**Course – M.Sc. in Food Science and Nutrition**

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|---|---|
| Semester | **2** |
| Paper Number | **MFSN 4201** |
| Paper Title | **Research Methodology, Statistical applications and Nutrition Through Life Cycle** |
| No. of Credits | 6 |
| Non composite/ composite | Non-Composite Full Theory |
| No. of periods assigned | 6 |
| Course description/ Objective | 1. Develop a scientific approach and know the processes of research<br>2. Understand concepts of statistical measures of central tendency, dispersion, variability and probability. |
| Reference List | 1.Bell, J. (2005): 4th Ed. Doing Your Research Project: A Guide for First-time Researchers in Education and Social Science, Viva Books, New Delhi<br>2. Holloway, I. (1997): Basic Concepts of Qualitiative Research, Blackwell Science, London.<br>3. Kothari, C.R. (2004): 2nd Ed. Research Methodology: Methods and Techniques, Wishwa Prakashan, New Delhi.<br>4. Kothari, C.R. Research Methodology. 2013 print. New Delhi: Sage publications. |
| Evaluation | **Theory:** 100 Marks (80 End sem + 20 CIA)<br><br>**Question Paper format: Theory end semester**<br>**Module 1: 40 marks**<br><br>SHORT QUESTION: FROM 7 QTNS ANSWER 5 (EACH 2 MARKS) = 5x2=10<br><br>LONG QUESTION: FROM 8 QTNS ANSWER 6 (EACH 5 MARKS) = 6x5=30<br><br>**Module 2: 40 marks**<br>SHORT QUESTION: FROM 7 QTNS ANSWER 5 (EACH 2 MARKS) = 5x2=10<br><br>LONG QUESTION: FROM 8 QTNS ANSWER 6 (EACH 5 MARKS) = 6x5=30 |

**MFSN 4201 – Research Methodology, Statistical applications and Nutrition Through Life Cycle**

*Course Outcome:*

- Understanding about the basic concepts, approaches and methods in conducting research
- Enabling them to appreciate and critique the nuances of designing a research study as well the ethical dimensions of conducting researches.
- To understand the basic concepts, theories and methods in statistics, learn statistical procedures for research and understand applications of statistical techniques for analysis and interpretation.

**Module 1 [Research Methodology & Statistical applications] F.M –50**

**1. Introduction to Research**

Concept, definition, meaning, nature, scope, and objectives of research.

**2. Research Ethics and Research Methods**

Ethical principles governing research involving human participants and researchers, including rights, dignity, privacy, and safety. Informed consent, confidentiality, anonymity, voluntary participation, avoidance of harm, conflicts of interest, and research bias. Ethical guidelines, research integrity, plagiarism, data falsification and fabrication, duplication, scientific misconduct, and ethical review and approval of research proposals.

**3. Types of Research**

- Basic and applied research
- Qualitative and quantitative research: overview and key differences
- Historical research
- Descriptive research methods: survey, case study, correlational studies, content analysis, and causal-comparative research
- Analytical studies: pre-experimental, experimental, and quasi-experimental designs
- Qualitative research approaches, including ethnography
- Evaluative research: characteristics and the use of qualitative methods in evaluation studies

**4. Research Report Writing**

Concept and purpose of research reporting. Synopsis preparation, types of research reports, characteristics of effective reports, structure and components of a research report, and guidelines for writing, formatting, and presenting research findings.

**5. Introduction to Statistics**

Fundamental principles and concepts of statistics. Orientation to qualitative and quantitative research procedures. Descriptive statistics and their applications in research.

**6. Organisation and Presentation of Data**

Nature of qualitative and quantitative data. Coding techniques and data reduction strategies. Data organisation through frequency distributions and thematic analysis. Use of percentages, percentiles, and frequency measures. Construction of univariate, bivariate, and multivariate tables. Graphical representation using diagrams, charts, and graphs.

**7. Statistical Measures and Data Analysis**

Classification and tabulation of data. Measures of central tendency and dispersion. Frequency distribution, histograms, frequency polygons, and ogives. Binomial and normal distributions and use of normal probability tables. Parametric and non-parametric tests. Hypothesis testing, Type I and Type II errors, and levels of significance. Application of Student's *t*-test for small samples, testing differences in means and proportions. Correlation analysis, including coefficient of correlation and rank correlation methods.

**Module 2 [Nutrition Through Life Cycle] F.M-50**

**1. Infant Nutrition**

Growth and physiological development during infancy. Nutritional requirements and Recommended Dietary Allowances (RDA). Infant feeding practices, including breastfeeding and formula feeding. Nutrition of low birth weight and premature infants. Introduction of complementary foods: importance of weaning, types of complementary foods, common feeding problems, growth patterns, developmental milestones, and appropriate feeding practices.

**2. Nutrition for Toddlers and Pre-school Children**

Growth and developmental milestones. Nutritional requirements and RDA. Common nutritional problems in early childhood, with emphasis on Protein–Energy Malnutrition (PEM), including SAM and MAM—clinical features, nutritional needs, and basic management strategies.

**3. Nutrition for School-age Children and Adolescents**

Physical growth and pubertal development. Nutritional requirements and RDA. Major nutritional concerns including undernutrition, obesity, disordered eating behaviours, iron deficiency anaemia, and early risk factors for osteoporosis.

**4. Nutrition in Adulthood**

Nutritional requirements and RDA for adults. Factors influencing nutrient needs. Psychosocial stages of development. Physiological changes during peri-menopause and menopause, and related dietary modifications.

**5. Nutrition in Special Conditions**

Nutrition during pregnancy: foetal growth and development, maternal nutritional requirements, RDA, weight gain, and maternal–foetal nutrition relationship. Nutrition during lactation: physiology of lactation, nutritional requirements, RDA, breastfeeding practices including colostrum and mature milk, benefits and barriers to breastfeeding, and low milk supply.Nutrition in old age: physiological changes and theories of ageing, nutritional requirements, common nutrition-related problems, degenerative diseases including Alzheimer's disease, dietary guidelines for healthy ageing, and the role of physical activity.

**Course – M.Sc. in Food Science and Nutrition**

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|---|---|
| Semester | **2** |
| Paper Number | **MFSN 4202** |
| Paper Title | **Food Microbiology, Food Toxicology and Food Safety** |
| No. of Credits | 6 |
| Non composite/ composite | Non-Composite Full Theory |
| No. of periods assigned | 6 |
| Course description/ Objective | 1. To understand the nature of microorganisms involved in food spoilage, food infections and intoxications.<br>2. To understand criteria for microbiological safety in various foods operations to avoid public health hazards due to food contamination. |
| Reference List | 1. Banwart GJ.(1987) Basic Food Microbiology . CBS Publishers and Distributors.<br>2. Frazier WC Westoff DC.(1998)Food Microbiology. 4thed. Tata McGraw- Hill Publishing Co. Ltd.<br>3. Garbutt John (1997) Essentials of Food Microbiology. Arnold London.<br>4. JayJM, Loessner DA, Martin J.(2005) Modern Food Microbiology. 7th ed. Springer<br>5. Pelczar MJ, Chan ECS, Krieg N. (1993) Microbiology. 5th ed. Tata McGraw-Hill Publishing Co. Ltd. |
| Evaluation | **Theory:** 100 Marks (80 End sem + 20 CIA)<br>**Question Paper format: Theory end semester**<br>**Module 1: 40 marks**<br><br>SHORT QUESTION: FROM 7 QTNS ANSWER 5 (EACH 2 MARKS) = 5x2=10<br>LONG QUESTION: FROM 8 QTNS ANSWER 6 (EACH 5 MARKS) = 6x5=30<br><br>**Module 2: 40 marks**<br>SHORT QUESTION: FROM 7 QTNS ANSWER 5 (EACH 2 MARKS) = 5x2=10<br><br>LONG QUESTION: FROM 8 QTNS ANSWER 6 (EACH 5 MARKS) = 6x5=30 |

**MFSN 4202 –Food Microbiology, Food Toxicology and Safety**

*Course Outcome:*

- To understand the nature of microorganisms involved in food spoilage, food infections and intoxications.
- To learn the ecology to determine how the microorganisms get into foods and why pathogenic microorganisms are a problem in particular foods.
- To understand criteria for safety in various foods operations to avoid public health hazards due to food contamination.
- To discuss food adulteration and the common food adulterants used.
- To get the knowledge of microbial toxins, food safety standards, and regulatory frameworks.

**Module 1 [Food Microbiology]** **F.M- 50**

**1. Introduction to Food Microbiology**

Scope and significance of food microbiology. Overview of the microbial world including bacteria, fungi, yeasts, viruses, and bacteriophages. Classification of bacteria based on morphology (Gram-positive and Gram-negative, motility, spore-forming and non-spore-forming) and physiological growth requirements (temperature, pH, water activity, and oxygen). General characteristics and role of fungi and yeasts in foods. Viruses and bacteriophages: characteristics and modes of multiplication. Factors influencing survival and growth of microorganisms in foods, including intrinsic factors and extrinsic factors.

**2. Microbial Food Spoilage and Control**

Concept, characteristics, and significance of food spoilage. Spoilage patterns of major food groups such as cereals, fruits and vegetables, meat, poultry, seafood, milk and milk products, and packaged and canned foods. Methods for control of microorganisms in foods, including physical removal, thermal processing (thermal destruction, thermal death time, D, Z, and F values, thermal death time curves, and the 12D concept), low-temperature preservation, reduction of water activity, acidification, use of antimicrobial preservatives, and food irradiation.

**3. Foodborne Infections and Intoxications**

Foodborne diseases caused by bacteria, moulds, and viruses. Bacterial pathogens including *Salmonella typhi, Helicobacter pylori, Campylobacter jejuni, Yersinia enterocolitica, Bacillus cereus, Staphylococcus aureus, Listeria monocytogenes, Clostridium botulinum,* and *Escherichia coli*—with reference to disease symptoms, mechanisms of pathogenesis, food sources, prevention, and identification methods. Food intoxications and poisonings including mycotoxins, puffer fish poisoning, ciguatera fish poisoning, and paralytic shellfish poisoning. Viral foodborne illnesses caused by Norovirus, Norwalk virus, Rotavirus, Astrovirus, Adenovirus, Reovirus, Parvovirus, and Hepatitis A virus—symptoms, modes of transmission, prevention, and detection methods.

**4. Microorganisms in Human Welfare and Food Biotechnology**

Role of microorganisms in human health and welfare, including normal microflora, prebiotics and probiotics. Single-cell protein production, fermented foods. Importance of microorganisms in food biotechnology, including genetically engineered microorganisms and their applications.

## Module 2 [Food Toxicology and Food Safety] F.M-50

### 1. Principles of Food Toxicology

Basic concepts and definitions in toxicology, including toxicants, toxins, and dose–response relationships. Types of toxicity—acute, sub-chronic, and chronic toxicity. Concepts of $LD_{50}$ (lethal dose) and $LC_{50}$ (lethal concentration). Factors influencing toxicity such as age, sex, genetic susceptibility, and environmental exposure. Risk assessment approaches used in food toxicology.

### 2. Food Toxins and Toxicants

Microbial toxins including endotoxins, exotoxins, and mycotoxins, with examples such as aflatoxins and botulinum toxin. Naturally occurring food toxicants such as alkaloids, glycoalkaloids, and lectins. Chemical contaminants in foods including pesticides, heavy metals, and food additives. Toxic compounds formed during food processing, including acrylamide, heterocyclic amines, and polycyclic aromatic hydrocarbons.

### 3. Food Safety and Quality Assurance

Microbiological quality standards for food and drinking water. Principles and application of Hazard Analysis and Critical Control Point (HACCP). Good Manufacturing Practices (GMP) and Good Hygienic Practices (GHP). Food standards, laws, and regulatory frameworks ensuring food safety, including the Food Safety and Standards Act, 2006, relevant Bureau of Indian Standards (BIS), and establishment of food testing laboratories with reference to NABL and ISO/IEC 17025:2017 accreditation.

### 4. Food Adulteration, Consumer Health, and Protection

Common food adulterants, methods of adulteration, and laboratory tests for detection. Health hazards associated with food adulteration. Consumer rights and responsibilities related to food safety. Procedures for lodging complaints and seeking redressal. Role of consumer organizations and government agencies in safeguarding consumer interests.

**Course – M.Sc. in Food Science and Nutrition**

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| Semester | 2 |
| Paper Number | **MFSN 4203** |
| Paper Title | **Principles of Food Science and Food processing** |
| No. of Credits | 6 |
| Non composite/ composite | Non-Composite Full Theory |
| No. of periods assigned | 6 |
| Course description/ Objective | ➢ To understand the historical perspective of food science.<br>➢ To learn about food additives, adulterants and fortification.<br>➢ To stay updated with emerging concepts of nutrition during different stages of life cycle. |
| Reference List | 1. Textbook of Food Science and Nutrition by Sunita Roy Chowdhury and Bani Tamber Aeri.<br>2. A Laboratory Manual of Food Analysis by Shalini Sehgal, Year – 2016 ISBN NO - 9789384588847<br>3. Whitney. E.R. and S.R Kolfes (2002) Understanding Nutrition 9th edition .Wadsworth Thomson Learning.<br>4. Gibson, G.R. and M.B. Roberfroil (1999) Coloric Mirobio, Nutrition and health, Kluwer Academic Publishers, Dordecht.<br>5. Thompson, L.U. (1993) Potential Health Benefits and problems associated with antinutrients in foods. Food Research International. 26; 134 – 149. |
| Evaluation | **Theory:** 100 Marks (80 End Sem + 20 CIA)<br>**Question Paper format: Theory end semester**<br>**Module 1: 40 marks**<br><br>SHORT QUESTION: FROM 7 QTNS ANSWER 5 (EACH 2 MARKS) = 5x2=10<br>LONG QUESTION: FROM 8 QTNS ANSWER 6 (EACH 5 MARKS) = 6x5=30<br><br>**Module 2: 40 marks**<br>SHORT QUESTION: FROM 7 QTNS ANSWER 5 (EACH 2 MARKS) = 5x2=10<br><br>LONG QUESTION: FROM 8 QTNS ANSWER 6 (EACH 5 MARKS) = 6x5=30 |

**MFSN 4203 –Principles of Food Science and Food Processing**

*Course Outcome:*

- To familiarize the students with fundamentals of food, nutrients and their relationship to health.
- To create awareness with respect to deriving maximum benefit from available food resources.

**Module 1 [Principles of Food Science]** **F.M -50**

**1. Introduction to Food Science**

Scope and importance of food science. Functions of food—physiological, psychological, and social.

**2. Cooking Methods and Effects on Nutrients**

Structure, composition, selection, storage, and cooking methods of major food groups and their effects on nutrient retention: cereals and pulses; fruits and vegetables; milk and milk products; eggs, meat, fish, and poultry; fats and oils. Food colloids—sols, gels, suspensions, foams, and emulsions.

**3. Water, pH, and Enzymes in Food Systems**

Role of water in foods, water activity, phase transitions, sorption isotherms, and food stability. Hydrogen ion concentration (pH) and oxidation–reduction potential in foods. Applications of enzymes and immobilized enzymes in food processing.

**4. Food Components and Their Functional Properties**

Carbohydrates (sugars, sweeteners, starch and non-starch polysaccharides, gelatinization and retrogradation), proteins (nutritional and functional properties), lipids (functional roles, emulsions, oxidation, rancidity, antioxidants, interesterification), and browning reactions (Maillard reaction and caramelization).

**5. Food Additives, Adulteration, and Fortification**

Food additives: definition, classification, functions, chemistry, applications, and toxicological evaluation. Food adulteration: common adulterants and methods of detection. Methods for improving nutritional quality of foods—enrichment, restoration, and fortification.

**6. Product Evaluation and Sensory Evaluation of Foods**

Sampling techniques for product evaluation and sample preparation.

Principles and applications of sensory evaluation in food quality and product development. Sensory perception of appearance, flavour, texture, taste, and sound. Selection and training of sensory panelists. Classification of sensory tests:

- Difference tests (paired comparison, triangle, duo-trio, difference from control)

- Descriptive tests
- Affective and acceptance tests
  Consumer acceptability and preference measurement.

**7. Advanced Sensory Evaluation Technologies**

Modern tools and techniques in sensory analysis including electronic nose (E-nose), electronic tongue (E-tongue), sensory mapping, texture analyzers, and emerging applications of virtual reality (VR) and augmented reality (AR).

**Module 2 [Principles of Food Processing] F.M – 50**

**1. Introduction to Food Processing**

Importance and scope of food processing in dietetics and nutrition. Impact of processing on food quality, safety, shelf life, and nutrient retention.

**2. Food Processing and Preservation Methods**

**Thermal Processing:** Principles, mechanisms, and effects of blanching, pasteurization, sterilization, UHT processing, canning, extrusion cooking, and frying on food quality and nutrients.
**Low-temperature Processing:** Principles and effects of refrigeration, chilling, freezing, freeze-drying (lyophilization), and freeze-concentration.
**Non-thermal Technologies:** Principles and effects of irradiation, high-pressure processing, pulsed electric field, fermentation, and emerging preservation technologies.
**Other Preservation Methods:** Drying, osmotic dehydration, concentration, evaporation, distillation, and hurdle technology.

**3. Processing of Major Food Groups**

**Fruits and Vegetables:** Processing of juices, jams, jellies, marmalades, purees, pastes, sauces, ketchup, pickles, preserves, and crystallized fruits; enzymatic browning and post-harvest handling.
**Cereals, Pulses, and Legumes:** Milling, germination, extrusion, and fortification; effects on digestibility and glycaemic index.
**Beverages:** Alcoholic and non-alcoholic beverages
**Confectionery Products:** Candies, toffees, caramels, and chocolate products.
**Dairy and Meat Products:** Pasteurization, homogenization, cheese and yoghurt manufacture; meat tenderization, curing, smoking, freezing.
**Oils and Fats:** Refining, hydrogenation, and interesterification; trans fats and health implications.
**Speciality and Functional Foods:** Introduction, applications, organic foods, and superfoods.

**4. Contaminants and Adulteration in Processed Foods**

Chemical and biological contaminants including heavy metals, pesticide residues, and microbial toxins. Common food adulterants and basic detection methods.

**Course – M.Sc. in Food Science and Nutrition**

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|---|---|
| Semester | **2 PRACTICAL** |
| Paper Number | **MFSN 4251** |
| Paper Title | **Food Microbiology, Food Science & Processing** |
| No. of Credits | 2+2+2 = 6 |
| Non composite/ composite | Non-Composite |
| No. of periods assigned | 12 |
| Course description/ Objective | ➢ To learn the microbiological techniques for food and water analysis.<br>➢ To critically analyse the planning and preparation of diets.<br>➢ To analyse the presence of adulterants in the food.<br>➢ To stay updated with the tests for food additives & fortifications. |
| Reference List | 1. A Laboratory Manual of Food Analysis by Shalini Sehgal, Year – 2016<br>2. Gaman, P.M. and Sherrington, K.B. (1996),The science of food, oxford, Butterworth – Heinemann.<br>3. Potter, Norman N. and Hotchkiss (1996) Food Science, 5th ed. C.B.S. Publication.<br>4. Manay, N. Shakuntala and Shadaksharaswami, N. (1987), Foods: Facts and Principles, Wiley Eastern Ltd.<br>5. Meyer, Lilian H. Ed. (1987), Food chemistry. Indian Ed. CBS Publishers and Distributors.<br>6. Frazier, Food Microbiology, Tata Mc Graw Hill 1978. |
| Evaluation | **Practical : 100 Marks (20 End Sem + 80 CIA)**<br>**Question Paper format: Practical end semester**<br>**Viva voce – 20 marks (End Sem)** |

**MFSN 4251 – Practical**

**Food Microbiology, Food Science & Processing**

**F.M -100**

*Course outcome:*

To learn the practical skills in microbiological analysis and emerging technologies, to ensure food quality, safety, and sustainability in the food industry.

1. Study of various microbiological laboratory equipments.
2. Preparation of different culture medium.
3. Determination of bacteria and viable microbes by different techniques.
4. Simple staining, Gram staining, acid fast staining.
5. Microbiological analysis of Water, Milk, Canned product, Fruit juices and Street foods.
6. Phosphatase test for pasteurization of milk, Gradation of milk by methylene blue reduction test, Coliform bacteria isolation from different water sources;
7. MIC test for antibiotics against Gram-positive and Gram-negative bacteria.
8. Antibiotic susceptibility test by disc diffusion assay method.
9. Shelf life study of food items based on microbial safety
10. Study the effect of cooking on cereals, pulses, vegetables fruits, egg, meat and sugar.
11. Determination of physical characteristics and presence of any food additives.
12. Study the effect of various additives in processing of food.
13. Preparation of stable emulsions in food system.
14. Proximate analysis of food samples: moisture, ash, protein, fat, fibre and carbohydrate content.
15. Estimation of gluten content in food
16. Thermal Processing techniques
17. Food Dehydration and Freeze-Drying
18. Fermentation and Probiotic Food Preparation
19. Detection of Food Adulterants and Contaminants
20. Sensory Evaluation and Shelf-Life Testing
21. Sample meal formulation for various age groups
22. Visit to food processing unit or any other organization dealing with advanced method in food microbiology and food processing.

**P.G Department of Food Science and Nutrition**

**SEMESTER 2**

| PAPER | MARKS | MODULE | THEORY | PRACTICAL | CREDIT | CLASSES |
|---|---|---|---|---|---|---|
| MFSN 4201 | 100 | 2 | Research Methodology, Statistical Applications and Nutrition Through Life Cycle | | 6 | 6 |
| MFSN 4202 | 100 | 2 | Food Microbiology , Food Toxicology and Food Safety | | 6 | 6 |
| MFSN 4203 | 100 | 2 | Principles of Food Science and food Processing | | 6 | 6 |
| MFSN 4251 | 100 | | | Food Microbiology, Food Science & Processing | 2+2+2=6 | 12 |

**Total Credit – 24** **Total classes – 30**