**KURUKSHETRA UNIVERSITY, KURUKSHETRA**

**Scheme**

**&**

**Syllabus**

**for**

**M.Tech (Food Technology)**

**w.e.f session 2014-2015**

**KURUKSHETRA UNIVERSITY, KURUKSHETRA**

**Scheme of Examination**

**M.Tech (Food Technology)**

**w.e.f session 2014-2015**

**Semester-I**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sub Code** | **Subject Title** | **External Marks** | **Internal Marks** | **Total Marks** | **Time** |
| MFT-101 | Food Rheology and Microstructure | 70 | 30 | 100 | 3hrs |
| MFT-102 | Flavour Technology | 70 | 30 | 100 | 3hrs |
| MFT-103 | Advances in Food Technology | 70 | 30 | 100 | 3hrs |
| MFT-104 | Experimental Design and Statistics | 70 | 30 | 100 | 3hrs |
| MFT-105 | Lab-I | 50 | 50 | 100 | 3hrs |

**Semester-I1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sub Code** | **Subject Title** | **External Marks** | **Internal Marks** | **Total Marks** | **Time** |
| MFT-201 | Novel Food Packaging Techniques | 70 | 30 | 100 | 3hrs |
| MFT-202 | Advances in Food Engineering | 70 | 30 | 100 | 3hrs |
| MFT-203 | Applications of Biotechnological Tools in Food Analysis | 70 | 30 | 100 | 3hrs |
| MFT-204 | Food Quality Assurance & Management | 70 | 30 | 100 | 3hrs |
| MFT-205 | Lab-II | 50 | 50 | 100 | 3hrs |

**MFT-101 FOOD RHEOLOGY AND MICROSTRUCTURE**

 **Internal- 30**

 **External-70**

 **Exam Duration: 3hrs**

**Note- The examiner will set eight questions taking two from each unit. The candidates are required to attempt five Questions in total, selecting at least one from each unit. All questions will carry equal marks.**

**Unit – I**

**Examining Food Microstructures:** History of Food Microstructure Studies, Light Microscopy, Transmission Electron Microscopy, Scanning Electron Microscopy, Other Instrumentation and Techniques

**Basic rheological concepts** : stress, strain, stiffness and hooke’s law, yield, ductility and necking, strain rate , poisson’s ratio, strength, shear deformation, uni-axial compression and extention, relation between various rheological parameters. Rheological classification of food: Mechanical characterization of food, equilibrium behavior, time dependent flow, time scale effects.

**Unit – II**

**Image Analysis:** Image Acquisition, Image Processing, Measurement Analysis

**Food Structuring:** Introduction, factor affecting texture, effect of enzyme on texture, Approaches to Food Structuring, Extrusion and Spinning, Structuring Fat Products, Structure and Stability, Gels, Gelation Mechanisms, Mixed Gels, The Microstructure of Gels, Structure-Property Relations in Gels

**Unit – III**

**Microstructural Components and Food Assemblies:** Water and Ice, Proteins, Lipids, Carbohydrates, Cells and Cell Membranes, Structural Aspects of Animal Tissue, Structural Aspects of Plant Tissue

**Food Microstructure and Quality:** Measurement of Texture, Structural Aspects of Food Texture,Quality and Structure

**Unit – IV**

**Microstructure and Mass Transfer: Solid-Liquid Extraction:** Fundamental Aspects of Extraction,the Extraction process, Extraction of Food Materials, Modifying Microstructure, Modeling the Extraction Process

**Simultaneous Heat and Mass Transfer: Dehydration:** Basic Concepts, The Drying Process, Osmotic Dehydration, Influence of Drying on Structural Properties, Frying of Foods

**The Micro-structural Approach:** Structure-Property Relationships, The Micro-structural Approach

**References**

1. Microstructural Principles of Food Processing & Engineering, [José Miguel Aguilera](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Jos%C3%A9+Miguel+Aguilera%22), [David W. Stanley](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22David+W.+Stanley%22) ,Springer Science & Business Media, 1999
2. Food Texture by Moskowitz , CRC Press,1987
3. Principles of Food Processing [Dennis R. Heldman](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Dennis+R.+Heldman%22), [Richard W Hartel](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Richard+W+Hartel%22), Springer Science & Business Media,1997
4. Phase Transitions in Foods, Yrjö H. Roos , Academic Press,1995

**MFT-102 FLAVOUR TECHNOLOGY**

 **Internal- 30**

 **External-70**

 **Exam Duration: 3hrs**

**Note- The examiner will set eight questions taking two from each unit. The candidates are required to attempt five Questions in total, selecting at least one from each unit. All questions will carry equal marks.**

**Unit – I**

**Introduction:** Fundamentals of flavour, Classification of food flavour, flavour profile, factors affecting flavours, bioflavour and reconstituted flavour, flavour release from foods, interaction of flavor compounds with foods

**Flavour Extraction:** Methods of flavour extraction, isolation, separation and equipment

**Unit – II**

**Flavour Precursors:** Flavour Compounds from Carbohydrates and Proteins, Lipid oxidation

**Flavour intensifiers:** Flavour intensifiers and their effects, Chemistry and technology of various flavour intensifiers

**Flavour Biogenesis:** Fruit aroma, vegetable aroma, Methyl ketones, diacetyl,

acetaldehyde, lactones, terpenes, esters, pyrazines, vanilla flavour, enzyme and

fermentation flavors

**Unit – III**

**Process Flavours:** Effect of processing on flavor compounds, Non enzymatic browning, heat reaction flavors

**Food Flavours:** Flavour constituents: Onion, garlic, cheese, milk, meat, wine, coffee, tea, chocolate, citrus flavour

**Unit – IV**

**Flavour encapsulation and stabilization:** Principles and techniques of flavour

encapsulation, types of encapsulation, factors affecting stabilization of encapsulated flavor and their applications in food industry, Packaging and flavor compounds interaction, Effect of storage, processing, transportation and environmental conditions on flavour components / constituents

 **Reference Book**

1. Source Book of Flavors, Gary Reineccius, Springer Science & Business Media, 1998
2. Flavour chemistry and technology, Heath, H. B., Avi publication company,1978
3. Understanding Natural Flavors, Piggott, J. R., Paterson, A., Blackie Academic & professional,1994
4. Food Flavor, Morton, I. D., Macleod A., Elsevier,1990
5. Food Flavourings, Ashurst P.R.,Blackie,Glasgow&London,1991

**MFT-103 ADVANCES IN FOOD TECHNOLOGY**

 **Internal- 30**

 **External-70**

 **Exam Duration: 3hrs**

**Note- The examiner will set eight questions taking two from each unit. The candidates are required to attempt five Questions in total, selecting at least one from each unit. All questions will carry equal marks.**

**Unit – I**

**Modeling of Microbial Food Spoilages:** Microbial growth dynamics models, partial differentiation equation models, application of models in thermal preservation, Concept, mechanism of microbial destructions, equipments etc.

**Membrane Technology:** Introduction to pressure activated membrane processes,

performance of RO/UF and NF and industrial application.

**Unit – II**

**Supercritical Fluid Extraction:** Property of near critical fluids (NCF), solubility and efficiency of NCF extraction, equipment and experimental techniques used in NCF extraction and industrial application

**Use of Microwave Energy in Foods:** Theory of microwave heating, dielectric properties of food materials, working principle of magnetron, microwave blanching, sterilization and finish drying.

**Unit – III**

**Hurdle Technology:** Types of preservation techniques and their principles, concept of hurdle technology and its application.

**High Pressure Processing of Foods:** Concept of high pressure processing, quality

changes, effects of pressure on microorganisms and its application in food processing.

**Unit – IV**

**Ultrasonic in Food Processing:** Properties and generation of ultrasonic, ultrasonic

imaging, application of ultrasonics as an analytical tool and processing techniques

**Newer Techniques in Food Processing:** Application of technologies of high intensity light, pulse electric field, micronization in food processing and preservation

**Nanotechnology:** Principles, mechanism and applications in foods

**References**

1. New Methods of Food Preservation (Non Thermal Processing of Foods), G. W. Gould, Springer Science & Business Media, 1995

2. Introduction to Food Engineering, [R Paul Singh](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22R+Paul+Singh%22), [R. Paul Singh](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22R.+Paul+Singh%22), [Dennis R. Heldman](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Dennis+R.+Heldman%22) Academic Press, 2008

3. Food processing technology, Fellows P. J., Elsevier, 2009

**MFT-104 EXPERIMENTAL DESIGN AND STATISTICS**

 **Internal- 30**

 **External-70**

 **Exam Duration: 3hrs**

**Note- The examiner will set eight questions taking two from each unit. The candidates are required to attempt five Questions in total, selecting at least one from each unit. All questions will carry equal marks.**

**Unit – I**

**Introduction:** Basic statistical concepts, concepts Strategy of experiments, basic principles, guidelines for designing experiments and importance of designed experiments in food research

**Multiple Regression and correlation:** Multivariate relationships, multiple linear regression, multiple and partial correlation, significance of testing in multiple correlation, variable selection in multiple regression

**Unit – II**

**Design of experiments:** Full factiorial design, 2K design, completely randomized design, randomized block design, central composite design, central composite rotatable design, factorial design, Box Behenken design, applications of various designs in food processing research, limitations of individual design

**Unit – III**

**Data analysis and modeling:** Multiple regression analysis, canonical analysis, ridge analysis, variable selection, mathematical modeling, interpretation of model parameters and selection criteria of best models

**Unit – IV**

**Multivariate analysis:** Concept of cluster analysis, factor analysis, principal component analysis

**References**

1. Statistical Methods , [George w autor snedecor](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22GEORGE+W+AUTOR+SNEDECOR%22), [Williamg autor cochran](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22WILLIAM+G+AUTOR+COCHRAN%22), Iowa State University Press, 1967
2. Response surface methodology ,R. H. Myers, John Wiley & Sons, 2014
3. Computer aided techniques in Food Technology, Israel Saguy, Taylor & Francis, 1983

 4. Response surfaces design and analysis, [Andre I. Khuri](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Andre+I.+Khuri%22), [John A. Cornell](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22John+A.+Cornell%22), CRC Press,1996

**MFT-105 LAB-1**

 **Internal- 50**

 **External-50**

 **Experiments**

1. Estimation of fatty acid in oil and fat.
2. Isolation & determination of lycopene from tomato products.
3. Separation of sugars by using paper chromatography.
4. Sensory evaluation/organoleptic properties of different flavor compounds of plant and food material
5. Determination of enzymatic and non enzymatic browning in stored processed products by spectrophotometer.
6. Study the effect of different drying methods on drying rates.
7. Analysis of different types of flavors such as whole or powdered spices and essential oils.
8. Production & quality evaluation of foods containing neutraceuticals.
9. Physiochemical Properties of Wheat
10. Quality evaluation of Rice
11. Malting of Barley

**MFT-201 NOVEL FOOD PACKAGING TECHNIQUES**

 **Internal- 30**

 **External-70**

 **Exam Duration: 3hrs**

**Note- The examiner will set eight questions taking two from each unit. The candidates are required to attempt five Questions in total, selecting at least one from each unit. All questions will carry equal marks.**

**Unit – I**

**Active and intelligent packaging:** Active Packaging Techniques and intelligent Packaging Techniques, current use of novel Packaging Techniques, consumers and novel Packaging

**Oxygen, ethylene and other scavengers:** Oxygen scavenging technology, selecting right types of oxygen scavenger, ethylene scavenging technology, corbon dioxide and other scavengers

**Antimicrobial food packaging:** Antimicrobial agents, constructing antimicrobial packaging systems, factors affecting the effectiveness of antimicrobial packaging

**Unit – II**

**Non-migratory bioactive polymers (NMBP) in food packaging:** Advantages of NMBP, Inherently bioactive synthetic polymers: types and application, Polymers with immobilized bioactive compounds and their applications

**Time Temperature indicators (TTIs):** Defining and classifying TTIs, Requierments for TTIs, development of TTIs, Maximizing the effectiveness of TTIs, Using TTIs to monitor shelf life during distribution

**The use of freshness indicator in packaging:** Compounds indicating the quality of packaged food products, freshness indicators, pathogen indicators, other methods for spoilage detection

**Unit – III**

**Packaging-flavour interaction:** Factors affecting flavour absorpstion, role of food matrix, role of differing packaging materials,flavour modification and sensory quality

**Moisture regulation:** Silica gel, clay, molecular sieve, humectants, salts, irreversible adsorption

**Developments in modified atmosphere packaging (MAP):** Novel MAP gas, testing novel MAP applications, applying high oxygen MAP

**Recyling packaging materials:** Recyclability of packaging plastics, improving the recyclability of plastics packaging, testing safety and quality of recycled materials, using recycled plastics in

packaging

**Unit – IV**

**Green plastics for food packaging:** Problems of plastic packaging wastes, range of biopolymers, developing novel biodegradable materials

**Integrating Intelligent packaging, storage and distribution:** Supply chain for perishable foods, role of packaging in the supply chain, creating integrated packaging, storage and distribution: alarm systems and TTIs

**Testing consumer responses to new packaging concepts:** New packaging techniques and the consumers, methods for testing consumer responses, consumer attitudes towards active and intelligent packaging

**Safety and legislative aspects of packaging:** Regulatory considerations, plastic, metal, paper and glass packaging

**References**

1. Novel Food Packaging Techniques, Ahvenainen,Elsevier, 2003

2. Food Packaging, Robertson, CRC Press, 2012.

3. Handbook of Package Engineering, [Joseph F. Hanlon](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Joseph+F.+Hanlon%22), [Robert J. Kelsey](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Robert+J.+Kelsey%22), [Hallie Forcinio](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Hallie+Forcinio%22) CRC Press, 1998

4. A Handbook of Food Packaging, Frank A. Paine, H.Y. Paine published by Springer Science & Business Media, 1992

**MFT-202 ADVANCES IN FOOD ENGINEERING**

 **Internal- 30**

 **External-70**

 **Exam Duration: 3hrs**

**Note- The examiner will set eight questions taking two from each unit. The candidates are required to attempt five Questions in total, selecting at least one from each unit. All questions will carry equal marks.**

**Unit – I**

**Fluid Foods:** Material and energy balance, Flow of fluids foods. Hygienic design concepts, sanitary pipe fittings, pumps and fans, bulk milk coolers, milk collecting and chilling centers, milk tanks, stirrers and mixers, milk reception equipment, pasteurizers, sterilizers and treatment by irradiations, CIP system, corrosion process and their controls

**Unit – II**

**Separators:** Centrifugation, separation, cyclone separators, homogenizers, ultra-filtration, reverse osmosis and electrodialysis, Equipment for cheese, ice cream, butter manufacture, and other special milk products

**Unit – III**

**Thermal Processing:** Thermal processing, sterilization classification U.H.T. systems and recent advances, factors affecting spoilage of different types of food products and design of thermal processes. Survival curves, thermal death curves, analysis of thermal resistance data, process time evaluation, Design of batch and continuous sterilization cycles in vat, inter-relationship between batch and continuous reactors, design calculations

**Unit – IV**

**Refrigeration:** Refrigeration cycles, performance of refrigeration compressors, refrigeration system balance and multiple evaporation systems. Flash cooling, design of condensors, evaporators, cooling towers, thermo-electric cooling, cryogenics, different refrigeration systems for ultra low refrigeration

**Thermodynamics of Food Freezing:** Properties o frozen foods, freezing point depression, Ice crystal formation, Enthalpy change during freezing, experimental related numerical

problems, Predicting rates of product freezing and design of food freezing equipment

**Energy Management:** Energy audit and management strategies in food process industries

**References**

1. Fundamentals of Engineering Heat and mass transfer, R.C. Sachdeva, New Age Science, 2009
2. Fundamentals of Food Process Engineering, R.T. Toledo, Springer Science & Business Media, 2007

 3. Food Engineering Operations, Brennan, J.G. and J.R.Cowell published by **Elsevier,1990**

 4. Food Process Engineering, Heldman,D.R. and R.P.Singh , Avi Pub. Cop., 1981

 5. Elements of Food Engineering, Harper J.C., Van Nostrand Reinhold, 1988

 6. Fundamentals of Food Engineering, [Stanley E. Charm](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Stanley+E.+Charm%22) , Avi Pub. Cop., 1971

**MFT-203 APPLICATIONS OF BIOTECHNOLOGICAL TOOLS**

 **IN FOOD ANALYSIS**

 **Internal- 30**

 **External-70**

 **Exam Duration: 3hrs**

**Note- The examiner will set eight questions taking two from each unit. The candidates are required to attempt five Questions in total, selecting at least one from each unit. All questions will carry equal marks.**

**Unit – I**

**Introduction:** Concept of Biotechnology, history, old vs new Biotechnology, Different food borne pathogens

**Genetic Engineering:** Concept, different vector systems used in gene cloning, gene cloning procedures: isolation of DNA fragment, joining to vector, expression & selector of recombinant with suitable example, DNA fingerprinting, Method of DNA fingerprinting, Identification techniques, Practical applications

**Unit – II**

**Polymerase Chain Reaction:** Introduction and principle, process of PCR, Development of a PCR assay, PCR optimization, Practical modifications to the PCR technique, Advantages and disadvantages, Applications, Application of PCR in the detection of different pathogen species, MPCR analysis

**Unit – III**

**ELISA**: Concept of Antigen & Antibody, ELISA, Types of ELISA, Methods, ELISA kits, Applications in food and agriculture

**Immunoassay kits:** Types of Immunoassays, Principle of detection of kits, Monoclonal Antibodies-antigen, antibody, Nomenclature, Production of monoclonal antibodies-in vitro and in -vivo, merits and demerits, application in food industries

**Unit – IV**

**Biosensor:** Types of biosensor- Calorimetric, Potentiometric, Amperometric, Optical, Piezoelectric, Immunosensors, Principle of detection, Application, Biosensors in food analysis

**References**

1. Biotechnolgy :Food Fermentation, V.K.Joshi & Pandey, Educational Publishers & Distributors, 1999

 2. Biotechnology in Food Industry, M.P.Tombs, Open University Press, 1990

 3. Modern Concepts of Biotechnology, H. D. Kumar, Vikas Publishing House

 (P) Ltd.

 4. Elements of Biotechnology, P. K. Gupta, Rastogi Publications

 5. Modern Food Micro-Biology, ed. J.M. Jay, 1986, Van Nostrand Reinhold

 Company, New York

 6. Recombinant DNA, ed. James D Watson and Michael Gilman, 2001, W. H

 Freeman and Company NY.

 7. Molecular Biotechnology: Principles and Application of Recombinant DNA,

 ed.Bernard R Glick and Jack J.Pasternak, ASM press Washington DC

 8. Essentials of Diagnostic Microbiology, ed. Lissa Anne Shimeld.

 9. Methodology of immunochemical and immuno-logical research, ed.

 Kwapinski- Willey inter science

 10. Commercial Biosensors, ed. Graham Ramsay, John Wiley Publishers

**MFT-204 FOOD QUALITY ASSURANCE AND MANAGEMENT**

 **Internal- 30**

 **External-70**

 **Exam Duration: 3hrs**

 **Note- The examiner will set eight questions taking two from each unit. The candidates are required to attempt five Questions in total, selecting at least one from each unit. All questions will carry equal marks.**

**Unit – I**

**Food laws, regulation, standards and specifications:** Agmark- 1937, FPO 1955, PFA – 1954, BIS –1952, consumer protection act –1986, Vanaspati control order –1978, export quality control and inspection act- 1963, food safety and standards act - 2006, ISO–9000 series: 9001, 9002, 9000 (2000)

**Food Quality aspects of Fruits & Vegetable ; Milk & Milk products, Meat & Poultry : I**ntroduction, Quality principles, Quality enhancement Model. Application of quality enhancement model.

**Unit – II**

**Statistical Quality Control, Production planning and Network analysis:** Introduction, Evaluation of food quality; Statistical approaches in quality control and quality assurance; objectives of production planning and concept of total quality control (TQM). Requirement of good manufacturing process (GMP), good hygienic process (GHP), use of hazard analysis critical control Point (HACCP) and its implication in food industries, Procedure of production control, Project planning network / PERT and CPM network.

**Measuring and controlling devices**-Role of transducers measurements in food processing: Humidity, Turbidity and colour, Food & Process temperature controller and indicators.

**Unit – III**

**Analytical Techniques in Foods:** Application and operating parameters of

Spectrophotometry, AAS, GC, HPLC.

**Industrial Legislation, Disputes and trade Unions:** Industrial legislation and laws, acts and disputes. Industrial disputes act –1947, WTO, GATT, CAC, Patent Laws and IPR

**Unit – IV**

**Industrial Organization structure:** Types of organization structure, Principles of

development of organization structure, forms of business organization, Division of industries, industrial sectors (private and public), Problems associated to public sector industries, social obligations of industries towards society

**References**

1. Quality control in food industry (Vol. I and II), [Amihud Kramer](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Amihud+Kramer%22), [Bernard A. Twigg](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Bernard+A.+Twigg%22) ,Avi Pub. Co., 1962

2. Hand book of analysis Fruits and Vegetables Pdts., Ranganna,Tata Mc Graw Hill

3. Modern method of analysis by Stewart and Whittaker, CRC Press, 1986

4. Food Analysis theory and practices ,S. N. Mahindru,Metropolitan book Co. Pvt. Ltd., 2003

5. Food Analysis theory and practices ,[Yeshajahu Pomeranz](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Yeshajahu+Pomeranz%22), [Clifton E. Meloan](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Clifton+E.+Meloan%22) Springer Science & Business Media, 2002

6. Food analysis and quality control, M.Jocob ,CBS Publications,1999

**MFT-205 LAB-II**

 **Internal- 50**

 **External-50**

 **Experiments**

1. Dehydration of water vapour permeability.
2. Determine thermal property of glass.
3. Ink adhesion of various food products packing.
4. Study of characteristics of FFS & vacuum film machine.
5. Testing and evaluation of quality attributes of raw & processed food.
6. Detection of food adulterants.
7. Study of application of HACCP to products.
8. Study of effect of temperature on viscosity/consistency of food sample.