

Master's Program in Food Science and Nutrition
Credit Score and Scheme

TABLE 1: STRUCTURAL FRAMEWORK OF THE TWO YEARS M.SC. PROGRAM UNDER NEP-2020				
SEMESTER	SEM-I	SEM-II	SEM-III	SEM-IV
Core Courses	DCC-01-Th (4 Cr) DCC-02 Th (4 Cr) DCC-03 Th (4 Cr) DCC-04 Th (4 Cr) DCC-05 Pract. (4 Cr)	DCC-06-Th (4 Cr) DCC-07 Th (4 Cr) DCC-08 Th (4 Cr) DCC-09 Pract. (4 Cr)	DCC-10-Th (4 Cr) DCC-11 Th (4 Cr) DCC-(12) Pract. (4 Cr)	DCC-13-Th (4 Cr) DCC-(14) Th (4 Cr) DCC-(15) Pract. (4 Cr)
Discipline Specific Elective (DSE) / Generic Elective Courses (GEC)		DSE/ GEC – 01 Th (4 Cr)	DSE-(02) Th (4 Cr) DSE-(03) Th (4 Cr)	DSE-(04) Th (4 Cr) DSE-(05) Th (4 Cr)
Total No. of Credits	20 + 0 = 20	16 + 4 = 20	12 + 8 = 20	12 + 8 = 20
	60 (DCC) + 20 (DSE/GEC) = 80			

- Duration of examination of each course shall be 3 hours (for Theory courses) and 4 hours (for Practical courses).
 - Each Core and Elective course will be of 100 marks.
 - It is mandatory to clear Theory and Internal Assessment courses separately. The minimum qualifying marks in both shall be 40 percent.
- The semester wise details of Master's Course are given below.

2.0 SCHEME OF TWO YEARS POST GRADUATE M.Sc. DEGREE PROGRAM IN FOOD SCIENCE AND NUTRITION
Program Code:

Program Faculty: Science

Program Name: TWO YEAR POST-GRADUATE DEGREE PROGRAM IN FOOD SCIENCE AND NUTRITION

SCHEME AND WEIGHTAGE OF COURSES

S. No.	Course Category	Title of the Course	Credits			Credits earned	Evaluation			Remarks
			L	T	P		IA	ESA	Total	
SEMESTER – I										
1	FSNDCC – 01	Applied Physiology	4	0	0	4	30	70	100	All Courses are compulsory Courses
2	FSNDCC – 02	Food Safety and Microbiology	4	0	0	4	30	70	100	
3	FSNDCC – 03	Nutritional Biochemistry	4	0	0	4	30	70	100	
4	FSNDCC – 04	Problems in Human Nutrition	4	0	0	4	30	70	100	
5	FSNDCC – 05	Nutritional Biochemistry and Microbiology Practical	0	0	4	4		100	100	
SEMESTER – II										
6	FSNDCC – 06	Advanced Nutrition	4	0	0	4	30	70	100	
7	FSNDCC – 07	Advanced Nutritional Biochemistry	4	0	0	4	30	70	100	
8	FSNDCC – 08	Research Methods and Biostatistics	4	0	0	4	30	70	100	
9	FSNDSE– 01A	Exercise Physiology and Sports Nutrition	4	0	0	4	30	70	100	Student may opt any one
	FSNDSE– 01B	Nutrition in Emergency and Disaster					30	70	100	
10	FSNDCC – 09	Advanced Nutrition and Biochemistry Practical	0	0	4	4		100	100	

SEMESTER – III										
11	FSNDCC – 10	Food Science	4	0	0	4	30	70	100	
12	FSNDCC – 11	Nutrition for Vulnerable and Special Groups	4	0	0	4	30	70	100	
13	FSNDSE – 02A	Public Health Nutrition	4	0	0	4	30	70	100	Student may opt any one
	FSNDSE – 02B	Food product Development and Marketing					30	70		
14	FSNDSE – 03A	Foundations of Clinical and Therapeutic Nutrition	4	0	0	4	30	70	100	Student may opt any one
	FSNDSE – 03B	Functional Food and Nutraceuticals					30	70		
15	FSNDCC – 12	Food Science and Community Nutrition Practical	0	0	4	4		100	100	
SEMESTER – IV										
16	FSNDCC – 13	Advanced Medical Nutrition Therapy	4	0	0	4	30	70	100	
17	FSNDCC – 14	Institutional Food Service Management	4	0	0	4	30	70	100	
18	FSNDSE – 04A	Metabolomics and Precise Nutrition	4	0	0	4	30	70	100	Student may opt any one
	FSNDSE – 04B	Food Processing and Technology					30	70		
19	FSNDSE – 05A	Dissertation	4	0	0	4	30	70	100	Students may opt any one
	FSNDSE – 05B	Entrepreneurship in Food and Nutrition					30	70		
20	FSNDCC – 15	Therapeutic Nutrition and Food Service Management Practical	0	0	4	4		100	100	
		Total							1000	

Note:

Course Categories: DCC–Discipline Core Course ;DSE–Discipline Specific Elective

Contact Hours: Lecture-1 Credit=1Hour/ Week

Practical-1 Credit=2 Hours / Week

**M.Sc. Food Science and Nutrition
Semester I**

Course Category	Title of the Course	Credits
FSNDCC – 01	Applied Physiology	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Note: Examiner is requested to set the question paper of 70 marks only. Each question paper is divided into three parts, Part- A, Part B and Part C.

There shall be a Terminal Examination at the end of each Semester carrying 70 marks. The question paper shall comprise three sections **Section A, Section B and Section C.**

Section A

Section shall be of **20 marks** and consist of **10 questions** carrying **2 marks** each to be answered in approximately *20 words* each. All questions shall be compulsory. The examiner shall set the question paper choosing at least 3 questions from each unit.

Section B

Section shall be of **30 marks** and consist of **9 questions** carrying **5 marks** each to be answered in approximately *250 words* each. A Candidate shall attempt any six questions. The examiner shall set the questions ensuring that at least three questions are drawn from each Unit.

Section C

Section shall be of **20 marks** and consist of three questions carrying 10 marks each to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Learning Objectives

1. Develop a comprehensive understanding of the structure and functions of cells, tissues, organs, and organ systems in the human body.
2. Explain the physiological mechanisms responsible for maintaining homeostasis under normal conditions.
3. Provide knowledge of the physiology of the Nervous, Digestive, Respiratory, Circulatory, Excretory, Endocrine, Immune system.
4. Develop an understanding of membrane transport mechanisms and their physiological significance.
5. Explain the composition and functions of blood, mechanisms of haemostasis, and the principles of common biochemical and haematological investigations.
6. Familiarize students with normal physiological processes and their alterations in common pathological conditions such as Hypertension, Heart failure, Endocrine disorders, Allergies, and Renal dysfunction.

Course Outcomes

1. Describe the structure and functions of cells, Plasma Membrane, Nucleus, Cytoplasmic organelles, and explain the mechanisms of membrane transport.
2. Describe the anatomy and physiology of the Digestive and Respiratory systems and explain the processes of Digestion, Respiration, and their regulation.
3. Explain the composition and functions of Blood, Haemopoiesis, Blood Coagulation, immune cells, and interpret the physiological basis of common blood investigations.
4. Describe the anatomy and physiology of the Kidneys and explain urine formation, fluid-electrolyte balance, acid-base regulation, and the action of diuretics.
5. Explain the structure and physiology of the musculoskeletal system, bone, and muscle function.

6. Explain the components and mechanisms of Innate and Adaptive immunity, antibody function, and the physiological basis of allergic reactions.
7. Describe the structure and function of the Cardiovascular and Endocrine systems and explain the physiological basis of cardiac function, blood pressure regulation, hormone action, and common Cardiovascular and Endocrine disorders.

UNIT I

1. Cell Structure and Function

- Cell: definition and functions
- Plasma membrane structure and functions
- Nucleus: structure and functions
- Cytoplasm and cellular organelles

2. Transport of Nutrients Across Membranes

- **Passive transport:** Diffusion (simple and facilitated), osmosis
- **Active transport:** Primary and secondary active transport

3. Blood

- Composition and functions of blood
- Blood clotting mechanism
- Red blood cells and erythropoiesis
- White blood cells: types and functions
- Platelets: structure and functions
- Blood, serum and plasma analysis:
 - Glucose
 - Cholesterol and lipid profile
 - Kidney function tests
 - Liver function tests

4. Digestive System

- Structure and functions of gastrointestinal tract
- Accessory organs of digestion: liver, pancreas and gall bladder
- Digestion and absorption of carbohydrates, proteins and fats

UNIT II

5. Respiratory System

- Respiratory tract: structure and functions
- Mechanism of respiration
- Regulation and control of respiration

6. Circulatory System

- Structure and functions of heart
- Cardiac cycle and cardiac output
- Blood pressure: regulation and influencing factors
- Hypertension and heart failure

7. Excretory System

- Anatomy and physiology of kidneys
- Structure and functions of nephron
- Mechanism of urine formation
- Normal and abnormal urinary constituents
- Role of kidney in acid–base balance and water regulation
- Diuretics

8. Reproductive System

- Male and female reproductive systems: structure and functions
- Menstrual cycle
- Physiology of pregnancy

UNIT III

9. Nervous System

- Classification and components of nervous system
- Structure and functions of neuron
- Reflex action

10. Musculoskeletal System

- Structure of bone
- Types, structure and functions of muscles

11. Immune System

- Types of immunity: innate and acquired
- White blood cells and their role in immunity
- Antibodies: structure and functions
- Allergy

12. Endocrine System

- Hormones: definition and characteristics
- Chemistry of hormones:
 - Steroid hormones
 - Protein and polypeptide hormones
 - Amino acid derivatives
- Structure and functions of:
 - Pituitary gland
 - Thyroid gland
 - Adrenal gland
- Common endocrine disorders

References

1. Ganong W.F. (1985): Review of Medical Physiology 12th edition Lange Medical Publication
2. Moran Campbell E.J, Dickinson C.J, Slater J.D, Edwards C.R.W and Sikora (1984): Clinical Physiology 5th edition ELBS Blackwell Scientific Publications.
3. Guyton A.C(1985): Functions of the Human Body 4th edition W.B. Saunders Company Philadelphia.
4. Guyton A.C and Hall J.B(1996): Textbook of Medical Physiology 9th edition W.B. Saunders Company, Prime Books (Pvt) Ltd. Bangalore.
5. Wilson K.J.W and Waugh.A (1996): Ross and Wilson Anatomy and Physiology in Health and Illness 8th edition Churchill Livingstone.
6. Chatterjee C.C. (1992): Human Physiology Vol I and II 11th edition Medical Allied Agency, Calcutta.
7. Kale C.A. and Neil F Samson (1974): Wright's Applied Physiology.
8. Griffith's M (1974): Introduction to Human Physiology MacMillan and Co.
9. Green J.N(1972): An Introduction to Human Physiology.
10. McArdle W.D, Katch F.I and Katch V.L(1996): Exercise Physiology, Energy Nutrition and Human Performance 4th edition Williams and Wilkins, Ballimore.
11. Jain A.K. Text book of Physiology Vol I and II Avichal Publishing Co New Delhi.

Course Category	Title of the Course	Credits
FSNDCC – 02	Food Safety and Microbiology	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Note: Examiner is requested to set the question paper of 70 marks only. Each question paper is divided into three parts, Part- A, Part B and Part C.

There shall be a Terminal Examination at the end of each Semester carrying 70 marks. The question paper shall comprise three sections **Section A, Section B and Section C.**

Section A

Section shall be of **20 marks** and consist of **10 questions** carrying **2 marks** each to be answered in approximately *20 words* each. All questions shall be compulsory. The examiner shall set the question paper choosing at least 3 questions from each unit.

Section B

Section shall be of **30 marks** and consist of **9 questions** carrying **5 marks** each to be answered in approximately *250 words* each. A Candidate shall attempt any six questions. The examiner shall set the questions ensuring that at least three questions are drawn from each Unit.

Section C

Section shall be of **20 marks** and consist of three questions carrying 10 marks each to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Course Objectives

1. Gain deeper knowledge of the role of microorganisms in humans and environment.
2. Understand the importance of microorganisms in food spoilage and to learn advanced techniques used in food preservation.
3. Understand the latest procedures adopted in various food operations to prevent food borne disorders and legal aspects involved in these areas.

Learning Outcomes

1. Explain the characteristics, classification, and roles of microorganisms in food, including factors affecting their growth, methods of detection, and sources of food contamination.
2. Analyze the mechanisms of microbial food spoilage, food fermentation, and food borne diseases, and evaluate the role of microorganisms in food production and preservation.
3. Evaluate physical, chemical, and biological methods of food preservation and recommend appropriate strategies to enhance food safety and shelf life.
4. Apply the principles of food sanitation, microbiological quality assessment, and the Hazard Analysis and Critical Control Point (HACCP) system to ensure safe food production and processing.
5. Interpret national and international food safety regulations, standards, and quality control systems, including those related to genetically modified foods and food safety enforcement agencies.

Unit I

1. **Microorganisms of importance in food-** role of bacteria and fungi, sources, taxonomy, morphology, cultural and physiological characteristics and biochemical activities.
2. **Factors Affecting Growth of Microorganisms-** intrinsic and extrinsic factors like pH, water activity, oxidation reduction potential, nutritional requirements, temperature, relative humidity, gaseous environment and inhibitory substances.
3. **Methods of Isolation and Detection of Microorganisms or their products in food**
 - a) Conventional methods
 - b) Rapid methods (newer technique) : Immunological methods- fluorescent, antibody, radio Immune assay, ELISA etc
 - c) Chemical methods- Thermo stable, nuclear, ATP measurement and PCR(Polymer chain reactions)
4. **Sources of contamination of food-** Water, air, soil, sewage, animals, during handling and processing.

Unit II

5. **General principles underlying spoilage.**

- (a) Chemical changes due to microbial spoilage.
- (b) Spoilage of different groups of foods- cereal and cereal products, vegetables and fruits, meat and meat products, egg and poultry, fish and other sea foods, sugar, milk and milk products, canned food.
- 6. **Role of microbes in fermented foods and genetically modified foods oriented fermented foods** Malt, bread, beverages, vinegar fermented vegetables, fermented dairy products. Single cell protein, fats, amino acids and enzymes from microorganisms.
- 7. **Food Preservation-** physical methods- drying, freeze drying, cold storage, heat treatment, irradiation, high pressure processing. Chemical preservatives and natural antimicrobial compounds. Biologically based preservation systems and probiotic bacteria.
- 8. **Food Borne Diseases-** infections and intoxications. Bacterial and viral food borne disorders. Food borne important animal parasites. Mycotoxins.

Unit III

- 9. **Food Sanitation-** microbiology in food plant sanitation, bacteriology of water, sewage and waste treatment and disposal.
- 10. **Indicators of food safety and quality-** microbiological criteria of foods and their significance.
- 11. **HACCP system and food safety-** Introduction, need, benefits and principles of HACCP.
 - Guidelines for application of HACCP principles.
 - The HACCP system in India
- 12. **Food control and enforcement agencies-** Food standards and regulation in India.
 - Regulations related to genetically modified foods.
 - International organizations and agreement in the area of food standard and quality control.

References

- 1. Relezar, M.I and Reid, R.D.(1993): Microbiology, Mc Graw Hill Book Company New York 5th edition.
- 2. Atlas, M .Ronald (1995): Principles of microbiology 1st edition, Mosby Year Book, Inc, Missouri, USA.
- 3. Topley and Wilson's(1983): Principles of Bacteriology, Virology and Immunity Edited by S.G. Wilson, A. Miles and M.T. Parkar vol1; General Microbiology and Immunity II: Systematic Bacteriology 7th edition Edward Arnold Publisher.
- 5. Block, J.G. (1999) Microbiology Principles and Explanations 4th Edition, John Wiley and sons Inc.
- 6. Frazier, W.C. (1988) Food Microbiology Mc Graw Hill Inc 4th Edition.
- 7. Jay James, M(2000): Modern Food Microbiology 6th Edition Aspen Publishers Inc, Maryland.
- 8. Banwart, G(1989) Basic Food Microbiology 2nd Edition CBS Publisher.
- 9. Garbutt, J(1997): essentials of Food Microbiology, 1st Edition Arnold International Students Edition
- 10. Doyle, P, Bemehat, L.R. and Mantiville, T.J(1997): Food Microbiology- Fundamentals and Frontiers, ASM Press, Washington, D.C.
- 11. Adams, M.R and M.G. Moss(1995): Food Microbiology 1st Edition New Age International (P) Ltd.
- 12. Benason, H.J.(1990) Microbiological applications C. Brown Publishers USA
- 13. Roday, S(1999) Food hygiene and sanitation 1st Edition Tata Mc Graw Hill, New Delhi.
- 14. Venderzant, C and D.F. Splitls Toesser(1992); Compendium of Methods For Microbiological Examinations of Foods 3rd Edition American Public Health Association, Washington, D.C.

Course Category	Title of the Course	Credits
FSNDCC – 03	Nutritional Biochemistry	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Note: Examiner is requested to set the question paper of 70 marks only. Each question paper is divided into three parts, Part- A, Part B and Part C. There shall be a Terminal Examination at the end of each Semester carrying 70 marks. The question paper shall comprise three sections **Section A, Section B and Section C.**

Section A

Section shall be of **20 marks** and consist of **10 questions** carrying **2 marks** each to be answered in approximately *20 words* each. All questions shall be compulsory. The examiner shall set the question paper choosing at least 3 questions from each unit.

Section B

Section shall be of **30 marks** and consist of **9 questions** carrying **5 marks** each to be answered in approximately *250 words* each. A Candidate shall attempt any six questions. The examiner shall set the questions ensuring that at least three questions are drawn from each Unit.

Section C

Section shall be of **20 marks** and consist of three questions carrying 10 marks each to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Course Objectives

1. Understand the biochemical basis for nutrition and health.
2. Understand the mechanisms adopted by the human body for regulation of metabolic Pathways.
3. Get an insight into interrelationships between various metabolic pathways.
4. Become proficient for specialization in nutrition.
5. Understand integration of cellular level metabolic events to nutritional disorders and Imbalances.

Learning Outcomes

1. Understand the chemical composition, structure, and functions of carbohydrates, lipids, proteins, and enzymes.
2. Explain the principles and applications of common biochemical laboratory techniques and analytical instruments.
3. Apply biochemical concepts to interpret physiological and clinical processes.
4. Analyze major metabolic pathways of carbohydrates, lipids, and proteins and their regulation.
5. Correlate biochemical knowledge with nutrition, health, disease diagnosis, and Home Science applications.
6. Develop practical and analytical skills for laboratory investigations and research in nutrition, biochemistry, and clinical sciences.

Unit I

1. **Electrolytic Dissociation** – Acids, bases, salts, buffers, Hendersen-Hasselbach equation. Theory of indicators and principles of measurement of pH.
2. **Basics of Instrumentation**- Physio-chemical principles and methodology – Centrifugation, Colorimetry, Photometry, Fluorimetry, Flame photometry.
3. **Chromatography**- principles and application in paper (circular, ascending and

descending), ion-exchange, column, thin layer, gas liquid and high performance liquid chromatographic techniques.

4. **Electrophoresis** – Principle and applications in paper and gel electrophoresis.
5. **Carbohydrates**- mono, di and polysaccharides. Isomerism. Homo and hetero polysaccharides. Mucopolysaccharides, lipopolysaccharides. Glycoprotein Proteoglycans. Important chemical reactions of monosaccharide.

Unit II

6. **Lipids**- Classification and chemistry of lipids and fatty acids, chemical properties of lipids- hydrolysis, saponification, hydrogenation, esterification, halogenations and acetylation. Characteristics of fats. Saponification number, acid number, Reichert-Meissel number. Rancidity of fats and oils. Phospholipids and steroids. Essential fatty acids.
7. **Proteins**- amino acids-classification and structure, reactions, Structure of Proteins, Peptide bonds, Denaturation of proteins. Plasma proteins- nature, properties, functions. Structures of Insulin, Myoglobin and Hemoglobin.
8. **Enzymes**- classification, general properties, catalysis, Coenzymes, specificity, isolation and purification, intracellular distribution of enzymes, allosteric enzymes, Isoenzymes. Kinetics- effect of time, temperature, pH on velocity of enzyme catalyzed reactions, inhibition of enzymes, and importance in clinical diagnosis.
9. **Biological Oxidation**- concept of free energy, redox potential ,Oxidative phosphorylation and Mitochondrial transport system (Electron transport chain)

Unit III

10. **Intermediary Metabolism**- Overview of intermediary metabolism.
11. **Carbohydrate metabolism**- Glycolysis, Glycogenolysis, Glycogenesis, Gluconeogenesis, Citric Acid Cycle, Hexose monophosphate shunt.
12. **Lipids Metabolism**: beta oxidation of saturated fatty acids, biosynthesis of fatty acids, Biosynthesis of cholesterol, formation and metabolism of Ketone bodies. Ketosis. Biosynthesis of triacyl glycerol and Phospholipids.
13. **Protein Metabolism**: Urea cycle, deamination and transamination of amino acids, metabolism of non protein amino acids. Biologically active peptides and polypeptides.
14. **Interrelationship between carbohydrate and lipid metabolism**- At organ level, enzymatic level, hormonal level and regulatory level.

References

1. Nelson, D. L., & Cox, M. M. (2021). *Lehninger Principles of Biochemistry* (8th ed.). W. H. Freeman and Company.
2. Rodwell, V. W., Bender, D. A., Botham, K. M., Kennelly, P. J., & Weil, P. A. (2021). *Harper's Illustrated Biochemistry* (32nd ed.). McGraw-Hill Education.
3. Satyanarayana, U., & Chakrapani, U. (2022). *Biochemistry* (7th ed.). Elsevier.

4. Voet, D., Voet, J. G., & Pratt, C. W. (2019). *Fundamentals of Biochemistry: Life at the Molecular Level* (6th ed.). John Wiley & Sons.
5. Devlin, T. M. (2019). *Textbook of Biochemistry with Clinical Correlations* (8th ed.). John Wiley & Sons.

Course Category	Title of the Course	Credits
FSNDCC – 04	Problems in Human Nutrition	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

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Section A

Section shall be of **20 marks** and consist of **10 questions** carrying **2 marks** each to be answered in approximately *20 words* each. All questions shall be compulsory. The examiner shall set the question paper choosing at least 3 questions from each unit.

Section B

Section shall be of **30 marks** and consist of **9 questions** carrying **5 marks** each to be answered in approximately *250 words* each. A Candidate shall attempt any six questions. The examiner shall set the questions ensuring that at least three questions are drawn from each Unit.

Section C

Section shall be of **20 marks** and consist of three questions carrying 10 marks each to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Learning Objectives

1. Understand the etiology, classification, and epidemiology of nutrient deficiency diseases.
2. Explain the physiological and biochemical basis of macro- and micronutrient deficiencies.
3. Identify the clinical manifestations and diagnostic methods for common nutrient deficiency disorders.
4. Evaluate the role of nutrition in the prevention and management of deficiency diseases.
5. Assess the effectiveness of national and international nutrition intervention programmes.
6. Develop evidence-based dietary and public health strategies to prevent nutrient deficiencies in different population groups.

Course Outcomes

1. Demonstrate comprehensive knowledge of the causes, pathophysiology, and public health significance of nutrient deficiency diseases.
2. Assess nutritional status using anthropometric, clinical, biochemical, and dietary assessment methods to identify nutrient deficiencies.
3. Analyze the clinical features, diagnosis, prevention, and dietary management of major vitamin, mineral, and protein-energy deficiency diseases.

4. Design appropriate nutritional intervention strategies, including food fortification, supplementation, dietary diversification, and nutrition education, for the prevention and control of nutrient deficiencies.
5. Critically evaluate national nutrition programmes and current research related to nutrient deficiency diseases and apply scientific evidence to improve nutritional health at individual and community levels.

Unit I

1. Pathogenesis of Nutritional Deficiency Disorders

- Mechanisms of nutrient deficiency:
 - Primary and secondary deficiencies
 - Cellular and molecular basis of nutrient depletion
 - Tissue nutrient pools and metabolic adaptation
 - Biochemical lesions, metabolic dysfunction and biomarkers
 - Acute and chronic deficiency disorders
- Conditional nutrient deficiencies:
 - Nutrient interactions
 - Starvation, fasting and metabolic adaptation
 - Protein conservation, endocrine and inflammatory responses
 - Refeeding syndrome
- Contemporary nutritional problems:
 - Undernutrition, severe acute malnutrition and obesity
 - Hidden hunger and multiple burdens of malnutrition
 - Nutrition transition, food security and sustainable nutrition
- Etiology and risk factors:
 - Dietary inadequacy, food insecurity and malabsorption
 - Disease and drug-induced deficiencies
 - Gut microbiome, genetic and environmental factors
- Public health significance:
 - Global and national burden
 - DALYs and economic impact
 - Nutrition surveillance and national nutrition programmes
- Prevention and control:
 - Dietary diversification
 - Food fortification and biofortification
 - Supplementation strategies
 - Functional foods, nutraceuticals and precision nutrition

2. Protein-Energy Malnutrition (PEM)

- Epidemiology, classification and terminology
- Molecular mechanisms, immune dysfunction, oxidative stress and inflammation
- Alterations in gut microbiome
- Clinical forms:
 - Marasmus
 - Kwashiorkor
 - Marasmic-kwashiorkor
- Diagnosis:
 - Anthropometry
 - Biochemical markers
 - Body composition and functional assessment

- Management:
 - WHO protocols
 - Therapeutic feeding (F-75, F-100, RUTF)
 - CMAM and nutritional rehabilitation
 - Long-term metabolic consequences

UNIT II

3. Vitamin Deficiency Disorders

- Vitamin metabolism, functions and deficiency mechanisms
- Biomarkers, clinical manifestations and diagnosis
- Prevention, therapeutic interventions and toxicity limits

Fat-soluble vitamins:

- Vitamin A deficiency
- Vitamin D deficiency
- Vitamin E deficiency
- Vitamin K deficiency

Water-soluble vitamins:

- Thiamine deficiency (Beriberi)
- Riboflavin deficiency
- Niacin deficiency (Pellagra)
- Pyridoxine deficiency
- Folate deficiency
- Vitamin B12 deficiency
- Vitamin C deficiency (Scurvy)

4. Mineral Deficiency Disorders

- Mineral homeostasis, absorption, bioavailability, biomarkers and nutrient interactions

Macromineral deficiencies:

- Calcium deficiency:
 - Osteopenia, osteoporosis, rickets and osteomalacia
 - Bone metabolism and management
- Magnesium deficiency:
 - Neuromuscular and cardiovascular effects
 - Role in enzyme function and energy metabolism

Trace mineral deficiencies:

- Iron deficiency anaemia:
 - Iron metabolism, diagnosis and management
- Iodine deficiency disorders:
 - Thyroid hormone synthesis, goitre and cretinism
 - Salt iodization programmes
- Zinc deficiency:
 - Growth, immunity and wound healing
- Selenium deficiency:
 - Antioxidant defense, thyroid function, Keshan and Kashin–Beck diseases
- Copper deficiency:
 - Haematological, neurological and connective tissue disorders
- Fluoride deficiency:
 - Dental caries and bone health

UNIT III

5. Inborn Errors of Metabolism

- Genetic basis, enzyme defects, molecular diagnosis and newborn screening
- Nutritional genomics and medical nutrition therapy

Disorders of protein metabolism:

- Phenylketonuria

- Maple Syrup Urine Disease
- Homocystinuria
- Tyrosinemia
- Histidinemia
- Albinism
- Leucine-induced hypoglycaemia

Disorders of carbohydrate metabolism:

- Galactosemia
- Hereditary fructose intolerance
- Essential fructosuria
- Hereditary lactose intolerance
- Pentosuria
- Glycogen storage disorders (overview)

Mineral and lipid metabolism disorders:

- Wilson's disease
- Familial hypercholesterolemia
- Hemochromatosis (overview)

6. Haemoglobinopathies

- Molecular genetics, epidemiology and pathophysiology
- Clinical manifestations and laboratory diagnosis
- Nutritional implications

Disorders:

- Sickle Cell Disease
- Alpha and Beta Thalassemia

Management:

- Nutrition therapy
- Iron chelation therapy
- Stem cell transplantation
- Gene-editing approaches (overview)

7. Emerging Nutritional and Metabolic Disorders

- **NAFLD/MASLD:**
 - Pathophysiology, insulin resistance, nutritional management and lifestyle interventions
- **Sarcopenia and Frailty:**
 - Muscle protein metabolism, diagnosis, nutrition and exercise interventions
- **Meta-inflammation:**
 - Chronic inflammation, adipokines, gut microbiota, oxidative stress and dietary modulation
- **Polycystic Ovary Syndrome (PCOS):**
 - Pathophysiology, endocrine and metabolic alterations, nutritional management, supplements and gut microbiome

References

1. **Gibney, M. J., Margetts, B. M., Kearney, J. M., & Arab, L.** *Public Health Nutrition*. 2nd Edition. Wiley-Blackwell.
2. **Mahan, L. K., Raymond, J. L., & Escott-Stump, S.** *Krause's Food & the Nutrition Care Process*. Elsevier.
3. **Shils, M. E., Shike, M., Ross, A. C., Caballero, B., & Cousins, R. J.** *Modern Nutrition in Health and Disease*. Lippincott Williams & Wilkins.
4. **Srilakshmi, B.** *Nutrition Science*. New Age International Publishers.
5. **Srilakshmi, B.** *Dietetics*. New Age International Publishers.
6. **Mudambi, S. R., & Rajagopal, M. V.** *Fundamentals of Foods, Nutrition and Diet Therapy*. New Age International Publishers.

7. **Gopalan, C., Rama Sastri, B. V., & Balasubramanian, S. C.** *Nutritive Value of Indian Foods*. National Institute of Nutrition (ICMR–NIN), Hyderabad.
8. **Indian Council of Medical Research (ICMR–National Institute of Nutrition).** *Nutrient Requirements for Indians (RDA & EAR Report)*. Latest Edition.
9. **World Health Organization (WHO).** *Guideline: Vitamin and Mineral Supplementation in Public Health*. WHO Publications.
10. **Food and Agriculture Organization (FAO) & World Health Organization (WHO).** *Human Vitamin and Mineral Requirements*. FAO/WHO.
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12. Robinson C.H, Lawler, M.R, Chenoweth, W.L and Garwick, A.W(1986): Normal and Therapeutic Nutrition 16th edition Macmillan Publishing Co. New Delhi.
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14. Banji M.S, Roa P.N and Reddy,V (2003): Textbook of human nutrition 2nd Edition Oxford and IBH Publishing Co Pvt Ltd

Course Category	Title of the Course	Credits
FSNDCC-05	Nutritional Biochemistry and Microbiology Practical	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Part A: Nutritional Biochemistry

Learning Objectives

1. Develop knowledge of safe laboratory practices and standard operating procedures.
2. Acquire practical skills in handling laboratory equipment, instruments, and biological specimens.
3. Learn standard microbiological, hematological, immunological, and biochemical laboratory techniques.
4. Develop competence in preparing laboratory reagents, culture media, and standard solutions.
5. Build the ability to analyze, interpret, and document laboratory observations and results accurately.

Course Outcomes

1. Perform laboratory procedures safely and accurately using standard techniques.
2. Operate and maintain common microbiology and clinical laboratory instruments effectively.
3. Conduct microbiological, hematological, immunological, and biochemical analyses independently.
4. Interpret laboratory findings and prepare accurate laboratory reports.
5. Demonstrate professional competence, ethical practices, and quality assurance in laboratory investigations.

Content:

1. Safe and systematic working in the laboratory. Concept of accuracy and concentration. Preparation of routine and standard laboratory reagent. Determination of strength of acids and alkali solution.
2. Principle, working use, care and maintenance of various instruments used in laboratory investigations-pH meter, water bath, spectrophotometer, colorimeter, desiccator, centrifuge, oven, and colorimeter.
3. Preparation of buffers and determination of their pH by use of laboratory indicators and pH meters.

4. Collection and storage of biological specimens – blood, urine, faeces etc.
5. Hematological Estimation
 - Hemoglobin, packed cell volume, red blood cell count, calculation of certain hematological Indices.
 - Total Leucocytes count, Differential Leukocytes count, Erythrocytes sedimentation rate, bleeding time and clotting time.
 - Determination of serum iron total iron binding capacity and transferrin saturation.
6. Estimation of serum proteins, Serum total protein, albumin, globulin and Albumin, Globulin ratio.
7. Estimation of blood urea.
8. Urine Analysis: Estimation of creatine, creatinine, urea, sugar and ascorbic acid (titrimetric method)
9. Qualitative tests for normal and abnormal constituents of urine
10. Estimation of blood glucose and lipid profile.
 - (a) Blood glucose
 - (b) Serum total cholesterol
 - (c) Serum triglyceride fractions
 - (d) LDL-Cholesterol HDL-Cholesterol fractions
 - (e) Total phospholipids concentration.
11. Assay of serum enzymes-Alkaline phosphatase, Amylase.

PART B: Microbiology

1. Microbiological apparatus and equipment - a basic introduction, instruments needed for isolation, cultivation and maintenance of microbes, tools needed in microbiology laboratory for inoculation and culturing
2. Cleaning and sterilization procedures for glassware.
3. Preparation and sterilization of laboratory media.
4. Staining of bacteria- gram's staining, use of oil immersion lens, and microscopic enumeration.
5. Spread plating, pour plating, streaking techniques.
6. Enrichment of isolated cultures, SPC, MPC. Coli count and Coli confirmations.
7. Study of biochemical characteristics of isolated cultures-
 - Fermentation reaction
 - IMVIC Tests
 - Catalase test
 - Oxidase test
 - Urease test
 - H₂S test
 - Coagulase test
8. Microbiological analysis of milk- raw boiled and pasteurized - MBRT Test.
9. Demonstration of Technique of
 - Radio Immune assay(RIA)
 - Enzyme Linked Immuno Sorbant Assay (ELISA)

References

1. Burtis, C. A., & Brun, D. E. (Eds.). (2023). *Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics* (9th ed.). Elsevier.
2. McPherson, R. A., & Pincus, M. R. (Eds.). (2021). *Henry's Clinical Diagnosis and Management by Laboratory Methods* (24th ed.). Elsevier.
3. Wilson, K., & Walker, J. (Eds.). (2018). *Principles and Techniques of Biochemistry and Molecular Biology* (8th ed.). Cambridge University Press.
4. Satyanarayana, U., & Chakrapani, U. (2022). *Biochemistry* (7th ed.). Elsevier.

5. Gropper, S. S., & Smith, J. L. (2021). *Advanced Nutrition and Human Metabolism* (8th ed.). Cengage Learning.

**M.Sc. Food Science and Nutrition
Semester II**

Course Category	Title of the Course	Credits
FSNDCC – 06	Advanced Nutrition	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Note: Examiner is requested to set the question paper of 70 marks only. Each question paper is divided into three parts, Part- A, Part B and Part C.

There shall be a Terminal Examination at the end of each Semester carrying 70 marks. The question paper shall comprise three sections **Section A, Section B and Section C**.

Section A

Section shall be of **20 marks** and consist of **10 questions** carrying **2 marks** each to be answered in approximately *20 words* each. All questions shall be compulsory. The examiner shall set the question paper choosing at least 3 questions from each unit.

Section B

Section shall be of **30 marks** and consist of **9 questions** carrying **5 marks** each to be answered in approximately *250 words* each. A Candidate shall attempt any six questions. The examiner shall set the questions ensuring that at least three questions are drawn from each Unit.

Section C

Section shall be of **20 marks** and consist of three questions carrying 10 marks each to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Learning Objectives:

1. Develop a comprehensive understanding of nutritional assessment by studying anthropometric, biochemical, clinical, dietary, body composition, and other methods used to evaluate nutritional status across different population groups.
2. Understand the scientific basis of human nutrition including nutrient requirements, Recommended Dietary Allowances (RDA), energy metabolism, energy expenditure, and the physiological functions of carbohydrates, dietary fibre, proteins, and lipids.
3. Apply evidence-based nutritional principles for planning balanced diets across the life cycle, including vegetarian and vegan diets, and for the prevention and management of obesity, diabetes, cardiovascular diseases, sarcopenia, and other nutrition-related disorders.
4. Explore recent advances in nutritional science such as precision nutrition, nutrigenomics, gut microbiome research, body composition assessment, and digital technologies to enhance nutrition practice and public health.
5. Develop critical thinking, scientific reasoning, and research skills to critically evaluate nutrition literature, interpret scientific evidence, and translate research findings into professional nutrition practice.

Course Outcomes

1. Evaluate nutritional status using anthropometric, clinical, biochemical, biophysical, dietary, and body composition assessment methods and interpret their strengths and limitations.
2. Apply the concepts of nutrient requirements, Dietary Reference Intakes (DRIs), and Recommended Dietary Allowances (RDA) to assess nutritional adequacy for individuals and population groups.

3. Assess body composition using conventional and advanced techniques and interpret body composition changes during growth, ageing, and disease conditions.
4. Calculate human energy requirements using standard methods and explain factors influencing energy metabolism, physical activity, and energy balance.
5. Explain the digestion, metabolism, physiological functions, and health implications of carbohydrates, dietary fibre, proteins, and lipids, and evaluate their role in health promotion and disease prevention.
6. Formulate nutritionally adequate diets, including vegetarian and plant-based diets, based on evidence-based dietary guidelines and individual nutritional requirements.
7. Critically appraise recent advances in nutritional sciences, including precision nutrition, nutrigenomics, gut microbiome, bioactive food components, and emerging technologies in nutrition assessment.
8. Demonstrate analytical, communication, and problem-solving skills to interpret nutrition research and apply scientific evidence in clinical, community, and public health nutrition settings.

UNIT I

1. Nutritional Status Assessment

- Concept, objectives and significance
- Parameters and indices: sensitivity, specificity, validity, reliability and accuracy
- Methods of assessment: anthropometric, clinical, biochemical, biophysical and dietary
- Nutrition screening tools: MUST, MNA, NRS-2002 and Subjective Global Assessment (SGA)
- Emerging biomarkers and digital technologies

2. Nutritional Requirements and Recommended Dietary Allowances

- Nutritional Requirement, EAR, RDA, AI, UL and AMDR
- Principles of deriving RDA
- Factors influencing nutrient requirements
- ICMR-NIN Nutrient Requirements and RDA for Indians
- Applications and limitations of RDA

3. Body Composition

- Biochemical composition and body composition models
- Assessment techniques: anthropometry, body density, dilution techniques, body cell mass, BIA, DXA, BOD POD, CT, MRI and ultrasound
- Direct method: cadaver analysis
- Body composition across the life cycle
- Sarcopenia and obesity

UNIT II

4. Human Energy Requirements

- Components and determinants of energy requirements
- Factors affecting BMR, thermic effect of food (TEF) and physical activity
- Physical Activity Level (PAL) and Metabolic Equivalent of Task (MET)
- Methods for estimating energy expenditure: direct and indirect calorimetry, doubly labelled water and predictive equations
- Energy requirements across the life cycle
- Energy balance, adaptive thermogenesis and obesity

5. Carbohydrates

- Classification, metabolism and physiological functions
- Blood glucose regulation
- Resistant starch: classification and health benefits
- Prebiotics, probiotics, synbiotics and postbiotics
- Glycemic Index (GI) and Glycemic Load (GL): determinants and clinical applications
- Gut microbiota and carbohydrate metabolism

6. Dietary Fibre

- Definition, classification and types
- Physiological functions and health benefits
- Dietary fibre, gut microbiota and short-chain fatty acids (SCFAs)
- Role in obesity, diabetes, cardiovascular disease and colorectal cancer
- Recommended dietary fibre intake for Indians

UNIT III

7. Proteins

- Classification and functions
- Protein quality evaluation: Biological Value (BV), Net Protein Utilization (NPU), PDCAAS and DIAAS
- Improvement of protein quality
- Protein requirements and Recommended Dietary Allowances (RDA) across the life cycle
- Plant versus animal proteins
- Protein nutrition in sports, healthy ageing and sarcopenia

8. Lipids

- Functions of fats and oils
- Essential fatty acids
- Omega-3 and omega-6 fatty acids
- Trans fatty acids: sources, health effects and recommendations
- Medium-chain triglycerides (MCT) and structured lipids
- Lipid requirements and dietary recommendations for Indians
- Lipids in cardiovascular health and metabolic disorders

9. Bioactive Food Components

- Functional foods: definition and classification
- Bioactive compounds from protein foods
- Non-glycerides in edible oils
- Polyphenols: classification, bioavailability and health benefits
- Phytoestrogens: sources, forms and physiological effects
- Anti-nutritional factors: protease inhibitors, saponins, amylase inhibitors, lectins, goitrogens, BOAA and phytates

10. Vegetarianism

- Classification of vegetarian diets
- Nutritional adequacy of vegetarian and vegan diets
- Planning balanced vegetarian diets
- Nutritional concerns: Vitamin B12, Iron, Calcium, Zinc and Omega-3 fatty acids
- Vegetarianism in health promotion and disease prevention
- Sustainable diets and the Planetary Health Diet

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1. Shills, Me; Oslan, JA. Shike, M. and Ross, A.C. (editors) (1999) Modern Nutrition in Health and Disease (ninth edition), Williams and Williams. A Waverly Co.
2. Bamji, M.S. Rao, N.P. Reddy. V (editors) (2003) Textbook of Human Nutrition. 2nd Edition Oxford & IBH Publishing co. Pvt. Ltd. New Delhi.

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- Jelliffe, D.B. The Assessment of the Nutritional status of the Community. Monograph Series 53 WHO.
- Gopal Das T. and Seshadri, S. Nutrition- Monitoring and Assessment- Oxford University Press, New Delhi.
- Gopalan (Ed.) Recent Trends in Nutrition. Oxford University Press, New Delhi.

Course Category	Title of the Course	Credits
FSNDCC – 07	Advanced Nutritional Biochemistry	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Note: Examiner is requested to set the question paper of 70 marks only. Each question paper is divided into three parts, Part- A, Part B and Part C.

There shall be a Terminal Examination at the end of each Semester carrying 70 marks. The question paper shall comprise three sections **Section A, Section B and Section C.**

Section A

Section shall be of **20 marks** and consist of **10 questions** carrying **2 marks** each to be answered in approximately *20 words* each. All questions shall be compulsory. The examiner shall set the question paper choosing at least 3 questions from each unit.

Section B

Section shall be of **30 marks** and consist of **9 questions** carrying **5 marks** each to be answered in approximately *250 words* each. A Candidate shall attempt any six questions. The examiner shall set the questions ensuring that at least three questions are drawn from each Unit.

Section C

Section shall be of **20 marks** and consist of three questions carrying 10 marks each to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Learning Objectives

- Develop a comprehensive understanding of nutritional biochemistry, including the structure, metabolism, biochemical functions, and physiological significance of vitamins, minerals, hormones, and other biomolecules essential for human health.
- Explain the molecular and biochemical basis of metabolism by studying nucleic acid structure and function, DNA replication, transcription, translation, gene regulation, recombinant DNA technology, genetic mutations, and protein biosynthesis.
- Understand the biochemical basis of metabolic and genetic disorders, including inborn errors of metabolism, haemoglobinopathies, micronutrient deficiencies, their clinical manifestations, diagnosis, and nutritional management.

4. Familiarize students with advanced biochemical research techniques, including isotopic methods, Nuclear Magnetic Resonance (NMR), calorimetric techniques, and their applications in nutritional and biomedical research.
5. Develop the ability to integrate biochemical knowledge with nutrition and health by relating metabolic pathways to nutritional status, disease prevention, therapeutic nutrition, and evidence-based nutrition research.

Course Outcomes:

1. Understand the structure, metabolism and biochemical functions of vitamins and minerals **and explain their importance in human health and nutrition.**
2. Describe the metabolism and physiological roles of water-soluble and fat-soluble vitamins along with the consequences of their deficiencies and excess intake.
3. Explain the functions, metabolism and biochemical significance of macro and trace minerals in maintaining normal body functions.
4. Understand the structure and functions of nucleic acids (DNA and RNA) and explain processes involved in DNA replication, transcription, genetic code and DNA repair mechanisms.
5. Describe recombinant DNA technology, genetic mutations, regulation of gene expression and protein biosynthesis and their applications in nutrition and health sciences.
6. Explain the biochemical roles and mechanisms of action of various hormones involved in growth, metabolism, reproduction and endocrine regulation.
7. Apply knowledge of biochemical concepts to understand nutritional disorders, metabolic abnormalities and clinical nutrition practices.

UNIT I

1. Vitamins

Structure, metabolism, functions, deficiency and significance: Water-soluble: Thiamine (B1), Riboflavin (B2), Niacin (B3), Pantothenic Acid (B5), Pyridoxine (B6), Biotin (B7), Folic Acid (B9), Cyanocobalamin (B12), Vitamin C. Fat-soluble: Vitamins A, D, E and K.

2. Minerals

Metabolism, functions and biochemical roles

- Macro minerals: Calcium, Phosphorus, Magnesium, Sodium, Potassium, Chloride.
- Trace minerals: Iron, Zinc, Copper, Selenium, Chromium, Manganese, Iodine, Fluorine and Cobalt.

3. Antioxidants and Free Radicals

- Free radicals and reactive oxygen species (ROS)
- Production and biological role of ROS
- Antioxidant defense mechanisms (enzymatic and non-enzymatic)
- Free radicals in health and disease
- Natural and dietary antioxidants

UNIT II

4. Nucleic Acids

- Structure and functions of DNA and RNA
- DNA replication, transcription and genetic code
- Purine and pyrimidine metabolism
- DNA repair mechanisms

5. Recombinant DNA Technology

- Principles of recombinant DNA technology
- Genetic mutations
- Regulation of gene expression
- Protein biosynthesis (translation)

6. Hormones

Biochemical roles and mechanism of action: ACTH, FSH, LH, hCG, Growth Hormone, T3, T4, TSH, Parathyroid Hormone, Insulin, Glucagon, Adrenal cortex hormones, Androgens, Estrogens and Progesterone.

UNIT III

7. Inborn Errors of Metabolism: Biochemical basis, clinical features and management

- Protein metabolism: Phenylketonuria, Maple Syrup Urine Disease, Homocystinuria, Albinism, Histidinemia, Tyrosinemia, Leucine-induced hypoglycemia.
- Carbohydrate metabolism: Galactosemia, Hereditary Fructose Intolerance, Hereditary Lactose Intolerance, Essential Fructosuria, Pentosuria.
- Other disorders: Wilson's disease, Familial Hypercholesterolemia.
- Haemoglobinopathies: Sickle Cell Anemia and Thalassemias.

8. Isotopes

- Radioactive and stable isotopes
- Applications in biochemistry and medicine

9. Nuclear Magnetic Resonance (NMR)

- Principle and applications

10. Calorimetry

- Principles of calorimetry
- Bomb calorimetry
- Respirometry (BMR and RMR)
- Applications in nutritional assessment

References:

- West, E.S., Todd, W.R, Nelson, H.S. and Vanbrugger, T.T:Textbook of Biochemistry Oxford and IBH Publishing Corp.
- White A, Handler, P and Smith, E.T. Principles of Biochemistry McGraw Hill Book Company.
- Pike R.L. and Brown R.L. Nutrition and Integrated Approach IIIrd Ed. John Urley and Lousie New York.
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- Tietz N.W(1976): Fundamentals of Clinical Chemistry W.B. Saunders Co.
- Vogel A.I (1962) 3rd Edition A Textbook of Quantitative Inorganic Analysis. The English Language book society and Longman.
- Raghuramulu N, Madhavan Nair and K. KalyansundaramS(2003): A Manual of Laboratory Techniques NIN, ICMR.
- King E.J and Wootton, I.D.P (1956): 3rd Edition. Microanaly-sis in Medical Biochemistry. J and A Churchill Ltd.
- Winton A.L and Winton K.B (1999): Techniques of Food Analysis. Allied Scientific Publishers.
- IndraGandhi National Open University School Of Continuing Education, Nutritional Biochemistry Practical Manual.

Course Category	Title of the Course	Credits
FSNDCC – 08	Research Methods and Biostatistics	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Note: Examiner is requested to set the question paper of 70 marks only. Each question paper is divided into three parts, Part- A, Part B and Part C.

There shall be a Terminal Examination at the end of each Semester carrying 70 marks. The question paper shall comprise three sections **Section A, Section B and Section C.**

Section A

Section shall be of **20 marks** and consist of **10 questions** carrying **2 marks** each to be answered in approximately *20 words* each. All questions shall be compulsory. The examiner shall set the question paper choosing at least 3 questions from each unit.

Section B

Section shall be of **30 marks** and consist of **9 questions** carrying **5 marks** each to be answered in approximately *250 words* each. A Candidate shall attempt any six questions. The examiner shall set the questions ensuring that at least three questions are drawn from each Unit.

Section C

Section shall be of **20 marks** and consist of three questions carrying 10 marks each to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Learning Objectives:

1. To understand the principles, concepts and ethics of scientific research in Food and Nutrition.
2. Formulate research problems and design appropriate research methodology and statistical techniques for data analysis and interpretation
3. Develop competence in scientific writing, ethical research practices and publication.

Course Outcomes:

1. Explain the concepts, types and methodologies of scientific research.
2. Design research studies and apply appropriate sampling and data collection techniques.
3. Perform statistical analysis and interpret research findings using biostatistical methods.
4. Prepare research proposals and scientific reports while adhering to research ethics and publication standards.

Unit I

1. Introduction to Statistics

- Scope, Importance, and Applications in Research

2. Basic Statistical Concepts

- Population, Sample, Parameter, Statistic, Variable, Scales of Measurement

3. Data Collection and Sampling

- Primary and Secondary Data
- Sources and Techniques of Data Collection
- Census and Sampling
- Probability and Non-probability Sampling Methods

4. Organization and Presentation of Data

- Classification and Tabulation
- Frequency Distribution
- Diagrammatic and Graphical Representation

5. Measures of Central Tendency

- Arithmetic Mean, Median, Mode

6. Measures of Dispersion and Skewness

- Range, Quartile Deviation, Standard Deviation, Coefficient of Variation
- Measures of Skewness and Introduction to Kurtosis

Unit II

7. Correlation Analysis

- Karl Pearson's Coefficient of Correlation
- Spearman's Rank Correlation

8. Regression Analysis

- Simple Linear Regression
- Construction and Interpretation of Regression Lines
- Regression Coefficients

9. Interpolation and Probability Distributions

- Interpolation and Extrapolation
- Binomial Distribution
- Normal Distribution

10. Tests of Association and Significance

- Association of Attributes
- Chi-square Test
- Goodness-of-Fit Test
- Student's *t*-test
- *F*-test

11. Analysis of Variance and Time Series

- One-way ANOVA
- Introduction to Two-way ANOVA
- Components and Trend Analysis of Time Series

12. Experimental Designs

- Completely Randomized Design (CRD)
- Randomized Block Design (RBD)
- Latin Square Design (LSD)
- Factorial Design

Unit III

13. Introduction to Research

- Meaning, Objectives, Scope, and Significance
- Types of Research
- Research Approaches
- Research Ethics and Academic Integrity

14. Research Problem and Literature Review

- Identification, Selection, and Formulation of Research Problems
- Techniques for Defining a Research Problem
- Sources, Methods, and Importance of Review of Literature

15. Hypothesis and Research Design

- Concept, Characteristics, Types, and Formulation of Hypothesis
- Exploratory, Descriptive, and Experimental Research Designs

16. Data Collection and Measurement

- Data Collection
- Sampling Techniques
- Measurement and Scaling in Research

17. Data Analysis and Hypothesis Testing

- Data Processing and Statistical Analysis

- Level of Significance
- Type I and Type II Errors

18. Interpretation and Presentation of Research Findings

- Interpretation of Results
- Presentation of Findings
- Report Writing

References

1. Creswell, J. W., & Creswell, J. D. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (5th ed.). Sage Publications.
2. Best, J. W., & Kahn, J. V. (2016). *Research in Education* (10th ed.). Pearson Education.
3. Daniel, W. W., & Cross, C. L. (2019). *Biostatistics: A Foundation for Analysis in the Health Sciences* (11th ed.). Wiley.
4. Gupta, S. C., & Kapoor, V. K. (2020). *Fundamentals of Mathematical Statistics* (12th ed.). Sultan Chand & Sons
5. Gupta, S. P. (2022). *Statistical Methods* (46th ed.). Sultan Chand & Sons.
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8. Kerlinger, F. N., & Lee, H. B. (2000). *Foundations of Behavioural Research* (4th ed.). Wadsworth Publishing.
9. Pagano, M., & Gauvreau, K. (2018). *Principles of Biostatistics* (2nd ed.). CRC Press.
10. Rosner, B. (2020). *Fundamentals of Biostatistics* (9th ed.). Cengage Learning.
11. Snedecor, G. W., & Cochran, W. G. (1989). *Statistical Methods* (8th ed.). Iowa State University Press.
12. Trochim, W. M. K., Donnelly, J. P., & Arora, K. (2016). *Research Methods: The Essential Knowledge Base* (2nd ed.). Cengage Learning

Course Category	Title of the Course	Credits
FSNDSE–01A	Exercise Physiology and Sports Nutrition	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Note: Examiner is requested to set the question paper of 70 marks only. Each question paper is divided into three parts, Part- A, Part B and Part C.

There shall be a Terminal Examination at the end of each Semester carrying 70 marks. The question paper shall comprise three sections **Section A, Section B and Section C.**

Section A

Section shall be of **20 marks** and consist of **10 questions** carrying **2 marks** each to be answered in approximately *20 words* each. All questions shall be compulsory. The examiner shall set the question paper choosing at least 3 questions from each unit.

Section B

Section shall be of **30 marks** and consist of **9 questions** carrying **5 marks** each to be answered in approximately *250 words* each. A Candidate shall attempt any six questions. The examiner shall set the questions ensuring that at least three questions are drawn from each Unit.

Section C

Section shall be of **20 marks** and consist of three questions carrying 10 marks each to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Learning Objectives-

1. Understand the physiological basis of exercise, including muscle function, cardiovascular, respiratory and metabolic responses.
2. Explain energy systems, nutrient metabolism and factors influencing physical performance.
3. Develop knowledge of fitness assessment methods and exercise training principles.
4. Understand the nutritional requirements of athletes and the role of diet in sports performance and health.
5. Apply principles of exercise physiology and sports nutrition in designing effective training and nutrition strategies.

Course Outcome-

1. Understand the physiology of skeletal muscles, muscle contraction, fatigue and adaptations to exercise training.
2. Explain cardiovascular, respiratory and metabolic responses to exercise and physical training.
3. Perform and interpret fitness assessments related to strength, endurance, flexibility and athletic performance.
4. Understand energy systems, nutrient metabolism and substrate utilization during different types of exercise.
5. Apply principles of exercise training and sports nutrition for improving performance, health and fitness.

Unit I

1. Skeletal Muscle

- Structure and types of skeletal muscle fibers
- Mechanism of skeletal muscle contraction and relaxation
- Types of muscle contraction
- Factors determining muscular strength
- Muscular fatigue
- Principles of exercise training for muscle adaptation

2. Cardio-Pulmonary System and Exercise

- Structure and functions of the cardiovascular and respiratory systems
- Physiological responses of the cardio-pulmonary system to exercise
- Acute and chronic adaptations to exercise training
- Effects of regular training on cardio-pulmonary function

3. Physiological Testing for Fitness and Performance

a) Assessment of Cardio-Respiratory Fitness

- Physiological components of fitness assessment
- Field tests
- Sub-maximal exercise tests
- Maximal exercise tests
- Lactate threshold test

b) Assessment of Anaerobic Power

- Vertical Jump Test
- 30-Second Cycle Sprint Test

c) Assessment of Muscular Strength

- Isometric strength testing
- Isokinetic strength testing
- Isotonic strength testing

d) Assessment of Flexibility

- YMCA Sit-and-Reach Test

Unit II

4. Energy Systems

a) Anaerobic Energy System

- Phosphagen (ATP-PC) System
- Lactic Acid (Glycolytic) System

b) Aerobic Energy System

- Formation of Acetyl-CoA
- Krebs Cycle
- Electron Transport Chain (ETC)
- Comparison of aerobic and anaerobic energy systems

c) Fuels for Exercise

- Carbohydrates, fats, and proteins as energy substrates during exercise

5. Physical Fitness

- Definition and types of physical fitness
- Factors affecting physical fitness
- Components of physical fitness and exercises for their improvement

6. Principles and Methods of Training

a) Fundamental Training Principles

- Overload
- Specificity
- Individualization
- Warm-up

b) Training Methods

- Continuous Training
- Interval Training

7. Exercise Prescription

- Flexibility exercises and their types
- Aerobic and anaerobic exercises: examples and benefits
- Exercise for health promotion
- Exercises for strengthening different body parts

Unit III

8. Fundamentals of Sports Nutrition

- Importance of nutrition in sports
- Energy requirements of athletes
- Factors affecting energy requirements

9. Macronutrient Requirements for Athletes

a) Carbohydrates

- Carbohydrate requirements for strength/power athletes
- Carbohydrate requirements for endurance athletes
- Carbohydrate loading

b) Proteins

- Protein requirements of athletes
- Factors affecting protein requirements
- Protein needs for strength and endurance athletes

c) Lipids

- Fat requirements for athletes

10. Micronutrients and Hydration

- Vitamin requirements of athletes

- Mineral requirements of athletes
- Fluid and electrolyte requirements during training and competition

References:

1. Dey, S.K. (2012). *A Textbook of Sports and Exercise Physiology*. Jaypee Publications.
2. Paul, T. (2025). *Sports and Exercise Physiology*. ED-Tech Press.
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5. Srilakshmi, R., Suganthi, V. & Ashok, C.K. (2024). *Exercise Physiology, Fitness and Sports Nutrition*. New Age International Publishers.
6. Bean, A. *The Complete Guide to Sports Nutrition*. Bloomsbury Sport, UK.
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Course Category	Title of the Course	Credits
FSNDSE – 01B	Nutrition in Emergency and Disaster	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Note: Examiner is requested to set the question paper of 70 marks only. Each question paper is divided into three parts, Part- A, Part B and Part C.

There shall be a Terminal Examination at the end of each Semester carrying 70 marks. The question paper shall comprise three sections **Section A, Section B and Section C.**

Section A

Section shall be of **20 marks** and consist of **10 questions** carrying **2 marks** each to be answered in approximately *20 words* each. All questions shall be compulsory. The examiner shall set the question paper choosing at least 3 questions from each unit.

Section B

Section shall be of **30 marks** and consist of **9 questions** carrying **5 marks** each to be answered in approximately *250 words* each. A Candidate shall attempt any six questions. The examiner shall set the questions ensuring that at least three questions are drawn from each Unit.

Section C

Section shall be of **20 marks** and consist of three questions carrying 10 marks each to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Course Objectives

1. Explain the causes, characteristics, and public health implications of natural and human-made disasters.
2. Evaluate the impact of emergencies on nutritional status, food security, and vulnerable populations.
3. Apply principles of disaster risk reduction, preparedness, response, rehabilitation, and recovery.
4. Assess nutritional status using anthropometric, clinical, dietary, and biochemical methods in emergency settings.
5. Design and implement nutrition interventions for prevention and management of acute and chronic malnutrition during emergencies.
6. Analyze the role of water, sanitation, hygiene (WASH), disease surveillance, and immunization in emergency response.
7. Plan, monitor, and evaluate emergency feeding programmes and humanitarian nutrition interventions.
8. Critically appraise national and international policies, guidelines, and humanitarian standards related to disaster nutrition and public health.

Unit I

1. Introduction to Emergencies and Disasters

- Concepts and classification of disasters
- Natural disasters: drought, floods, earthquakes, cyclones, famine
- Human-made disasters: war, civil unrest, industrial accidents, complex humanitarian emergencies
- Causes and consequences of emergencies on health and nutrition
- Case studies from India and global humanitarian crises

2. Disaster Management

- Disaster risk reduction and resilience
- Disaster preparedness, response, recovery and rehabilitation
- National and international disaster management policies
- Health sector preparedness and emergency coordination
- Role of government, NGOs and humanitarian agencies

3. Nutrition in Emergencies

- Causes of malnutrition during emergencies
- Nutritional problems among vulnerable populations
 - Infants and young children
 - Pregnant and lactating women
 - Elderly
 - Persons with disabilities
- Protein-energy malnutrition
- Micronutrient deficiencies and their prevention
- Infant and Young Child Feeding (IYCF) during emergencies

Unit II

4. Public Health Issues in Emergencies

- Water, sanitation and hygiene (WASH)
- Safe water supply and water quality management
- Food safety and environmental sanitation
- Personal hygiene promotion
- Vector control

5. Communicable Disease Surveillance and Control

- Disease surveillance systems
- Outbreak investigation and response
- Immunization in emergencies
- Prevention and control of communicable diseases
- Integrated disease surveillance

6. Nutritional Assessment and Surveillance

- Principles and scope of nutritional assessment
- Indicators of nutritional status
- Anthropometric assessment
 - Weight-for-height
 - Height-for-age
 - Weight-for-age
 - BMI
 - Mid Upper Arm Circumference (MUAC)
- Clinical and biochemical assessment
- Dietary assessment methods
- Community nutritional surveillance
- Screening and monitoring of acute malnutrition
- Data interpretation and reporting

Unit III

7. Food Security and Emergency Nutrition

- Food security concepts and assessment
- Assessment of food needs during emergencies

- Household food security
- Food distribution systems
- Targeting vulnerable populations
- General food distribution and supplementary feeding

8. Nutrition Rehabilitation

- Therapeutic feeding programmes
- Community-based Management of Acute Malnutrition (CMAM)
- Nutrition Rehabilitation Centres
- Ready-to-Use Therapeutic Foods (RUTF)
- Local production of therapeutic and supplementary foods
- Nutrition counselling during emergencies

9. Programme Planning, Monitoring and Humanitarian Response

- Planning emergency nutrition programmes
- Monitoring and evaluation of feeding programmes
- Logistics, transportation and food storage
- Food quality assurance and safety
- Public nutrition approaches for emergency preparedness
- Role of international organizations (WHO, UNICEF, WFP, FAO, IFRC, Sphere Standards)
- Recent advances in humanitarian nutrition and disaster response
- Emerging issues: climate change, pandemics, migration and nutrition emergencies

References

1. **World Health Organization (WHO).** *Nutrition in Emergencies: Principles and Guidelines*. WHO Publications.
2. **UNICEF.** *Improving Child Nutrition: The Achievable Imperative for Global Progress*. United Nations Children's Fund.
3. **Sphere Association.** *The Sphere Handbook: Humanitarian Charter and Minimum Standards in Humanitarian Response*.
4. **Food and Agriculture Organization (FAO).** *Food Security and Nutrition in Emergencies*. FAO Publications.
5. **World Food Programme (WFP).** *Emergency Food Assistance and Nutrition Programming Guidelines*.
6. **Park, K.** *Park's Textbook of Preventive and Social Medicine*. Banarsidas Bhanot Publishers.
7. **Srilakshmi, B.** *Nutrition Science*. New Age International Publishers.
8. **Gopalan, C., Rama Sastri, B.V. & Balasubramanian, S.C.** *Nutritive Value of Indian Foods*. National Institute of Nutrition (NIN), ICMR.
9. **National Institute of Nutrition (NIN), ICMR.** *Dietary Guidelines for Indians*. Indian Council of Medical Research.
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Course Category	Title of the Course	Credits
FSNDCC – 09	Advanced Nutrition and Biochemistry Practical	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Part A: ADVANCED NUTRITION PRACTICAL

Learning Objectives

1. Acquire practical skills in assessing nutritional status using anthropometric, dietary, biochemical, and body composition techniques.

2. Apply scientific methods for estimating nutrient and energy requirements across different stages of the life cycle.
3. Evaluate dietary protein quality and assess nutrient adequacy of diets.
4. Perform and interpret metabolic balance studies and understand their applications in nutrition research.
5. Develop competency in the use of growth standards, nutrition software, and statistical tools for nutritional assessment.
6. Gain exposure to recent techniques in nutrition research and body composition assessment.

Course Outcomes

1. Assess the nutritional status of individuals using anthropometric measurements, dietary surveys, growth charts, body composition techniques, and standard nutritional assessment methods.
2. Estimate basal metabolic rate (BMR), total energy expenditure (TEE), and nutrient requirements using standard methods, predictive equations, and current dietary guidelines.
3. Evaluate dietary quality and nutrient adequacy through protein quality assessment, nutrient intake analysis, and metabolic balance studies, and formulate nutritionally balanced diets.
4. Apply modern nutritional assessment tools, including Bioelectrical Impedance Analysis (BIA), dietary analysis software, and laboratory and body composition data for clinical and research applications.
5. Demonstrate competence in planning, conducting, interpreting, and reporting nutrition practicals while adhering to ethical principles and evidence-based practices in nutritional sciences.

1. Human Energy Metabolism

- Estimation of Basal Metabolic Rate (BMR) using predictive equations and comparison with kymograph method
- Calculation of Total Energy Expenditure (TEE) using factorial method and Physical Activity Level (PAL)
- Estimation of energy expenditure using Satyanarayana method and MET values
- Calculation of energy requirements for different physiological groups using ICMR-NIN recommendations

2. Assessment of Nutritional Status

Anthropometric Assessment

- Plotting and interpretation of WHO growth standards:
 - Weight-for-age
 - Height-for-age
 - Weight-for-height/BMI-for-age
- Assessment using:
 - Body Mass Index (BMI)
 - Mid Upper Arm Circumference (MUAC)
 - Head and chest circumference
 - Skinfold thickness
 - Waist circumference
 - Waist-hip ratio
 - Waist-height ratio
- Body composition assessment using Bioelectrical Impedance Analysis (BIA)

3. Dietary Assessment

- 24-hour dietary recall method
- Food Frequency Questionnaire (FFQ)
- Weighment method for dietary survey
- Nutrient analysis using food composition tables and ICMR software

4. Evaluation of Protein Quality

- Amino acid score and chemical score calculation

- Net Dietary Protein Calories percentage (NDPCal%)
- Planning and evaluation of supplementary feeding formulations
- Optimization of cereal–pulse combinations for improving protein quality
- Comparison of protein quality using PDCAAS and DIAAS

5. Balance Studies

- Calcium balance study
- Nitrogen balance study
- Interpretation of mineral and nitrogen balance data

6. Body Composition Assessment

- Calculation and interpretation of BMI
- Estimation of body fat percentage using skinfold equations
- Interpretation of BIA reports
- Demonstration of advanced techniques:
 - DEXA
 - BOD POD
 - CT/MRI

7. Research Applications in Nutrition

- Preparation of anthropometric data sheets and field survey formats
- Calculation and interpretation of WHO growth standard Z-scores
- Interpretation of biochemical indicators:
 - Hemoglobin
 - Serum albumin
 - Blood glucose
 - Lipid profile
- Preparation of mini research protocols for nutritional assessment

8. Animal Experimentation and Research Ethics

- Principles of laboratory animal experimentation in nutrition research
- Ethical guidelines: CPCSEA and 3Rs (Replacement, Reduction and Refinement)
- Alternatives to animal experimentation:
 - Cell culture models
 - Computational models

References

1. Shills, Me; Oslan, JA. Shike, M. and Ross, A.C. (editors) (1999) Modern Nutrition in Health and Disease (ninth edition), Williams and Williams. A Waverly Co.
2. Bamji, M.S. Rao, N.P. Reddy. V (editors) (2003) Textbook of Human Nutrition. 2nd Edition Oxford & IBH Publishing co. Pvt. Ltd. New Delhi.
3. WHO (1985) Energy & Protein requirements-report of joint FAO/WHO. UNO-expert consultation Technical report series 724 WHO, Geneva.
4. Ziegler, E.E. and Filer, Jr. L. J. (Des.) (1996). Present knowledge in nutrition. 7th edition. IISI Press. Washington DC.
5. Passmore, R. and Eastwood M.A. Human Nutrition and Dietetics EIBS/ Churchill Livingstone.
6. Swaminathan, M. Essentials of Foods and Nutrition, Vol 1. Fundamental Aspects, Vol II, Applied Aspects. The Bangalore Printing & Publishing Co. Ltd. Bangalore.
7. Jelliffe, D.B. The Assessment of the Nutritional status of the Community. Monograph Series 53 WHO.
8. Gopal Das T. and Seshadri, S. Nutrition- Monitoring and Assessment- Oxford University Press, New Delhi.
9. Gopalan (Ed.) Recent Trends in Nutrition. Oxford University Press, New Delhi

Part B: Advanced Nutritional Biochemistry Practical

Learning Objectives

1. Understand the principles and applications of biochemical methods used for analysis of food and biological samples.
2. Develop skills in performing biochemical estimations with accuracy and reproducibility.
3. Gain practical knowledge of mineral, vitamin, protein and metabolite analysis.
4. Understand chromatographic and electrophoretic techniques used in biochemical investigations.
5. Apply laboratory techniques for interpretation of biochemical parameters related to nutrition and health.

Course Outcomes :

1. Perform biochemical estimation of minerals and vitamins using standard laboratory techniques and interpret the nutritional significance of serum calcium, phosphorus, Vitamin A, thiamine, and riboflavin.
2. Demonstrate molecular biology and protein analysis techniques, including DNA isolation and protein estimation using the Micro-Kjeldahl method, while understanding their applications in nutrition and biomedical research.
3. Apply chromatographic techniques such as paper chromatography, thin-layer chromatography (TLC), gas chromatography (GC), and ion-exchange chromatography for the separation and identification of biomolecules.
4. Demonstrate electrophoretic techniques for the separation and analysis of serum proteins and interpret electrophoretic patterns in relation to nutritional and clinical conditions.
5. Evaluate antioxidant capacity and develop laboratory competence by performing biochemical analyses, interpreting experimental data, following laboratory safety and quality assurance practices, and relating findings to nutritional assessment and research.

1. Estimation of Minerals

- Serum calcium estimation
- Serum phosphorus estimation

2. Estimation of Vitamins

- Colorimetric estimation of Vitamin A
- Fluorimetric estimation of Thiamine and Riboflavin

3. Molecular Biology Technique

- Isolation of DNA

4. Chromatographic Techniques

Demonstration of separation techniques:

- Amino acids and sugars by paper and thin-layer chromatography
- Lipids by thin-layer chromatography (TLC)
- Fatty acids by gas chromatography (GC)
- Amino acids by ion exchange chromatography

5. Electrophoretic Techniques

Demonstration of separation techniques:

- Serum proteins by paper electrophoresis
- Serum proteins by disc gel electrophoresis

6. Protein Estimation

- Estimation of protein by Micro-Kjeldahl method

7. Antioxidant Analysis

- Estimation of total antioxidant capacity of plant extracts
- References

1. **Plummer, D.T.** *An Introduction to Practical Biochemistry*. McGraw Hill Education.
2. **Jayaraman, J.** *Laboratory Manual in Biochemistry*. New Age International Publishers.
3. **Varley, H., Gowenlock, A.H. & Bell, M.** *Practical Clinical Biochemistry*. CBS Publishers.
4. **Sadasivam, S. & Manickam, A.** *Biochemical Methods*. New Age International Publishers.
5. **Wilson, K. & Walker, J.** *Principles and Techniques of Biochemistry and Molecular Biology*. Cambridge University Press.
6. **Berg, J.M., Tymoczko, J.L., Gatto, G.J. & Stryer, L.** *Biochemistry*. W.H. Freeman Publishers.
7. **Harper's Illustrated Biochemistry**. McGraw Hill Education.
8. **Gopalan, C., Rama Sastri, B.V. & Balasubramanian, S.C.** *Nutritive Value of Indian Foods*. National Institute of Nutrition (NIN), ICMR.
9. **National Institute of Nutrition (NIN), ICMR.** *Laboratory Techniques in Biochemistry and Nutrition*.
10. **Tietz, N.W.** *Textbook of Clinical Chemistry and Molecular Diagnostics*. Elsevier.

M.Sc. Food Science and Nutrition Semester III

Course Category	Title of the Course	Credits
FSNDCC – 10	Food Science	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Note: Examiner is requested to set the question paper of 70 marks only. Each question paper is divided into three parts, Part- A, Part B and Part C.

There shall be a Terminal Examination at the end of each Semester carrying 70 marks. The question paper shall comprise three sections **Section A, Section B and Section C**.

Section A

Section shall be of **20 marks** and consist of **10 questions** carrying **2 marks** each to be answered in approximately *20 words* each. All questions shall be compulsory. The examiner shall set the question paper choosing at least 3 questions from each unit.

Section B

Section shall be of **30 marks** and consist of **9 questions** carrying **5 marks** each to be answered in approximately *250 words* each. A Candidate shall attempt any six questions. The examiner shall set the questions ensuring that at least three questions are drawn from each Unit.

Section C

Section shall be of **20 marks** and consist of three questions carrying 10 marks each to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Learning Objectives:

1. Gain knowledge regarding the physical and chemical properties of the food constituents.
2. Understand the chemical reactions and physical changes which occur during the production, processing, storage and handling of foods and their applications.
3. Be familiar with the recent advances and research in the field.

4. To gain the knowledge of techniques involved in new product development.
5. To know the role of food additives and safety issues regarding intake of food additives.
6. To gain knowledge in terms of quality evaluation of food product using sensory and objective evaluation

Course Outcome:

1. Explain the principles of food science, food colloids, browning reactions, food additives, and emerging developments in food science and technology.
2. Analyze the functional properties of carbohydrates, proteins, lipids, enzymes, pigments, and minerals, and evaluate their roles in food processing, preservation, and product development.
3. Apply knowledge of food chemistry to assess the quality, stability, safety, and functionality of food products using appropriate scientific principles.
4. Perform sensory and objective evaluation of foods using standardized methods, interpret analytical data, and assess food quality through physical, chemical, physicochemical, and instrumental techniques.
5. Evaluate recent advances in food processing technologies, food ingredients, quality assurance, and regulatory standards to support innovation, product development, and quality control in the food industry.

UNIT I:

1. Food Science: Scope and Recent Developments

- Food Science as an interdisciplinary discipline
- Emerging trends in Food Science and Technology

2. Food Colloids and Colloidal Systems

- Principles of colloidal chemistry
- Classification and physicochemical properties of colloidal systems
- Food colloids: sols, gels, emulsions, foams and suspensions
- Stability, rheological behaviour and applications of colloidal systems in food products
- Industrial applications of food colloids

3. Browning Reactions in Foods

- Enzymatic browning: mechanism, influencing factors and prevention
- Non-enzymatic browning:
 - Maillard reaction
 - Caramelization
 - Ascorbic acid browning
- Nutritional and sensory implications
- Industrial significance and control measures

4. Food Additives

- Concept, classification and regulatory aspects
- Functional properties and applications of:
 - Antioxidants
 - Preservatives
 - Colouring agents
 - Flavouring agents
 - Emulsifiers and stabilizers
 - Anti-caking agents
 - Buffering agents
 - Sequestrants
 - Sweeteners (natural and artificial)
 - Antifoaming agents
- Safety evaluation and national/international regulations (FSSAI, Codex Alimentarius, JECFA)

UNIT II

5. Functional Properties of Carbohydrates

- Chemical and physicochemical properties of sugars
- Functional role of sugars in food systems
- Natural and artificial sweeteners
- Starch chemistry
- Native and modified starches
- Applications of modified starches in food and confectionery industries
- Food hydrocolloids: classification, functionality and industrial applications
- Non-starch polysaccharides:
 - Cellulose
 - Hemicellulose
 - Carboxymethyl cellulose
 - Pectin
 - Gums and mucilages

6. Functional Properties of Proteins

- Structure-function relationship
- Solubility, hydration, gelation, emulsification and foaming
- Protein concentrates, isolates and hydrolysates
- Novel plant proteins and alternative protein sources
- Industrial applications

7. Food Lipids

- Chemistry and classification of fats and oils
- Functional properties of food lipids
- Refining and processing technology of edible oils
- Lipid oxidation and deterioration
- Methods for prevention of oxidative rancidity
- Structured lipids and specialty fats
- Recent advances in edible oil technology

UNIT III

8. Enzymes in Food Processing

- Classification and characteristics of food enzymes
- Industrial applications of:
 - Carbohydrases
 - Proteases
 - Lipases
 - Oxidoreductases
- Immobilized enzymes
- Enzyme technology in food processing

9. Natural Food Pigments

- Chemistry and stability of natural pigments
- Chlorophylls
- Carotenoids
- Anthocyanins
- Betalains
- Curcuminoids
- Natural colourants from plant, microbial and animal sources
- Stability and industrial applications

10. Functional Role of Minerals in Food Processing

- Technological functions of minerals
- Mineral interactions during food processing
- Bioavailability and fortification

- Role in food preservation and quality

11. Food Quality Evaluation

A. Sensory Evaluation

- Principles of sensory science
- Sensory attributes of foods
- Selection and training of sensory panelists
- Design of sensory laboratories
- Preparation and presentation of food samples

Sensory Evaluation Methods

- Difference tests:
 - Paired comparison
 - Duo-trio
 - Triangle test
- Discrimination tests
- Ranking and rating tests
- Hedonic evaluation
- Descriptive analysis
- Threshold and sensitivity tests
- Quantitative descriptive analysis (QDA)

B. Objective Evaluation

- Principles, advantages and limitations
- Physical methods
- Chemical methods
- Physicochemical methods
- Instrumental texture analysis
- Color measurement
- Rheological measurements
- Microscopic examination
- Modern analytical techniques for food quality assessment

References

1. Bower, Jane, Food theory and applications, Mac Millan publishing company. 1992
2. Potter, N.N. & Hotchkiss, J.H., Food Science, CBS publishers & Distributors New Delhi. 1996
3. Pomeroy, Y., Functional properties of food components, Academic press, INC. 1991
4. Early, R., The technology of dairy products, VCH publishers, INC.
5. Belitz, H.D. and Grosch, W. (1999) Food Chemistry. Springer – Verlag, Berlin Heidelberg
6. Damodaran, S. and Parot, A (1997) Food Proteins and their Applications. Marcel Dekker Inc
7. Davis, M.B., Austin, J. and Partridge, D.A. (1991) Vitamin C: Its Chemistry and Biochemistry. The Royal Society of Chemistry T.G. House, Science Park, Cambridge CB4 4WF
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9. Friberg, S.E. and Larsson, K. (editors) (1997) Food Emulsions. Marcel Dekker, New York
10. Goldberg, I. (ed)(1994) Functional Foods Chapman and Hall, Inc
11. Gunasekaran, S. (ed)(2001) Nondestructive Food Evaluation Marcel Dekker Inc, New York
12. Tombs, M.P. (1991) Biotechnology in the Food Industry Prentice-Hall Inc, India
13. O'Brien, L.O., Nabors and Gelardi, R.C. (1991) Alternative Sweeteners. Marcel Dekker, New York
14. Risch, S.J. and Hotchkiss, J.H. (ed)(1991) Food Packaging Interactions II. ACS Symposium Series 473, American Chemical Society, Washington D.C.
15. Marhawa, S.S. and Arora, J.K. (2000) Food Processing: Biotechnological Applications Asiatech Publishers Inc, New Delhi
16. Mahindru, S.N. (2000) Food Safety – A Techno-legal Analysis. Tata McGraw Hill Publishing Co Ltd., New Delhi

17. Mahindru, S.N. (2000) Food Additives- Characteristics – Detection and Estimation Tata McGraw Hill Publishing Co Ltd.
18. Borwankar, R.P. and Shoemaker, C.E. (1992) Rheology of Foods. Elsevier Science Publishers Ltd., England
19. Charalambour, G. (1990) Flavours and Off-Flavours' 89, Elsevier Science Publishers Ltd., P.O. Box 211, 1000 AE Amsterdam, The Netherlands.
20. Salunke, D.K. and Kodam, S.S. (2001): Handbook of Vegetable Science and Technology, Marcel Dekker, Inc., 270, Madison Avenue, New York, NY, 10016.
21. FAO Food and Nutrition Paper: Manual of Food Quality Control – Parts 14/1 (1979) to (1986), FAO of the United Nations Rome.
22. Srilakshmi, B. (1996) Food Science, New Age International (P) Ltd. New Delhi.
23. Sharma, A (2006) Text Book of Food Science and Technology, Lucknow.
24. McWilliams, M. (1997) Foods: Experimental Perspectives, Merrill, Prentice Hall New Jersey, 3rd Edition.

Course Category	Title of the Course	Credits
FSNDCC – 11	Nutrition for Vulnerable and Special Groups	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Note: Examiner is requested to set the question paper of 70 marks only. Each question paper is divided into three parts, Part- A, Part B and Part C.

There shall be a Terminal Examination at the end of each Semester carrying 70 marks. The question paper shall comprise three sections **Section A, Section B and Section C.**

Section A

Section shall be of **20 marks** and consist of **10 questions** carrying **2 marks** each to be answered in approximately *20 words* each. All questions shall be compulsory. The examiner shall set the question paper choosing at least 3 questions from each unit.

Section B

Section shall be of **30 marks** and consist of **9 questions** carrying **5 marks** each to be answered in approximately *250 words* each. A Candidate shall attempt any six questions. The examiner shall set the questions ensuring that at least three questions are drawn from each Unit.

Section C

Section shall be of **20 marks** and consist of three questions carrying 10 marks each to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Course Objectives

1. Gain comprehensive knowledge of the nutritional requirements of vulnerable and special population groups across different stages of the life cycle.
2. Understand the physiological, social, and environmental factors influencing the nutritional status and health of vulnerable populations.
3. Develop the ability to assess nutritional needs and plan appropriate dietary interventions for the prevention and management of malnutrition and nutrition-related disorders.

Learning Outcomes

1. Explain the nutritional requirements, physiological changes, and dietary recommendations for vulnerable and special groups, including infants, children, adolescents, pregnant and lactating women, older adults, and individuals with special health conditions.

2. Analyze the causes, consequences, and risk factors associated with malnutrition and nutrition-related disorders in vulnerable populations and evaluate appropriate preventive and therapeutic nutritional strategies.
3. Assess the nutritional status of individuals and groups using appropriate assessment methods and recommend evidence-based dietary modifications to meet specific nutritional needs.
4. Apply the principles of nutrition education, and community-based interventions to improve the nutritional well-being of vulnerable and special populations.

Unit I

1. The Vulnerable sections of society - who are vulnerable, why they are vulnerable, effects of malnutrition on the vulnerable sections of society: during growth phase, malnutrition in expectant & nursing women, other vulnerable sections of society, government programmes addressing vulnerable populations

2. Nutrition in Pregnancy

- Importance of nutrition prior to (pre maternal period) and during pregnancy (pre natal period).
- Physiology and endocrinology of pregnancy and embryonic and foetal growth and development.
- Nutritional requirements during pregnancy.
- Adolescent pregnancy.
- Low Birth Weight (LBW), Small for Gestational Age (SGA) and Intrauterine Growth Restriction (IUGR)
- Complications of pregnancy and management and importance of antenatal care.

3. Nutrition in Lactation

- Development of mammary tissue and role of hormones.
- Physiology and endocrinology of lactation - synthesis of milk components, let down reflex, role of hormones, lactational amenorrhea, and effect of breast feeding on maternal health.
- Human milk composition and factors affecting breastfeeding and fertility.
- Management of lactation - Prenatal breastfeeding skill education. Feeding of problems due to sore nipples, engorged breast, inverted nipples etc., galactogogues
- Exclusive breastfeeding.
- Baby friendly hospitals initiative.

Unit II

4. Nutrition in Infancy

- Infant physiology, growth and development.
- Nutritional requirements during infancy.
- Breast feeding - Reasons for encouraging breast feeding.
- Artificial feeding - Comparative composition of human & bovine milk, Infant formula feeding: indications, safe preparation, risks and limitations
- Code on breast feeding and marketing of formula foods - National IYCF Guidelines
- Weaning and supplementary feeding.
- Feeding of premature and immature babies, feeding problems.

5. Nutrition in preschool and school children

- Growth and development.
- Nutritional requirements.
- Food behaviour - food habits and common dietary errors.
- Nutritional issues, problems and common diseases.

6. Nutrition in Adolescents

- Physical changes during adolescence.
- Nutritional requirements.
- Food behaviour - food habits and dietary practices.
- Nutritional problems and eating disorders

UNIT III

7. Geriatric Nutrition

- The ageing process - Physiological, biochemical and body composition changes.
- Socio-psychological aspects of ageing - Special problems of elderly.
- Nutritional requirements of the elderly & dietary management to meet nutritional needs.

8. Nutritional requirements for special conditions:

- Nutritional requirement in high altitude.
- Nutritional requirement in cold and polar environment.
- Nutritional requirement in hot environment.
- Nutritional requirement in space missions.
- Nutritional requirement in disaster and emergency situations

References:

1. Ghosh, S. (1992): The Feeding and care of Infants and Young Children, VHAI, 6th Ed., New Delhi.
2. WHO (1978): A Growth Chart for International Use in Maternal and Child Health Care, Geneva.
3. Swaminathan, M. (1985): Essentials of Food and Nutrition, Vols. I and II. Ganesh & Co. Madras.
4. Indian National Code for Protection and Promotion of Breast Feeding, Govt. of India. Ministry of Social Welfare, New Delhi, 1983.
5. Indian Council of Medical Research of Medical Research (1989): Recommended Dietary Intakes for Indians.
6. Gopalan, C (Ed.), (1993): Recent Trends in Nutrition, Oxford University Press.
7. Sachdeva, H.P.S., Chaudhary, P. (1994): Nutrition in Children. Developing Country Concerns, Dept. of Pediatrics, Maulana Azad Medical College, New Delhi.
8. International Food Policy Research Institute (1997). Care and Nutrition: Concepts and Measurement. International Food Policy Research Institute Washington DC., USA.
9. Ward, R.H.T; Smith, S.K.; Donnai, D. (eds) (1994) Early Fetal Growth and Development. London, RCOG. Press.
10. Wallace, H.M. and Giri, K. (1990) Health Care of Women and Children in Developing Countries. Third Party Publishing Co. Oakland.
11. Luke, B., Johnson, T. R.B.; Petrie, R.H. (1993). Clinical Maternal-Fetal Nutrition. Little Brown and Co, Boston.
12. Haggerty, PA; Rustein SO (1999) Breastfeeding and Complimentary Infant Feeding and the Postpartum Effects of Breastfeeding. Demographic and Health Surveys Comparative Studies Calverton, MA., Macro International.
13. Koletzko, B.; Hernell, O.; Michaelson, K. (2000) Short and Long Term Effects of Breastfeeding on Infant Health. Plenum Press, New York.
14. WHO / University of California, Davis (1998) Complimentary Feeding of Young Children in Developing Countries. Review of Current Scientific Knowledge. Geneva, WHO.

Course Category	Title of the Course	Credits
FSNDSE – 02A	Public Health Nutrition	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Note: Examiner is requested to set the question paper of 70 marks only. Each question paper is divided into three parts, Part- A, Part B and Part C.

There shall be a Terminal Examination at the end of each Semester carrying 70 marks. The question paper shall comprise three sections **Section A, Section B and Section C.**

Section A

Section shall be of **20 marks** and consist of **10 questions** carrying **2 marks** each to be answered in approximately *20 words* each. All questions shall be compulsory. The examiner shall set the question paper choosing at least 3 questions from each unit.

Section B

Section shall be of **30 marks** and consist of **9 questions** carrying **5 marks** each to be answered in approximately *250 words* each. A Candidate shall attempt any six questions. The examiner shall set the questions ensuring that at least three questions are drawn from each Unit.

Section C

Section shall be of **20 marks** and consist of three questions carrying 10 marks each to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Learning Objectives

1. Understand the concepts, scope and importance of community nutrition in improving public health.
2. Explain factors affecting nutritional status, population dynamics and health-related issues in communities.
3. Develop knowledge of nutritional assessment, surveillance and monitoring techniques.
4. Familiarize students with national and international nutrition policies, programmes and food security initiatives.
5. Develop skills in planning, implementing and evaluating community nutrition programmes and nutrition education activities.

Course Outcomes:

1. Understand the concepts and principles of community nutrition and public health.
2. Explain determinants of health, nutrition status and food security.
3. Apply methods for nutritional assessment, monitoring and surveillance.
4. Describe national and international nutrition policies and programmes.
5. Develop skills in planning, implementing and evaluating community nutrition interventions.

UNIT I

1. Community Nutrition

- Definition and key concepts
- Role of public nutritionists in health care delivery
- Ecology of health – determinants of community health and nutrition: environment, infection and health services
- Specific determinants of food behaviour

2. Population Dynamics

- Importance and application of demography
- Demographic transition
- Population structure: sex composition and age composition
- Fertility behaviour
- Population policy
- Fertility, nutrition and quality of life – interrelationship

3. Health Economics and Economics of Malnutrition

- Health economics and economics of malnutrition in India and globally
- Malnutrition: causes, consequences, indicators and interventions to combat it

4. Primary Health Care of the Community

- National health care: concept, levels and health care delivery system in India

UNIT II

5. Nutritional Status

- Determinants of nutritional status of individuals and populations
- Nutritional and non-nutritional indicators
- Direct parameters – an overview
- Indirect assessment of nutritional status
 - Mortality rates
 - Morbidity rates
 - Ecological factors

6. Planning and Conducting a Nutritional Status Assessment Survey

- Defining scope and objectives of survey
- Defining population and selecting samples
- Selecting and standardizing parameters
- Executing the survey: organizing team, materials, training and field testing
- Verification and cross-checking of data
- Interpretation of data and reporting
- Monitoring and evaluation

7. Nutrition Monitoring and Nutrition Surveillance

- Objectives
- Uses
- Infrastructure
- Key indicators
- Current programmes

8. Food and Nutrition Security

- Definition, need, levels and determinants
- Food production
- Food policy
- Food pricing
- Role of government in maintaining food security and nutrition security in India

UNIT III

9. National Food and Nutrition Policies

- Plan of action and programmes in India
 - ICDS
 - Nutrient deficiency control programmes
 - Supplementary feeding programmes
 - Food security programmes
 - Health-based interventions (primary health care and family welfare programmes)
 - Food-based interventions including fortification

- Genetic improvement of foods

10. International Agencies and Nutrition Programmes

11. Community Nutrition Programme Management

- Planning:
 - Identification of problem
 - Analysis of causes
 - Resources and constraints
 - Selection of intervention
 - Setting a strategy
- Implementation and supervision
- Monitoring
- Surveillance
- Evaluation

12. Nutrition Education

- Need
- Channels
- Sectors
- Methods

References

Learning Objectives

After completing the course, students will be able to:

1. Explain the principles, classification and application of therapeutic diets.
2. Apply appropriate methods of nutritional screening and comprehensive assessment.
3. Demonstrate the steps of the Nutrition Care Process in clinical settings.
4. Explain indications, administration, monitoring and complications of nutrition support.
5. Assess nutritional requirements during stress, surgery, burns, trauma, sepsis and critical illness.
6. Apply Medical Nutrition Therapy for obesity, infectious diseases and metabolic complications.
7. Plan dietary interventions for gastrointestinal, hepatobiliary and pancreatic disorders.
8. Integrate evidence-based, personalized and emerging approaches in clinical nutrition practice.
9. Develop appropriate therapeutic diets and nutrition education strategies for individual patients.

Course Outcomes

On successful completion of the course, students will be able to:

1. Explain the principles and application of therapeutic diets and evidence-based nutrition therapy.
2. Conduct systematic nutrition screening and assessment using appropriate clinical, anthropometric, biochemical and dietary methods.
3. Apply the Nutrition Care Process to identify nutrition problems and develop, monitor and evaluate individualized interventions.
4. Demonstrate knowledge of oral, enteral and parenteral nutrition and manage common complications, including refeeding syndrome.
5. Apply Medical Nutrition Therapy in stress, surgery, critical illness, obesity and infectious diseases.
6. Design appropriate dietary interventions for gastrointestinal, liver, gall bladder and pancreatic disorders.
7. Integrate current concepts such as precision nutrition, immunonutrition, ERAS, gut microbiota and nutrition informatics into clinical practice.
8. Demonstrate professional skills in case analysis, therapeutic diet planning, nutrition counselling and clinical documentation.

Unit I

1. Concepts of Diet Therapy

- Principles, objectives and classification of therapeutic diets
- Modification of normal and texture-modified diets
- Specialized and evidence-based nutrition therapy

- Personalized and precision nutrition: overview

2. Nutrition Assessment and Nutrition Care Process

- Nutrition screening and risk assessment
- Clinical, anthropometric, biochemical, biophysical and dietary assessment
- Socioeconomic and lifestyle assessment
- Nutrition Care Process: Assessment, Diagnosis, Intervention, Monitoring and Evaluation
- Standardized documentation, eNCPT/IDNT and nutrition informatics

3. Nutrition Support

- Oral nutritional supplements
- Enteral and parenteral nutrition: indications, contraindications, routes and formula selection
- Monitoring, complications and refeeding syndrome
- Home nutrition support
- Immunonutrition and ERAS nutrition
- Recent advances in nutrition support

Unit II

4. Nutrition in Stress and Surgical Conditions

- Metabolic and physiological response to stress, trauma and surgery
- Pre- and post-operative nutrition
- Burns, trauma and sepsis
- Introduction to critical care nutrition
- Nutritional requirements and dietary management
- ERAS principles

5. Weight Management

- Etiology, epidemiology and classification of obesity
- Energy balance, metabolic syndrome and sarcopenic obesity
- Complications and Medical Nutrition Therapy
- Physical activity and behaviour modification
- Pharmacological management, bariatric surgery and prevention

6. Nutrition in Fever and Infectious Diseases

- Nutrition, immunity and metabolism during infection
- General dietary management
- Tuberculosis, typhoid and HIV/AIDS
- COVID-19 and Long COVID
- Emerging infections
- Micronutrients and immune function

Unit III

7. Upper Gastrointestinal Disorders

- Gastritis, peptic ulcers and *H. pylori* infection
- GERD, oesophagitis and dyspepsia
- Dietary modifications

8. Lower Gastrointestinal Disorders

- Diarrhoea, constipation and diverticular disease
- IBS and inflammatory bowel disease
- Malabsorption, celiac disease, lactose intolerance and steatorrhoea
- Low-FODMAP diet
- Gut microbiota, probiotics, prebiotics, synbiotics and postbiotics

9. Liver, Gall Bladder and Pancreatic Disorders

- Liver functions and nutritional implications
- Viral hepatitis, fatty liver disease, alcoholic liver disease and cirrhosis
- Hepatic encephalopathy and liver transplantation
- Cholecystitis and cholelithiasis
- Acute and chronic pancreatitis

- Pancreatic enzyme replacement therapy
- Nutritional management

References

1. Mahan, L.K., Raymond, J.L. Krause's Food & the Nutrition Care Process. Elsevier.
2. Nelms, M., Sucher, K.P., Lacey, K. Nutrition Therapy and Pathophysiology. Cengage.
3. Escott-Stump, S. Nutrition and Diagnosis-Related Care. Wolters Kluwer.
4. Gandy, J. Manual of Dietetic Practice. Wiley-Blackwell.
5. Ross, A.C. et al. Modern Nutrition in Health and Disease. Wolters Kluwer.
6. Gibney, M.J. et al. Clinical Nutrition. Wiley-Blackwell.
7. Shils, M.E. et al. Modern Nutrition in Health and Disease. Wolters Kluwer.
8. Payne, A. and Barker, H. Advancing Nutrition and Dietetics in Gastrointestinal Disease.
9. McClave, S.A. et al. ASPEN Adult Nutrition Support Core Curriculum. ASPEN.
10. Mueller, C.M. The ASPEN Adult Nutrition Support Core Curriculum. ASPEN.

Course Category	Title of the Course	Credits
FSNDSE – 03A	Functional Food and Nutraceuticals	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Note: Examiner is requested to set the question paper of 70 marks only. Each question paper is divided into three parts, Part- A, Part B and Part C.

There shall be a Terminal Examination at the end of each Semester carrying 70 marks. The question paper shall comprise three sections **Section A, Section B and Section C.**

Section A

Section shall be of **20 marks** and consist of **10 questions** carrying **2 marks** each to be answered in approximately *20 words* each. All questions shall be compulsory. The examiner shall set the question paper choosing at least 3 questions from each unit.

Section B

Section shall be of **30 marks** and consist of **9 questions** carrying **5 marks** each to be answered in approximately *250 words* each. A Candidate shall attempt any six questions. The examiner shall set the questions ensuring that at least three questions are drawn from each Unit.

Section C

Section shall be of **20 marks** and consist of three questions carrying 10 marks each to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Learning Objectives:

1. Gain in-depth knowledge of functional foods, nutraceuticals, and bioactive food components, including their sources, properties, and health benefits.
2. Understand the scientific basis, mechanisms of action, and applications of functional foods and nutraceuticals in health promotion and disease prevention.
3. Develop an understanding of the formulation, quality assurance, regulatory aspects, and commercialization of functional foods and nutraceutical products.

Course Outcomes:

1. Explain the concepts, classification, sources, and health-promoting properties of functional foods, nutraceuticals, and bioactive compounds, and distinguish them from conventional foods and dietary supplements.

2. Analyze the mechanisms of action and scientific evidence supporting the role of functional foods and nutraceuticals in the prevention and management of chronic diseases and lifestyle disorders.
3. Evaluate the production, processing, formulation, and quality assessment of functional food and nutraceutical products, including factors affecting their efficacy, stability, and safety.
4. Apply knowledge of bioactive ingredients and functional food development to recommend appropriate dietary interventions and innovative food products for specific health conditions.
5. Interpret national and international regulations, labeling requirements, safety standards, and ethical considerations related to the development, marketing, and use of functional foods and nutraceuticals.

UNIT I

1. Introduction to Functional Foods and Nutraceuticals

- Concept, definition and scope
- Functional foods, nutraceuticals, dietary supplements, fortified foods and medical foods
- Classification of functional foods and nutraceuticals
- Development and emerging trends
- Market potential and consumer awareness

2. Bioactive Components of Functional Foods

- Phytochemicals: polyphenols, flavonoids, carotenoids, glucosinolates, phytosterols
- Bioactive peptides
- Dietary fibre and resistant starch
- Omega-3 fatty acids
- Probiotics, prebiotics, synbiotics and postbiotics
- Functional lipids and bioactive carbohydrates

3. Mechanism of Action and Health Benefits

- Bioavailability and bioaccessibility of bioactive compounds
- Antioxidant, anti-inflammatory and immunomodulatory mechanisms
- Role in oxidative stress and gut microbiota modulation
- Nutrigenomics and personalized nutrition: basic concepts

UNIT II

4. Functional Foods in Health Promotion and Disease Prevention

Role of functional foods in:

- Cardiovascular diseases
- Diabetes mellitus and metabolic syndrome
- Obesity and weight management
- Gastrointestinal disorders
- Bone and joint health
- Cancer prevention
- Cognitive health and healthy ageing
- Women's health across the life cycle

5. Development of Functional Foods

- Selection of functional ingredients
- Sources of bioactive compounds (plant, animal and microbial)
- Processing and formulation of functional foods
- Stability and storage of bioactive compounds
- Encapsulation and novel delivery systems (overview)

6. Evaluation of Functional Foods

- Safety assessment
- Quality assurance and quality control
- Consumer acceptance and ethical considerations

UNIT III

7. Nutraceuticals

- Definition, classification and applications
- Nutraceutical ingredients: vitamins, minerals, amino acids, fatty acids, herbal extracts and phytoconstituents
- Role in health promotion and disease management
- Recommended intake, dosage and safety considerations
- Adverse effects and toxicity

8. Regulatory and Commercial Aspects

- National and international regulatory framework
- FSSAI regulations for nutraceuticals and health supplements
- Health claims and nutrition claims
- Labelling requirements
- Good Manufacturing Practices (GMP)
- Intellectual property rights and commercialization

9. Recent Advances and Future Perspectives

- Functional foods for gut microbiome modulation
- Plant-based functional foods
- Sustainable functional foods

References

1. Wildman, R.E.C. and Wallace, T.C. (Latest Edition). Handbook of Nutraceuticals and Functional Foods. CRC Press.
2. Bagchi, D. (Ed.). Nutraceutical and Functional Food Regulations in the United States and Around the World. Academic Press.
3. Gibson, G.R. and Williams, C.M. Functional Foods: Concept to Product. Woodhead Publishing.
4. Shi, J. (Ed.). Functional Food Ingredients and Nutraceuticals. CRC Press.
5. Gupta, R.C., Lall, R. and Srivastava, A. (Eds.). Nutraceuticals: Efficacy, Safety and Toxicity. Academic Press.
6. Shahidi, F. and Ambigaipalan, P. Bioactives and Functional Foods. CRC Press.
7. FSSAI. Food Safety and Standards (Health Supplements, Nutraceuticals, Food for Special Dietary Use, Food for Special Medical Purpose, Functional Foods and Novel Foods) Regulations (Latest Amendment).
8. ICMR-NIN. Dietary Guidelines for Indians (Latest Edition).
9. ICMR-NIN. Nutrient Requirements for Indians (Latest Edition).
10. Gibson, G.R., Hutkins, R., Sanders, M.E., et al. The International Scientific Association for Probiotics and Prebiotics (ISAPP) Consensus Statements (latest publications).
11. FAO/WHO Reports on Functional Foods, Probiotics and Food Bioactives.
12. Recent review articles from peer-reviewed journals such as Trends in Food Science & Technology, Critical Reviews in Food Science and Nutrition, Journal of Functional Foods, Nutrients, Food & Function, and Nutrition Reviews.

Course Category	Title of the Course	Credits
FSNDCC – 12	Food Science and Community Nutrition Practical	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Part A- Food Science Practical

Learning Objectives

1. Use laboratory equipment safely and accurately while following Good Laboratory Practices (GLP).
2. Perform proximate analysis including determination of moisture, protein, fat, ash, crude fibre, and carbohydrate in food samples.
3. Determine important quality parameters of fats, oils, cereals, and milk using standard analytical methods.
4. Detect common food adulterants and evaluate the quality and purity of different food products.
5. Conduct sensory evaluation tests, analyze experimental data, and interpret results for assessing food quality and consumer acceptability.

Course Outcomes:

1. Demonstrate proficiency in laboratory safety, Good Laboratory Practices (GLP), sample preparation, and the use of analytical instruments for food analysis.
2. Perform proximate analysis of food samples by estimating moisture, protein, fat, ash, crude fibre, and carbohydrate using standard laboratory methods.
3. Analyze the physicochemical quality of cereals, fats, oils, and milk by determining key quality parameters and interpreting the analytical results.
4. Assess the quality, purity, and safety of food products by detecting common adulterants using standard qualitative and quantitative techniques.
5. Conduct sensory evaluation of food products using appropriate sensory methods, analyze the data statistically, and prepare scientific laboratory records and reports.

Content:

1. Laboratory Techniques and Food Analysis
 - Principles of qualitative and quantitative food analysis
 - Preparation of standard solutions

2. Proximate Analysis of Foods

Introduction to Proximate Composition

- Moisture
- Protein
- Fat
- Ash (Mineral Content)
- Crude Fibre
- Carbohydrate (By Difference)

Practical Activities

1. Determination of moisture content.
2. Determination of protein content (Gluten estimation in wheat flour).
3. Determination of crude fat content.
4. Determination of total ash (Mineral content).
5. Determination of crude fibre.
6. Estimation of carbohydrate by difference.

3. Analysis of Cereals, Fats and Oils

A. Experiments on Cereals

- Moisture estimation
- Gluten estimation
- Ash determination
- Fibre estimation

B. Chemistry of Fats and Oils

Practical determination of:

1. Iodine Value
2. Acid Value
3. Peroxide Value
4. Saponification Value

Interpretation of analytical results for assessing oil quality.

4. Analysis of Milk and Milk Products

Practical determination of:

1. Specific gravity (Lactometer reading) and percentage purity of milk
2. Moisture content
3. Total solids (TS)
4. Fat content
5. Solids-Not-Fat (SNF)
6. Protein estimation by Walker's Formal Titration Method
7. Lactose estimation by Benedict's Quantitative Method
8. Titratable acidity of milk

Interpretation of milk quality based on analytical parameters.

5. Food Quality Assessment and Detection of Adulterants

Practical detection of adulterants in food samples:

- Detection of Metanil Yellow in food colours and spices
- Detection of Rhodamine B in food samples
- Detection of added sugar in honey
- Detection of sodium bicarbonate (NaHCO_3) in flour
- Detection of vanaspati adulteration in ghee
- Detection of rancidity in fats and oils
- Detection of protein, urea, starch and added sugar in milk
- Detection of mineral oil in edible oils

6. Sensory Evaluation of Foods

Practical Exercises

- Principles of sensory evaluation
- Selection and training of sensory panel members
- Types of sensory panels
- Development of sensory score cards
- Sensory data collection, statistical analysis, and interpretation
- Threshold tests for sweet, salty, sour and bitter tastes
- Hedonic rating test for consumer acceptability of a new food product
- Comparative sensory evaluation using score cards

References:

1. Sharma, S. Practical biochemistry, classic publishing house, Jaipur, 1993.
2. Mody, N.I. Experimental food chemistry, Avi publishing company, INC, Westport, Connecticut.
3. A manual of laboratory techniques, National Institute of Nutrition. 1983.

4. Sathe, A.V.(1999) A first course in food analysis, New age International (p) limited Publishers, New Delhi.
5. Sethi M. and Rao, E.S. (2001) Food Science Experiments and Applications, CBS Publishers & Distributors, New Delhi.

Part B: Community Nutrition Practical

Learning Objectives

1. Understand the nutritional problems, socio-economic factors, and health challenges affecting different communities.
2. Develop skills in nutritional status assessment and identification of nutrition-related problems among vulnerable groups.
3. Apply knowledge of community nutrition principles for planning and implementing nutrition intervention strategies.
4. Develop low-cost nutritious recipes and effective nutrition education materials using innovative tools and techniques.
5. Design and evaluate nutrition education tools for assessing knowledge, attitude, and practices related to nutrition and health.

Course Outcomes

1. Analyze nutritional status and socio-economic variations among rural, urban, and suburban communities using available data.
2. Apply appropriate nutritional assessment techniques for identifying nutrition problems in vulnerable populations.
3. Develop and evaluate affordable, culturally acceptable, and nutritionally adequate food solutions for community needs.
4. Prepare effective nutrition information, education, and communication (IEC) materials using digital and AI-based tools.
5. Design and implement community-based nutrition education programmes and assess their effectiveness.

1: Comparative Analysis of Rural, Urban, and Suburban Communities

- Comparison of rural, urban, and suburban communities through analysis of secondary data.
- Assessment of:
 - Malnutrition status
 - Socio-economic status
 - Prevalence and types of nutritional problems
- Collection, compilation, and interpretation of data from available sources such as NFHS, WHO, UNICEF, government reports, and research studies.
- Preparation of analytical reports highlighting community-wise nutritional disparities.

2. Identification of Nutritional Problems and Strategies for Vulnerable Groups

- Identification of nutrition-related problems among vulnerable groups:
 - Infants and children
 - Adolescents
 - Pregnant and lactating women
 - Elderly population
 - Socio-economically disadvantaged groups
- Training in nutritional status assessment techniques:
 - Anthropometric assessment
 - Dietary assessment
 - Clinical assessment
 - Biochemical assessment
- Development of nutrition intervention strategies and implementation of community-based projects.

3. Development of Low-Cost Nutritious Recipes

- Development and standardization of low-cost nutritious recipes for different vulnerable groups.
- Evaluation of recipes based on:
 - Nutritional composition
 - Cost effectiveness
 - Sensory acceptability
 - Availability of local ingredients
- Planning nutrition interventions at:
 - Micro level (individual/family)
 - Meso level (community/institutional)
 - Macro level (population-based strategies)

4. Development and Evaluation of Nutrition Information, Education, and Communication (IEC) Materials

- Development of nutrition and health education materials using digital tools such as Canva and AI-based tools.
- Preparation of IEC materials:
 - Charts
 - Posters
 - Flash cards
 - Flip charts
 - Flannel graphs
 - Leaflets and pamphlets
 - Puppets
 - Role plays
 - Jingles and other communication materials
- Use of demonstration techniques for nutrition education.
- Evaluation of IEC materials for effectiveness and acceptability.

5. Formulation and Assessment of Nutrition Education Tools

- Development of tools for assessing Knowledge, Attitude, and Practices (KAP) related to nutrition.
- Preparation and validation of questionnaires and assessment formats.
- Conducting KAP surveys among target groups.
- Analysis and interpretation of findings for planning nutrition education interventions.

References:

1. Park, K. (2023). Park's Textbook of Preventive and Social Medicine. 27th Edition. Banarsidas Bhanot Publishers, Jabalpur.
2. Srilakshmi, B. (2021). Community Nutrition. 3rd Edition. New Age International Publishers, New Delhi.
3. Reddy, S. & Rao, G.M.S. (2019). Public Health Nutrition. Scientific Publishers, Jodhpur.
4. Gopalan, C., Rama Sastri, B.V. & Balasubramanian, S.C. (2019). Nutritive Value of Indian Foods. National Institute of Nutrition, Indian Council of Medical Research (ICMR), Hyderabad.
5. World Health Organization (WHO). Nutrition: Improving Health and Well-being through Nutrition. Geneva: WHO.
6. Food and Agriculture Organization (FAO). Nutrition Education and Communication: Approaches and Strategies. Rome: FAO.

7. Indira Gandhi National Open University (IGNOU). Community Nutrition (CFN/MFN Series) – Study Materials. School of Continuing Education, IGNOU, New Delhi.
8. National Institute of Nutrition (NIN), ICMR. Dietary Guidelines for Indians. Hyderabad: Indian Council of Medical Research.
9. UNICEF. Improving Child Nutrition: The Achievable Imperative for Global Progress. United Nations Children's Fund, New York.
10. Sharma, S. & Kaur, M. (2018). Nutrition Education and Communication. Scientific Publishers, Jodhpur.

**M.Sc. Food Science and Nutrition
Semester IV**

Course Category	Title of the Course	Credits
FSNDCC – 13	Advanced Medical Nutrition Therapy	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Note: Examiner is requested to set the question paper of 70 marks only. Each question paper is divided into three parts, Part- A, Part B and Part C.

There shall be a Terminal Examination at the end of each Semester carrying 70 marks. The question paper shall comprise three sections **Section A, Section B and Section C.**

Section A

Section shall be of **20 marks** and consist of **10 questions** carrying **2 marks** each to be answered in approximately *20 words* each. All questions shall be compulsory. The examiner shall set the question paper choosing at least 3 questions from each unit.

Section B

Section shall be of **30 marks** and consist of **9 questions** carrying **5 marks** each to be answered in approximately *250 words* each. A Candidate shall attempt any six questions. The examiner shall set the questions ensuring that at least three questions are drawn from each Unit.

Section C

Section shall be of **20 marks** and consist of three questions carrying 10 marks each to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Learning Outcomes

After successful completion of the course, students will be able to:

- Plan individualized Medical Nutrition Therapy for major chronic diseases.
- Apply evidence-based guidelines in clinical dietetics.
- Manage nutrition support in critically ill patients.
- Demonstrate effective counselling and communication skills.
- Critically evaluate current research and advances in clinical nutrition.

Course Objectives

The course aims to:

- Develop advanced competencies in medical nutrition therapy for chronic and complex diseases.
- Apply evidence-based dietary management in endocrine, renal, cardiovascular, neurological, and oncological disorders.
- Strengthen professional skills in diet counselling, nutrition education, and critical care nutrition.
- Integrate emerging concepts in precision nutrition and evidence-based clinical practice.

Learning Objectives

Students will be able to:

1. Explain nutritional implications of major clinical disorders.
2. Conduct basic clinical nutrition assessment.
3. Plan individualized Medical Nutrition Therapy.
4. Apply principles of enteral and parenteral nutrition.
5. Develop therapeutic diets for complex clinical conditions.
6. Apply counselling and behaviour-change techniques.
7. Identify important diet–drug interactions.
8. Describe emerging trends in clinical nutrition and dietetics.

Course Outcomes

On completion, students will be able to:

1. Explain pathophysiology and nutrition-related complications of major diseases.
2. Assess nutritional status and identify nutrition problems.
3. Develop evidence-based MNT and therapeutic diets.
4. Plan and monitor nutrition support in critically ill patients.
5. Apply effective nutrition counselling strategies.
6. Recognize important food–drug interactions.
7. Apply current clinical guidelines in dietetic practice.
8. Discuss emerging concepts in precision and personalized nutrition

Unit I

1. Diabetes Mellitus

- Classification, etiology, diagnosis and pathophysiology
- Glycemic targets, GI/GL and carbohydrate counting
- Medical Nutrition Therapy and meal planning
- Insulin, oral hypoglycemic agents and artificial sweeteners
- CGM and diabetes technology
- Exercise and diabetes education
- Acute and chronic complications
- Prevention and lifestyle management

2. Renal Diseases

- Kidney functions and nutritional assessment
- AKI, CKD, glomerulonephritis and nephrotic syndrome
- ESRD, hemodialysis and peritoneal dialysis
- Kidney transplantation and renal calculi
- Protein-energy wasting
- Dietary management of protein, energy, sodium, potassium, phosphorus and fluids

Unit II

3. Cardiovascular Diseases and Hypertension

- Atherosclerosis, dyslipidemia, CAD, angina, MI and heart failure
- Primary and secondary hypertension and RAAS
- DASH, Mediterranean and Portfolio diets
- Sodium and potassium management
- Lifestyle modification and prevention

4. Neurological Disorders

- Dysphagia and stroke
- Alzheimer's and Parkinson's diseases
- Epilepsy and ketogenic diet
- Multiple sclerosis
- Nutrition support and rehabilitation

5. Nutrition and Cancer

- Cancer biology and cancer-related malnutrition/cachexia

- Nutrition screening and assessment
- MNT during chemotherapy, radiation and immunotherapy
- Stem cell transplantation
- Nutrition support and survivorship
- Diet and cancer prevention

Unit III

6. Critical Care Nutrition

- Metabolic response to critical illness
- ICU nutrition assessment
- Energy and protein requirements
- Enteral and parenteral nutrition
- Nutrition in trauma, burns, sepsis and ARDS
- Nutrition in acute liver and kidney failure
- Nutrition in Multiple organ failure
- Monitoring, complications and refeeding syndrome
- Current ESPEN, ASPEN and SCCM recommendations
- Goals and principles of nutrition in palliative care
- Role of the dietitian in multidisciplinary palliative care teams

7. Nutrition Education and Counseling

- Behaviour Change Communication
- Motivational Interviewing
- Counselling techniques and patient-centred communication
- Tele-nutrition and nutrition literacy
- Ethical and legal issues

8. Diet–Drug Interactions and Recent Advances

- Food–drug and nutrient–drug interactions
- Pharmacokinetic and pharmacodynamic interactions
- Drug effects on nutrient metabolism
- Polypharmacy and nutraceutical interactions
- Precision nutrition
- Nutrigenomics and nutrigenetics
- Gut microbiome and personalized nutrition
- AI in dietetics
- Functional and medical foods
- Evidence-based clinical practice guidelines

Reference

1. Mahan, L.K. & Raymond, J.L. Krause's Food & the Nutrition Care Process.
2. Nelms, M. et al. Nutrition Therapy and Pathophysiology.
3. Ross, A.C. et al. Modern Nutrition in Health and Disease.
4. Mueller, C.M. The ASPEN Adult Nutrition Support Core Curriculum.
5. ADA Standards of Care in Diabetes
6. ESPEN Clinical Nutrition Guidelines
7. ASPEN Nutrition Support Guidelines
8. KDIGO Clinical Practice Guidelines
9. SCCM Critical Care Nutrition Guidelines

Course Category	Title of the Course	Credits
FSNDCC – 14	Institutional Food Service Management	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Note: Examiner is requested to set the question paper of 70 marks only. Each question paper is divided into three parts, Part- A, Part B and Part C.

There shall be a Terminal Examination at the end of each Semester carrying 70 marks. The question paper shall comprise three sections **Section A, Section B and Section C.**

Section A

Section shall be of **20 marks** and consist of **10 questions** carrying **2 marks** each to be answered in approximately *20 words* each. All questions shall be compulsory. The examiner shall set the question paper choosing at least 3 questions from each unit.

Section B

Section shall be of **30 marks** and consist of **9 questions** carrying **5 marks** each to be answered in approximately *250 words* each. A Candidate shall attempt any six questions. The examiner shall set the questions ensuring that at least three questions are drawn from each Unit.

Section C

Section shall be of **20 marks** and consist of three questions carrying 10 marks each to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Learning Objectives

1. Understand the principles, scope, and management practices of institutional food service operations.
2. Develop skills in food procurement, menu planning, production, service, and quality control.
3. Apply concepts of financial management, costing, budgeting, and resource management in food service institutions.
4. Understand personnel management, facility planning, equipment selection, hygiene, and sanitation practices.
5. Gain knowledge of food safety regulations and apply management strategies for efficient and sustainable food service operations.

Course Outcomes

1. Explain the concepts and functions of management and their application in institutional food services.
2. Plan and manage food procurement, storage, menu development, production, and service systems.
3. Apply costing, budgeting, inventory control, and quality management techniques in food service operations.
4. Design effective food service facilities and implement hygiene, sanitation, and safety practices.
5. Evaluate food service operations and apply professional skills for efficient management of institutional food services

UNIT I

1. Introduction to Institutional Food Management

2. Food Service Management

- Philosophy, principles, and functions of management
- Management approaches and applications in food service operations

3. Financial Management

- Concept and scope of management accounting
- Costing, budgeting, bookkeeping, and financial control

- Food cost management and analysis

4. Personnel Management

- Concept and scope of human resource management
- Recruitment, selection, and employment practices
- Employee benefits, training, development, and legal aspects

UNIT II

5. Food Management

- Characteristics and quality aspects of food
- Food purchasing, forecasting, specifications, and procurement procedures
- Receiving, inventory control, and storage management
- Menu planning: types, factors affecting menu planning, and evaluation
- Food production, food service, cleaning, and waste management

6. Food Delivery and Service Systems

- Types of food service systems
- Food service operations in hospitals, schools, colleges, industries, airlines, and other institutions
- Customer relationship management

7. Quality and Quantity Control

- Quantity food production principles
- Recipe standardization and adjustment
- Product standards and production control

8. Food Cost Accounting

- Importance and methods of food costing
- Cost classification: materials, labour, and overheads
- Cost analysis, reports, and break-even analysis

UNIT III

9. Food Service Space Organization

- Kitchen planning and design
- Layout, workflow, ventilation, lighting, safety, and sanitation
- Storage and service area planning

10. Catering Equipment Management

- Equipment planning, selection, purchasing, and installation
- Equipment operation, maintenance, and safety

11. Hygiene, Sanitation, and Food Safety

- Environmental hygiene
- Food handling and personal hygiene practices
- Food safety hazards and consumer perception

12. Food Service Laws and Regulations

- Food laws, labour laws, hygiene, and safety regulations
- Implementation of food safety standards
- Employee welfare schemes.

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1. **Sethi, M. (2004).** *Institutional Food Management*. New Delhi: New Age International Publishers. ([WorldCat](#))
2. **Sethi, M. (2005).** *Catering Management: An Integrated Approach*. New Delhi: Wiley Eastern Limited. ([Home Science](#))
3. **Payne-Palacio, J. & Theis, M. (2016).** *Introduction to Foodservice Management: Principles and Practices*. 13th Edition. Pearson Education.

4. **Spears, M.C. & Gregoire, M.B. (2004).** *Foodservice Organizations: A Managerial and Systems Approach*. 5th Edition. Pearson Education.
5. **West, B.B., Wood, L., Harger, V.F. & Shuggart, G.S. (1988).** *Food Service in Institutions*. 6th Edition. New York: John Wiley & Sons.
6. **Kotschevar, L.H. & Terrell, M.E. (1997).** *Foodservice Planning: Layout and Equipment*. 2nd Edition. New York: John Wiley & Sons.
7. **Ninemeier, J.D. (2010).** *Management of Food and Beverage Operations*. American Hotel & Lodging Educational Institute.
8. **Longrée, K. & Armbruster, G. (1996).** *Quantity Food Sanitation*. New York: John Wiley & Sons.
9. **Foskett, D., Paskins, P. & Rippington, N. (2011).** *The Theory of Hospitality and Catering*. Hodder Education.
10. **Food Safety and Standards Authority of India (FSSAI).** *Food Safety and Hygiene Guidelines*. Government of India.
11. **World Health Organization (WHO).** *Five Keys to Safer Food Manual*. Geneva: WHO.
12. **Indira Gandhi National Open University (IGNOU).** *MFN-007: Entrepreneurship and Food Service Management*. School of Continuing Education, IGNOU, New Delhi. ([Indira Gandhi National Open University](#))
13. **IGNOU eGyanKosh.** *MFN-007: Entrepreneurship and Food Service Management – Study Material (History and Development of Food Service System and related units)*. Indira Gandhi National Open University, New Delhi. ([Egyankosh](#))

E-Resources

- IGNOU eGyanKosh: Digital learning resources for Food Service Management courses. ([Egyankosh](#))
- Food Safety and Standards Authority of India (FSSAI) official guidelines.
- World Health Organization (WHO) food safety resources.
- Food and Agriculture Organization (FAO) food safety and nutrition resources.

Course Category	Title of the Course	Credits
FSNDSE – 04A	Metabolomics and Precise Nutrition	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Note: Examiner is requested to set the question paper of 70 marks only. Each question paper is divided into three parts, Part- A, Part B and Part C.

There shall be a Terminal Examination at the end of each Semester carrying 70 marks. The question paper shall comprise three sections **Section A, Section B and Section C**.

Section A

Section shall be of **20 marks** and consist of **10 questions** carrying **2 marks** each to be answered in approximately *20 words* each. All questions shall be compulsory. The examiner shall set the question paper choosing at least 3 questions from each unit.

Section B

Section shall be of **30 marks** and consist of **9 questions** carrying **5 marks** each to be answered in approximately *250 words* each. A Candidate shall attempt any six questions. The examiner shall set the questions ensuring that at least three questions are drawn from each Unit.

Section C

Section shall be of **20 marks** and consist of three questions carrying 10 marks each to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Learning Objectives

1. Explain the fundamental concepts, evolution and scope of metabolomics.
2. Describe major analytical platforms used for metabolite profiling.
3. Understand sample preparation, quality control and metabolite identification.
4. Interpret basic metabolomics data using statistical and bioinformatics approaches.
5. Explain the relationship between diet, metabolism, gut microbiota and health.
6. Evaluate applications of metabolomics in clinical, personalized and precision nutrition.

Course Outcomes

1. Explain the principles and workflow of metabolomics.
2. Differentiate targeted and untargeted metabolomics approaches.
3. Describe applications of GC-MS, LC-MS and NMR in nutritional research.
4. Interpret basic metabolite profiles and metabolic pathways.
5. Identify potential nutritional and disease biomarkers.
6. Critically evaluate nutritional metabolomics research.

UNIT I

1. Introduction to Metabolomics

- Definition, history and evolution of metabolomics
- Metabolome and metabolic phenotyping
- Scope and significance of metabolomics
- Metabolomics in systems biology and nutritional sciences
- Relationship between genomics, transcriptomics, proteomics and metabolomics
- Targeted and untargeted metabolomics
- Metabolomics, metabonomics and fluxomics: basic concepts

2. Metabolites and Metabolic Profiling

- Major classes of metabolites: carbohydrates, amino acids, lipids, organic acids, nucleotides and vitamins
- Primary and secondary metabolites
- Endogenous and exogenous metabolites
- Metabolic pathways and pathway networks
- Metabolic fingerprints and metabolic signatures
- Factors affecting the human metabolome: diet, age, lifestyle, environment and gut microbiota

3. Metabolomics Workflow

- Study design and selection of study population
- Biological sample selection: blood, plasma, serum, urine, saliva, feces and tissues
- Sample collection, processing, storage and preservation
- Sample preparation and extraction
- Quality control and quality assurance
- Sources of biological and analytical variation
- Ethical considerations in metabolomics research

UNIT II

4. Analytical Platforms in Metabolomics

- Principles and applications of Mass Spectrometry (MS)
- Gas Chromatography–Mass Spectrometry (GC-MS)
- Liquid Chromatography–Mass Spectrometry (LC-MS)
- Tandem Mass Spectrometry (MS/MS)
- Ionization techniques: basic concepts
- Nuclear Magnetic Resonance (NMR) spectroscopy
- Comparison of MS- and NMR-based metabolomics

- Chromatographic separation and metabolite identification

5. Metabolite Identification and Quantification

- Targeted metabolite analysis
- Untargeted metabolite profiling
- Qualitative and quantitative metabolomics

UNIT III

6. Nutritional Metabolomics

- Concept and scope of nutritional metabolomics
- Metabolic response to dietary intake
- Nutritional biomarkers and dietary exposure assessment
- Metabolomics for assessment of food intake and dietary patterns
- Metabolic effects of carbohydrates, proteins and fats
- Metabolomics of vitamins, minerals and bioactive food components
- Food-derived metabolites and bioactive compounds
- Metabolomics in nutritional intervention studies

7. Diet–Microbiome–Metabolome Interactions

- Gut microbiota and host metabolism
- Microbial metabolites: short-chain fatty acids, bile acids and other microbial products
- Dietary modulation of gut microbiota and metabolome
- Gut microbiome–metabolome interactions in health and disease
- Role of metabolomics in studying probiotics, prebiotics and dietary fibre

8. Clinical and Precision Nutrition Applications

- Metabolomics in obesity and metabolic syndrome
- Type 2 diabetes and insulin resistance
- Cardiovascular and inflammatory diseases
- Malnutrition and nutritional deficiencies
- Metabolomics in cancer and other chronic diseases
- Nutrigenomics, metabolomics and personalized nutrition
- Applications of metabolomics in clinical nutrition

Reference

1. Lindon, J.C., Nicholson, J.K. and Holmes, E. *The Handbook of Metabonomics and Metabolomics*. Elsevier.
2. Villas-Bôas, S.G. et al. *Metabolome Analysis: An Introduction*. Wiley.
3. Fan, T.W.M., Lane, A.N. and Higashi, R.M. *Metabolomics: Principles and Applications*. CRC Press.
4. Gropper, S.S. and Smith, J.L. *Advanced Nutrition and Human Metabolism*. Cengage Learning.
5. Nelson, D.L. and Cox, M.M. *Lehninger Principles of Biochemistry*. W.H. Freeman.
6. Murray, R.K. et al. *Harper's Illustrated Biochemistry*. McGraw-Hill.

Course Category	Title of the Course	Credits
DSE – 04B	Food Processing and Technology	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Note: Examiner is requested to set the question paper of 70 marks only. Each question paper is divided into three parts, Part- A, Part B and Part C.

There shall be a Terminal Examination at the end of each Semester carrying 70 marks. The question paper shall comprise three sections **Section A, Section B and Section C.**

Section A

Section shall be of **20 marks** and consist of **10 questions** carrying **2 marks** each to be answered in approximately *20 words* each. All questions shall be compulsory. The examiner shall set the question paper choosing at least 3 questions from each unit.

Section B

Section shall be of **30 marks** and consist of **9 questions** carrying **5 marks** each to be answered in approximately *250 words* each. A Candidate shall attempt any six questions. The examiner shall set the questions ensuring that at least three questions are drawn from each Unit.

Section C

Section shall be of **20 marks** and consist of three questions carrying 10 marks each to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Learning Objectives

1. Understand the principles, scope, and importance of food processing and technology in improving food quality, safety, and shelf life.
2. Gain knowledge of various food preservation methods, processing operations, and technologies used in the food industry.
3. Understand processing techniques for cereals, pulses, fruits, vegetables, dairy, meat, and other food products.
4. Develop knowledge of food packaging, quality control, food safety systems, and regulatory requirements.
5. Familiarize with emerging technologies, sustainable processing approaches, and innovations in the food processing sector.

Course Outcomes

1. Understand the principles, scope, and significance of food processing and preservation technologies.
2. Describe various food processing methods, unit operations, and advanced processing techniques.
3. Apply processing technologies for development and value addition of different food products.
4. Evaluate food quality, packaging systems, food safety practices, and regulatory standards.
5. Analyze emerging trends, sustainable practices, and innovations in food processing and technology.

UNIT I

1. Food Processing: Concepts and Industrial Significance

- Principles, scope, and objectives of food processing
- Evolution of food processing technologies and the food industry
- Role of food processing in nutrition, food security, sustainability, and value addition
- Emerging challenges and opportunities in food processing

2. Food Raw Materials and Quality Characteristics

- Physical, chemical, functional, nutritional, and sensory properties of food raw materials
- Quality determinants and post-harvest changes
- Factors influencing raw material quality during production, handling, and storage
- Quality assessment and grading of food commodities

3. Principles and Technologies of Food Preservation

- Thermal processing: pasteurization, sterilization, blanching, and aseptic processing
- Low-temperature preservation: chilling, freezing, and cryogenic preservation
- Dehydration, concentration, and freeze drying
- Fermentation, biopreservation, and chemical preservation techniques
- Hurdle technology and preservation strategies

4. Unit Operations in Food Processing

- Cleaning, washing, sorting, grading, and size reduction
- Mixing, homogenization, emulsification, and extrusion basics
- Separation processes: filtration, centrifugation, membrane separation, and evaporation
- Process optimization and equipment considerations

Unit II

5. Processing of Major Food Commodities

- Cereals, millets, pulses, and legumes
- Fruits and vegetables: minimal processing and value addition
- Milk and dairy products: processing and functional dairy foods
- Meat, poultry, fish, and egg processing
- Nutritional implications of food processing

6. Advanced Food Processing Technologies

- Extrusion cooking and texturization
- Membrane processing technologies
- High Pressure Processing (HPP)
- Pulsed Electric Field (PEF), irradiation, cold plasma, and ultrasound processing
- Minimal processing technologies for quality retention

7. Food Packaging, Storage, and Shelf-Life

- Principles and functions of food packaging
- Packaging materials and selection criteria
- Active, intelligent, biodegradable, and sustainable packaging systems
- Modified Atmosphere Packaging (MAP) and Controlled Atmosphere Storage (CAS)
- Shelf-life prediction and extension techniques

8. Functional Food Product Development

- Principles of food product development
- Value-added and convenience foods
- Functional foods, nutraceuticals, and fortified foods
- Product formulation, optimization, and consumer acceptance
- Market trends and commercialization

Unit III

9. Food Quality Assessment and Quality Management

- Physical, chemical, microbiological, and sensory evaluation techniques
- Instrumental methods for food quality analysis
- Statistical quality control and quality assurance systems
- Food quality certification and accreditation

10. Food Safety and Regulatory Framework

- Food safety hazards and risk assessment
- Good Manufacturing Practices (GMP), Good Hygiene Practices (GHP), HACCP, ISO 22000, and Food Safety Management Systems
- Food adulteration, contaminants, allergens, and traceability
- National and international food laws and standards (FSSAI, Codex Alimentarius, FDA, EFSA)

11. Sustainable Food Processing and Waste Utilization

- Food industry by-products and value-added utilization
- Circular bioeconomy and zero-waste processing

- Sustainable processing technologies
- Environmental impact assessment and life-cycle approach
- Green technologies in food processing

References

1. **Ramaswamy, H. & Marcotte, M. (2006).** *Food Processing: Principles and Applications*. CRC Press, Taylor & Francis.
2. **Fellows, P.J. (2017).** *Food Processing Technology: Principles and Practice*. 4th Edition. Woodhead Publishing, Elsevier.
3. **Sivasankar, B. (2002).** *Food Processing and Preservation*. Prentice Hall of India, New Delhi.
4. **Manay, N.S. & Shadaksharaswamy, M. (2008).** *Foods: Facts and Principles*. New Age International Publishers.
5. **Potter, N.N. & Hotchkiss, J.H. (1995).** *Food Science*. 5th Edition. Chapman & Hall.
6. **Indira Gandhi National Open University (IGNOU).** *Food Processing and Preservation, Food Science and Technology, and Food Quality and Safety – Study Materials*. School of Continuing Education, IGNOU, New Delhi.
7. **Food Safety and Standards Authority of India (FSSAI).** *Food Safety and Standards Regulations and Guidelines*. Government of India, New Delhi.

Course Category	Title of the Course	Credits
FSN DSE – 05A	Dissertation	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	Main Examination	70
	Internal Assessment	30

Learning Objectives

Upon successful completion of the Dissertation/Research Project, the student will be able to:

1. Develop the ability to identify and formulate a research problem relevant to Foods and Nutrition through critical review of scientific literature.
2. Design and conduct an independent research study using appropriate research methodology, ethical principles, and scientific approaches.
3. Apply suitable analytical, statistical, and interpretative techniques for the collection, analysis, and presentation of research data.
4. Demonstrate competence in scientific writing, documentation, referencing, and dissemination of research findings through dissertation and oral presentation.
5. Develop critical thinking, problem-solving, and research communication skills for professional practice, higher studies, and lifelong learning.

Course Outcomes

After successful completion of the Dissertation/Research Project, the student will be able to:

1. Identify a relevant research problem in Foods and Nutrition and formulate clear research objectives based on a comprehensive review of literature.
2. Plan and execute an independent research project by applying appropriate research design, methodology, ethical standards, and scientific principles.
3. Analyze, interpret, and present research findings using suitable statistical tools and scientific evidence to draw meaningful conclusions.
4. Prepare and defend a dissertation demonstrating originality, scientific rigor, effective communication, and adherence to academic and ethical standards.
5. Integrate research findings into evidence-based practice and propose recommendations for improving food, nutrition, health, or future research.

Content

Every student shall be allotted a Research Supervisor from the Department. Depending upon the interdisciplinary nature of the research work, a Co-Supervisor/Minor Guide may also be appointed from the same or any other relevant department with the approval of the Head of the Department. The allotment of the Research Supervisor shall be completed during the Second Semester.

In consultation with the Research Supervisor, the student shall identify and finalize a suitable research topic relevant to the programme and in accordance with the departmental research priorities. The Research Supervisor shall continuously guide and monitor the progress of the student throughout the course of the research work.

Each student shall prepare a Research Proposal outlining the rationale, objectives, review of literature, methodology, expected outcomes, and work plan. The proposal shall be presented before the Department through a seminar for evaluation and approval. Suggestions and constructive feedback received from the faculty members shall be incorporated into the research plan before the commencement of the study.

The research work shall normally be carried out during the Third and Fourth Semesters under the guidance of the Research Supervisor. Students shall maintain regular interaction with the supervisor and demonstrate satisfactory progress throughout the research period. Prior to the submission of the dissertation, every student shall deliver a Pre-submission Seminar presenting the objectives, methodology, major findings, conclusions, and future scope of the research. The seminar shall provide an opportunity for critical evaluation and suggestions from the faculty for improving the quality of the dissertation.

The dissertation shall be prepared in accordance with the prescribed University guidelines and shall normally comprise 60–80 A4-size typed pages, excluding preliminary pages, bibliography, references, and appendices. The dissertation shall demonstrate originality, scientific rigor, ethical research practices, and proper citation of all sources. The use of plagiarism detection software and compliance with the University's plagiarism policy shall be mandatory. The completed dissertation, duly certified by the Research Supervisor, shall be submitted to the Head of the Department on or before the date notified by the University.

Students shall submit the prescribed number of hard-bound copies along with a soft copy and other documents as required by the University. In addition, each student shall submit five copies of an abstract of the dissertation, not exceeding 400 words (excluding the title), highlighting the objectives, methodology, major findings, and conclusions of the study. The dissertation shall be evaluated by the appointed examiners, followed by a Viva-Voce Examination conducted by a panel of examiners.

The final evaluation shall be based on the quality of the research work, scientific approach, presentation of the dissertation, seminar performance, and the student's ability to defend the research findings during the viva-voce examination.

Course Category	Title of the Course	Credits
FSN DSE – 05B	Entrepreneurship in Food and Nutrition	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Note: Examiner is requested to set the question paper of 70 marks only. Each question paper is divided into three parts, Part- A, Part B and Part C.

There shall be a Terminal Examination at the end of each Semester carrying 70 marks. The question paper shall comprise three sections **Section A, Section B and Section C.**

Section A

Section shall be of **20 marks** and consist of **10 questions** carrying **2 marks** each to be answered in approximately *20 words* each. All questions shall be compulsory. The examiner shall set the question paper choosing at least 3 questions from each unit.

Section B

Section shall be of **30 marks** and consist of **9 questions** carrying **5 marks** each to be answered in approximately *250 words* each. A Candidate shall attempt any six questions. The examiner shall set the questions ensuring that at least three questions are drawn from each Unit.

Section C

Section shall be of **20 marks** and consist of three questions carrying 10 marks each to be answered in *500 words* each. A Candidate shall attempt any two questions. The examiner shall set one question from each Unit.

Learning Objectives

At the end of the course, students will be able to:

1. Understand the concepts, principles, and scope of entrepreneurship in food and nutrition.
2. Identify business opportunities in food processing, nutrition consultancy, food service, and wellness sectors.
3. Develop entrepreneurial skills in business planning, marketing, financial management, quality assurance, and regulatory compliance.
4. Prepare a feasible business plan for a food or nutrition enterprise using innovation and sustainable business practices.

Course Outcomes

After successful completion of the course, students will be able to:

1. Explain the concepts, characteristics, and entrepreneurial opportunities in the food and nutrition sector.
2. Analyze market potential, legal requirements, food safety regulations, and financial aspects of food enterprises.
3. Design and present a viable business plan for a food, nutrition, or wellness startup with appropriate marketing and management strategies.

UNIT I

1. Concepts, need, scope, and characteristics of entrepreneurship.
2. Emerging opportunities in food processing, clinical nutrition, wellness, nutraceuticals, functional foods, organic foods, sports nutrition, community nutrition, and digital health.
3. Market research and consumer behaviour.
4. Identification of niche markets and target customers.
5. Business idea generation and opportunity assessment.
6. Business planning and Business Model Canvas.
7. Feasibility analysis, SWOT analysis, and risk assessment.

UNIT II

8. Marketing strategies, branding, and positioning.
9. Marketing mix (4Ps), digital marketing, and e-commerce.
10. Financial planning, budgeting, pricing strategies, and funding sources.
11. Food business regulations, FSSAI, licensing, and food laws.
12. Intellectual Property Rights (IPR) and business registration.
13. Business ethics and sustainable entrepreneurship.

UNIT III

14. Startup ecosystem and government support schemes.
15. Case studies of successful food and nutrition enterprises.
16. Guest lectures by entrepreneurs and industry experts.
17. Business incubation, entrepreneurship support systems, and venture funding.
18. Preparation of a comprehensive business plan.
19. Business pitch, project presentation, evaluation, and feedback.

References:

1. Hisrich, R. D., Peters, M. P., & Shepherd, D. A. *Entrepreneurship*. McGraw-Hill.

2. Desai, V. *Dynamics of Entrepreneurial Development and Management*. Himalaya Publishing House.
3. Khanka, S. S. *Entrepreneurial Development*. S. Chand & Company.
4. Kotler, P., & Keller, K. L. *Marketing Management*. Pearson.
5. Fellows, P. J. *Food Processing Technology: Principles and Practice*. Woodhead Publishing.
6. Potter, N. N., & Hotchkiss, J. H. *Food Science*. Springer.
7. Pandey, G. *Financial Management*. Vikas Publishing House.
8. Government of India. *Food Safety and Standards Act (FSSAI) Regulations*.
9. IGNOU. *Entrepreneurship and Food Service Management (MFN-007)*. (Indira Gandhi National Open University)

Course Category	Title of the Course	Credits
FSNDCC – 15	Clinical and Therapeutic Nutrition and Food Service Management Practical	Credit: 4 4Hrs/Week
Duration of Examination: 3 hrs	Max. Marks:	100
	End of Term Exam	70
	Continuous Assessment	30

Part A:

Learning Objectives

1. Develop practical skills in nutritional assessment, diet planning, therapeutic diet preparation, and dietary counseling for individuals with different health conditions.
2. Apply the principles of Medical Nutrition Therapy (MNT) in planning and evaluating diets for various clinical disorders across different age groups.
3. Demonstrate competency in institutional food service management, including menu planning, quantity food production, recipe standardization, food safety, and quality control.
4. Perform nutrition screening, documentation, and patient education using evidence-based practices and professional communication skills.
5. Integrate clinical nutrition and food service management principles to deliver efficient, safe, and nutritionally adequate food services in healthcare and institutional settings.

Course Outcomes

1. Assess the nutritional status of individuals using anthropometric, clinical, biochemical, dietary, and socioeconomic assessment methods, and formulate appropriate nutrition care plans.
2. Plan, prepare, and evaluate therapeutic diets for various disease conditions by applying the principles of Medical Nutrition Therapy (MNT) and evidence-based nutrition practice.
3. Demonstrate proficiency in nutrition counseling, patient education, diet documentation, and communication skills for effective clinical nutrition practice.
4. Apply institutional food service management principles, including quantity food production, menu planning, recipe standardization, cost control, food safety, and quality assurance.
5. Integrate clinical dietetics and food service management competencies to provide comprehensive nutrition care and efficiently manage food service operations in hospitals and other institutional settings.

Part A: Therapeutic Nutrition Practical

1. Planning and Preparation of Therapeutic Diets

Plan and prepare diets using **Food Exchange Lists** and **Food Composition Tables** with appropriate modifications for the following conditions:

a) Modification in Consistency

- Liquid diet
- Soft diet
- Semi-solid diet
- Normal diet

b) Modification in Fibre and Residue

- High-fibre diet

- Low-fibre/Low-residue diet
- c) Diet in Diarrhoea**
 - Easily digestible, low-fibre diet
 - Adequate fluids and electrolytes
- d) Diet for Peptic Ulcer**
 - Soft, non-irritating diet
 - Small, frequent meals
- e) Diet for Liver Diseases**
 - High-carbohydrate, adequate protein (unless contraindicated)
 - Controlled fat and sodium as required
- f) Diet for Obesity**
 - Calorie-restricted, balanced diet
 - High fibre and adequate protein
- g) Diet for Fevers and Infections**
 - High-protein, high-calorie diet
 - Adequate fluids and vitamins
- h) Diet for Diabetes Mellitus**
 - Insulin-dependent (Type 1)
 - Non-insulin-dependent (Type 2)
 - Controlled carbohydrate intake using exchange lists
- i) Diet for Cardiovascular Diseases**
 - Low saturated fat and cholesterol
 - Low sodium, high fibre
- j) Diet for Kidney Diseases**
 - Controlled protein, sodium, potassium, phosphorus, and fluids according to disease stage
- k) Diet for Trauma (Burns)**
 - High-protein, high-calorie diet
 - Increased vitamins and minerals for wound healing
- l) Diet for Surgery**
 - Pre-operative and post-operative diet progression
 - Adequate protein and energy for recovery

2. Market Survey of Commercial Nutritional Supplements

Conduct a survey of commercially available:

- Oral nutritional supplements (ONS)
- Enteral nutrition formulas
- Parenteral nutrition products
- Protein supplements
- Disease-specific nutritional formulas

Compare them based on:

- Brand name
- Manufacturer
- Nutrient composition
- Indications
- Cost
- Availability

3. Preparation of Diet Counselling Aids

- Diet charts
- Food exchange lists
- Food models
- Posters
- Pamphlets/Brochures

- Flip charts
- Nutrition education leaflets

4. Case Studies

Select **3–5 admitted patients** from a hospital unit and document the following:

Patient Assessment

- Personal information
- Medical diagnosis
- Clinical history
- Anthropometric measurements
- Biochemical investigations
- Clinical findings
- Dietary assessment

Nutritional Management

- Nutritional diagnosis
- Nutrient requirements
- Therapeutic diet planning
- Diet modifications during hospital stay

Follow-up

- Dietary counselling
- Patient acceptability and compliance
- Discharge diet plan
- Maintenance diet after discharge

Report Writing

Each case study should include:

1. Patient profile
2. Medical history
3. Clinical assessment
4. Nutritional assessment
5. Biochemical findings
6. Nutritional diagnosis
7. Diet prescription
8. Sample meal plan
9. Nutrition counselling
10. Outcome and follow-up
11. References

References

1. Krause's Food & the Nutrition Care Process – A comprehensive reference for clinical nutrition, medical nutrition therapy, and diet planning.
2. Williams' Essentials of Nutrition and Diet Therapy – Covers principles of therapeutic nutrition and dietary management of diseases.
3. Clinical Dietetics and Nutrition – An authoritative text on clinical nutrition and therapeutic diets.
4. Textbook of Human Nutrition – Provides a strong foundation in human nutrition and nutrient requirements.
5. Nutritive Value of Indian Foods – Standard reference for nutrient composition of Indian foods.
6. Dietary Guidelines for Indians – Evidence-based dietary recommendations for the Indian population.
7. Recommended Dietary Allowances (RDA) and Estimated Average Requirements (EAR) for Indians – Current nutrient requirement recommendations for Indians.
8. Indian Council of Medical Research publications on nutrition, food safety, and clinical dietetics.

9. National Institute of Nutrition manuals and publications on food composition, dietary guidelines, and nutrition education.

PART B: Food Service Management Practical

Learning Objectives

1. Develop practical skills in planning, organizing, and managing institutional food service operations in accordance with quality, safety, and hygiene standards.
2. Apply the principles of quantity food production, recipe standardization, menu planning, and cost control for different institutional settings.
3. Evaluate the organization, workflow, and management practices of various food service establishments through field visits and practical observations.
4. Demonstrate competency in food and beverage service, restaurant operations, catering management, and customer service practices.
5. Prepare a comprehensive project proposal for establishing and managing a food service enterprise using managerial, financial, and operational principles.

Course Outcomes

1. Evaluate the organization, infrastructure, and operational efficiency of institutional food service establishments and commercial catering units.
2. Plan, standardize, and produce quantity meals, balanced menus, and catering services while applying principles of nutrition, food safety, and cost control.
3. Demonstrate proficiency in restaurant operations, food and beverage service, tray service, breakfast service, billing procedures, and professional hospitality practices.
4. Analyze food service systems, kitchen layouts, workflow, and resource utilization to enhance operational efficiency and quality management.
5. Design a feasible food service enterprise plan, integrating menu planning, infrastructure, equipment selection, budgeting, staffing, and regulatory requirements for institutional or commercial food service operations.

Content

1. Market Survey and Product Analysis

- Conduct market surveys of processed and convenience foods.
- Evaluate product quality, packaging, labeling, pricing, and consumer acceptance.

2. Evaluation of Food Service Establishments

- Visit hospitals, hostels, hotels, industrial canteens, and other institutional food service units.
- Prepare a report on organizational structure, food production, hygiene, and service systems

3. Institutional Kitchen Planning

- Study and analyze layouts of different institutional kitchens.
- Assess workflow, equipment placement, and space utilization.

4. Quantity Food Production and Costing

- Practice quantity cooking for institutional feeding.
- Apply principles of standardized production, portion control, yield, and cost analysis.

5. Recipe Standardization

- Standardize recipes for **100, 250, and 500 servings**.
- Calculate ingredient quantities, yield, portion size, and production cost.

6. Meal Planning for Institutional Feeding

- Plan and organize balanced menus for hospitals, schools, hostels, industries, and other institutions.
- Evaluate nutritional adequacy and cost-effectiveness.

7. Industrial Catering Management

- Plan and organize food services for industrial catering.
- Develop production schedules, staffing patterns, and service plans.

8. Special Event Catering

- Plan menus and organize catering for:
 - Birthday parties
 - Mocktail parties
 - Banquets
 - Kitty parties
 - Wedding buffets

9. Menu Planning and Design

- Prepare and evaluate menus for different food service establishments and occasions.
- Apply principles of menu planning, pricing, and nutritional balance.

10. Restaurant Operations

- Study types of restaurants and restaurant organization.
- Practice restaurant etiquette, table setting, cover laying for different meal courses, napkin folding, and sideboard arrangement.

11. Beverage Preparation and Service

- Prepare and serve hot and cold beverages.
- Demonstrate standard beverage service techniques.

12. Breakfast Service

- Plan, prepare, and serve **Indian, Continental, and English breakfasts**.
- Practice appropriate table layouts and service procedures.

13. Tray Service

- Demonstrate tray setup and service for hospitals, room service, and institutional settings.

14. Restaurant Billing and Cash Handling

- Practice order taking, bill preparation, and payment procedures using standard service protocol.

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