, components of a business plan, and feasibility study . Financing the New Venture: Importance of new venture financing, types of ownership securities, venture capital, types of debt securities, determining ideal debt-equity mix, and financial institutions and banks. Launching the New Venture: Choosing the legal form of new venture, protection of intellectual property, and marketing the new venture. Managing Growth in New Venture: Characteristics of high growth new ventures, strategies for growth, and building the new venture capital. Harvesting Rewards: Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy.

MODULE I: Concept and functions of marketing; concepts and scope of marketing management; concepts and elements of marketing mix.

MODULE II: Concept of market structure, micro and macro environments; Consumer behaviour; consumerism; Marketing opportunities- Analysis, marketing research and marketing information systems.

MODULE III : Market measurement- present and future demand; Market forecasting; market segmentation, targeting and positioning, Allocation and marketing resources,

Marketing Planning Process, Product policy and planning: Product-mix; product line; product life cycle, New product development process. Product brand, packaging, services decisions. Marketing channel decisions, Retailing, wholesaling and distribution, Pricing Decisions, Price determination and pricing policy of milk products in organized and unorganized sectors of dairy industry, Promotion-mix decisions.

MODULE IV: Advertising; how advertising works? Deciding advertising objectives, advertising budget and advertising message, Media Planning, Personal Selling, Publicity; Sales Promotion, Food and Dairy Products Marketing.

MODULE V : International Marketing and International Trade, Salient features of International Marketing, Composition & direction of Indian exports; International marketing environment; Deciding which & how to enter international market; Exports- Direct exports, indirect exports, Licensing, Joint Ventures, Direct investment & internationalization process, Deciding marketing Programme; Product, Promotion, Price, Distribution Channels. Deciding the Market Organization; World Trade Organization (WTO).

Suggested Readings:

1. Chhabra TN & Suria RK. 2001. Management Process and Perspectives. Kitab Mahal. Jhingan ML. 2005.

2. International Economics. 5th Ed. Virnda Publ. Kotler P. 2000.

3. Marketing Management. Prentice Hall. Reddy SS, Ram PR, Sastry TVN & Bhavani ID. 2004.

4. Agricultural Economics. Oxford & IBH.

MSUFT-306B: Supply Chain and Retail Management (Elective)
(Credit: 3 Marks: 100)
Course outcomes (COs):

CO1: Relate the importance of Logistics and Supply Chain Management in today's business environment.

CO2: Model the process of smooth flow of goods and services and maximise value generated.

CO3: Examine the various subdivisions such as Warehousing, Inventory and compare the dependency of each such division with each other.

CO4: Estimate Demand forecasting and Material handling.

Theory:

MODULE-I: Introduction to supply chains in India, Types of food Chain,Factors Influencing Food Supply Chains, Case studies in food supply chain.

MODULE II: Food Production: Entities in agriculture supply chain, Agriculture and poverty alleviation, barriers in development of agri-industry, future steps for agriculture industry. Case studies on farmer empowerment by Industry. Food Manufacturing: Importance of food processing, market conditions, food processing and packaging, Inventory management, food safety, procurement, Case studies Food retailing: The retail environment, Online retailing of food, Future challenges in food retailing Food Logistics: movement of Food, Trends in food logistics, packaging in logistics, temperature controlled in supply chains, Case studies

MODULE III: Challenges in International food supply chains: International food supply chains, Factor affecting international food supply, International politics and food, Case studies Food Sourcing and Procurement: sourcing, sourcing models, purchasing models, supplier segmentation, supplier development, strategic sourcing, sustainable procurement, case example Risk Management: Risk management and uncertainty, Risks in the supply chain, Risks in the food supply chain, managing supply chain risks, managing risks in food supply chains, Case examples.

MODULE IV: Trends in Food Supply Chains: Traceability and use of technology, food production, food processing in as technological context, food packaging in a technological context, food logistics.Cold Chain technology and Management:Food regulation, safety and quality: Attributes to consider when designing food supply chains, food regulation and its effect on safety, food laws and regulation, Reference standards, compatibility standards, private food standards, other initiatives within the food supply chains, case examples.

MODULE V: Sustainability challenges in food supply chain: Introduction to sustainability, sustainable supply chains, sustainable food supply chains, measuring sustainability, developing sustainability within food supply chains, case studies

Suggested Readings:

1.Food Supply Chain Management and Logistics from Farm to fork. Samir Dani, Kogan Page
2.Food Supply Chain Management. Michael A. Bourlakis (Editor), Paul W. H. Weightman (Editor), Wiley-Blackwell.
3.Food Safety Regulatory Compliance: Catalyst for a Lean and Sustainable Food Supply

Chain, by Preston W. Blevins

MSUFT-306C: IPR, Biosafety & Bioethics (Elective)
Credits: 3: Marks: 100
Course outcomes (COs):

CO1: Relate the awareness about Intellectual Property Rights (IPRs) to take measure for the protecting their ideas.

CO2: Outline business strategies by taking account of IPRs

CO3: Make use of the ability to assist in technology upgradation and enhancing competitiveness.

CO4: Test for genetically modified organisms (GMOs) and its effect on human health

Theory:

Module I: Intellectual property rights

Intellectual property right and Intellectual its importance. Types of IPR. PATENTS Macro economic impact of the patent system Patent and kind of inventions protected by a patent. Patent document and protection inventions. Granting of patent Rights of a patent. Searching a patent. Drafting of a patent. Filing of a patent. The different layers of the international patent system (national, regional and international options) COPYRIGHT General Additional Reading: Latest editions of Designs Act, Copyright RELATED RIGHTS. Distinction between related rights and copyright. Rights covered by copyright.

TRADEMARKS and its importance, Rights of trademark, Industrial design. Protection provided by industrial designs.

Module II: Bioethics

Introduction, ethical conflicts in biological sciences - interference with nature, bioethics in health care - patient confidentiality, informed consent, euthanasia, artificial reproductive technologies, prenatal diagnosis, genetic screening, gene therapy, transplantation. Bioethics in research – cloning and stem cell research, Human and animal experimentation, animal rights/welfare, Agricultural biotechnology - Genetically engineered food, environmental risk, labeling and public opinion. Sharing benefits and protecting future generations - Protection of environment and biodiversity – bio-piracy. Bio-weapons.

Module III: Biosafety

Biosafety and Biosecurity - introduction; historical background; Introduction to biological safety cabinets; primary containment for biohazards; biosafety levels, biosafety levels of specific microorganisms; recommended biosafety levels for infectious agents and infected animals; definition of GMOs & LMOs; principles of safety assessment of transgenic plants – sequential steps in risk assessment; concepts of familiarity and substantial equivalence; risk – environmental risk assessment and food and feed safety assessment; problem formulation – protection goals, compilation of relevant information, risk characterization and development of analysis plan; risk assessment of transgenic crops vs cisgenic plants or products derived from RNAi, genome editing tools.

Suggested Readings:

1. Ganguli, P. (2001). Intellectual Property Rights: Unleashing the KnowledgeEconomy.New Delhi: Tata McGraw-Hill Pub.
2. National IPR Policy, Department of Industrial Policy & Promotion, Ministry ofCommerce, GoI
3. Complete Reference to Intellectual Property Rights Laws. (2007). Snow White PublicationOct.
4. Kuhse, H. (2010). Bioethics: an Anthology. Malden, MA: Blackwell.

MSUFT-391 Milk and Milk product processing Lab
Credit: 3: Marks: 100
Course outcomes (COs):

CO1: Construct methods to handle milk safely in industry keeping quality factors in mind.

CO2: Experiment with different methods of analysis of milk required to perform in industrial laboratory.

CO3: Analyzeand asses the milk quality and apply various methods for various methods for safe handling, cleaning, sanitation and CIP in dairy industry

CO4: Develop and formulate methods for analysis of new dairy products and also by-product utilization in dairy industry.

List of Experiments

1. Study on basics of reception of milk at the plant; platform tests in milk; estimation and fatand SNF in milk;
2. Operation of LTLT & HTST Pasteurization;
3. Preparation of special milks;
4. Cream separation & standardization of milk;
5. Preparation and evaluation of table butter, icecream, cheese and indigenous milk productsuch as khoa, chhana, paneer, ghee, rosogolla, gulab jamun, shrikhand, lassi, burfi etc.;
6. Visit to dairy plants.

MSUFT-392 Meat and Fish Processing Lab
Credit: 3: Marks: 100
Course Outcomes (COs)

CO1: Construct methods to handle meat and fish safely in industry keeping quality factors in mind.

CO2: Experiment with different methods of analysis of meat and fish required to perform in industrial laboratory.

CO3: Analyze and asses the meat and fish quality

CO4: Develop and formulate methods for analysis of new meat and fish products.

List of Experiments

1. Slaughtering and dressing of meat animals;

2. Study of post-mortem changes; meat cutting and handling; pickled meat and fishproducts,

3. Pre-evaluation of meat quality;

4. Preservation by dehydration, freezing, canning, curing, smoking and pickling of fishand meat; shelf-life studies on processed meat products;

5. Evaluation of quality of eggs; preservation of shell eggs;

6. Estimation of meat: bone ratios; preparation of meat products- barbecued sausages,loaves, burger, and fish finger;

7. Visit to meat processing plants.

MSUFT 381-Seminar (Sessional)

Credit: 2; Marks: 100

Objective: The students will be given a seminar topic related to Food Science and Technology or allied areas where they have to prepare a power point presentation and deliver it at the end semester examination.

Course Outcomes (COs)

CO1: Outline the engineering principles in the area of food science, technology, and allied areas related to the project topic.

CO2: Organize the previous literature reviews related to the project topic.

CO3: Analyze and assess the importance of the seminar leading to the related project.

CO4: Develop or design the seminar presentation using the engineering principles related to food science and technology.

SEMESTER IV

MSUFT-481: Project Work (Sessional)
Credit: 20: Marks: 100
Objective:
Students will be assigned with an objective oriented industrial problem related Food Industries and a comprehensive project to be prepared highlighting techno-economic feasibility and sustainability
A time period of 2 months will be allowed to each student for completing their project work. It is expected from the students to make prior planning in the beginning of the semester to get associated with any Research Laboratory/ industry/organization/ individual-manoeuvre and utilize this limited time frame to complete the project. Students will get acquainted with the principle, theory, work flow, experimentation, proper referencing and acknowledgement. The evaluation will be based upon the depth of understanding of the project work, efforts and project presentation skills before the quorum panel.
Course outcomes (COs):

CO1: Assess and compile engineering principles in the area of food science, technology, and allied areas.

CO2: Apply these principles in practical problem-solving in food technology and relevant fields.

CO3: Discuss with professional organizations and scientific community with reasonable clarity on topics within food science, engineering, technology, and allied areas

MSUFT-482: Industrial/Laboratory visit (Sessional)
Credit: 1: Marks: 100
Objective:
A guided academic-excursion to an industry/laboratory, significant to the course work. The individual will make a report based upon his visit and will be evaluated by the way the facts, techniques and other information are documented.
Course Outcomes (COs)

CO1: Make use of knowledge gained from in-plant training and skills in the food industry.

CO2: Develop innovative processes and products that will benefit both the industry and society as a whole.

MSUFT-483 Journal Club and seminar presentation (Sessional)
Credit: 1: Marks: 100

Objective:
Under the guidance of a professor an individual will do a thorough study of a scientific journal of his choice and interest. The evaluation will be based upon the depth of understanding of the journal and paper presentation skills before the quorum panel.

Course Outcomes (COs)

CO1: Outline the way of selection of journal and methods to present it related to food sector.

CO2: Explain and interpret the data of the journal to obtain sufficient knowledge out of it so that it can be used for future application

CO3: Apply previous knowledge and build concept to organize the technologies used in the journals to present in a very clear way

CO4: Analyze and compare the various methods and techniques used in different journals to make a complete presentation

CO5: Create various methods applying the technologies learnt in the journals for future work in the food research or industry.

MSUFT-491 Grand Viva (Sessional)
Credit: 2: Marks: 100
Objective: To make an overall evaluation of the student`s in depth knowledge and skills learned in this course work.

Course outcome (CO):

CO1: Judge a student's entire knowledge in relevant subjects obtained over the course of two years in the M.Sc. Food Science & Technology program.

CO2: Solve real life problem situation with the entire knowledge about Food Science and Technology.