



UNIVERSITY OF CALCUTTA

Notification No. CSR/74/2026

It is notified for information of all concerned that in terms of the provisions of Section 54 of the Calcutta University Act, 1979, (as amended), and, in the exercise of his powers under 9(6) of the said Act, the Vice-Chancellor has, by an order dated 07.07.2026, approved the new revised complete Syllabus of 4-Year Honours & Honours with Research and 3-year MDC Courses of Studies in **Food & Nutrition** under CCF, 2022 including (PO) / (CO) .

The above shall take effect from the Odd semester examinations, 2026 and onwards.

SENATE HOUSE

Kolkata-700073

08.07.2026

08/07/2026

Prof.(Dr.) Debasis Das

Registrar

SYLLABUS FOR UNDERGRADUATE MAJOR COURSE IN
FOOD AND NUTRITION UNDER NEP, 2022

Semesterwise Course Structure									
Semester	DSC/Core	Minor	IDC/MDC	AEC	SEC	CVAC	Intern ship (Either Sem2/4 /6)	Dissertation/ Research Work Or DSC- 1,2,3	Total Credit
1	1x4=4 3 Th1P/ TU	1X4=4(M1) 3T 1P/TU	1X3=3 2Th 1P/TU	1X2=2 2Th 0P/TU	1X4=4 3Th 1P/TU	2x2= 4			21
2	1x4=4 3 Th1P/ TU	1X 4=4(M1) 3Th 1P/TU	1X3=3 2Th 1P/TU	1X2=2 2Th 0P/TU	1X4= 4 3Th 1P/TU	2x2= 4	1x3 =3		21/24
3	2x4=8 (2x)3 Th 1P/TU	1X 4=4(M2) 3Th 1P/TU	1X3=3 2Th 1P/TU	1X2=2 2Th 0P/TU	1X4= 4 2Th 2P/TU				21
4	4x4=16 (4x)3 Th 1P/TU	1X 4=4(M2) 3Th 1P/TU		1X2=2 2Th 0P/TU			1x3 =3		22/25
5	4x4=16 (4x)3 Th 1P/TU	2X4=8 (M1+M2) (2 x)3Th 1P/TU							24
6	3x4=12 (3x)3 Th 1P/TU	2X4=8 (M1+M2) (2 x)3Th 1P/TU					1x3 =3		20/23
7	4x4=16 (4x)3 Th 1P/TU							1x4=4(1Th +3P) for Dist. Or (3Th+1U)For DSC-1	20
8	3x4=12 (3x)3 Th 1P/TU							1x8=8 ForDissertation Or 3Th+1TU(DSC 2) 3Th+1TU(DSC 3)	20
Credits	22x4=88	8x4=32	3x3=9	4x2=8	3x4=12	4x2=8	1x3=3	(1x4+1x8) =12	169+3 =172
Marks	22x100= 2200	8x100= 800	3x75= 225	4x50= 200	3x100 = 300	4x50 = 200	1x75 = 75 (either Sem2/4 /6)	1x100+1x200 =300 (Dist/ RW)or 1x100(DSC-1) 1x100(DSC-2) 1x100(DSC-3)	4300

Semester	Category of course	Course Title	Credits		
			Theory	practical	Total
I	DSC/Core (Major) (C-1)	Basic Food Science I	3	1	4
	SEC-1	Nutrition and Health Education	4	-	4
	Minor-1	Basic Food Science I	3	1	4
II	DSC/Core (Major) (C-2)	Basic Food Science II	3	1	4
	SEC-2	Nutritional Epidemiology & Public Health	4	-	4
	Minor-2	Basic Food Science-II	3	1	4
III	DSC/Core (Major) (C-3)	Human Nutrition I	3	1	4
	DSC/Core (Major) (C-4)	Human Physiology I	3	1	4
	SEC-3	Food Service Management	4	-	4
	Minor-1	Basic Food Science I	3	1	4
IV	DSC/Core (Major) (C-5)	Human Nutrition-II	3	1	4
	DSC/Core (Major) (C-6)	Human Physiology II	3	1	4
	DSC/Core (Major) (C-7)	Food commodities I	3	1	4
	DSC/Core (Major) (C-8)	Nutritional Biochemistry I	3	1	4
	Minor-2	Basic Food Science-II	3	1	4

V	DSC/Core (Major) (C-9)	Community Nutrition	3	1	4
	DSC/Core (Major) (C-10)	Food Commodities II	3	1	4
	DSC/Core (Major) (C-11)	Nutritional Biochemistry II	3	1	4
	DSC/Core (Major) (C-12)	Diet Therapy I	3	1	4
	Minor-3	Human Nutrition-I	3	1	4
	Minor-4	Human Nutrition -I	3	1	4
VI	DSC/Core (Major) (C-13)	Food Preservation	3	1	4
	DSC/Core (Major) (C-14)	Diet Therapy II	3	1	4
	DSC/Core (Major) (C-15)	Food Microbiology	3	1	4
	Minor -3	Human Nutrition I	3	1	4
	Minor-4	Human Nutrition II	3	1	4
VII	DSC/Core (Major) (C-16)	Maternal and Child Nutrition	3	1	4
	DSC/Core (Major) (C-17)	Entrepreneurship Development in Food Industry	3	1	4
	DSC/Core (Major) (C-18)	Geriatric Nutrition	3	1	4
	DSC/Core (Major) (C-19)	Food safety and Quality Control	3	1	4
	DSC/Core (Major) (C-20)	Diet Counseling and Patient Care	3	1	4
VIII		WITH RESEARCH			
	RM1/Core (Major)	Research Methodology 1	3	1(Tutorial)	4
	RM2/Core (Major)	Research Methodology 2	3	1	4
	RI/Core (Major)	Research Internship	3 (Project) 1 (Viva Voce)		4
	DIS/Core (Major)	Dissertation	4 (Thesis) 2 (Presentation) 2 (Viva Voce)		8
VIII		WITHOUT RESEARCH			
	RM1/Core (Major)	Research Methodology 1	3	1(Tutorial)	4
	RM2/Core (Major)	Research Methodology 2	3	1	4
	DSC/Core (Major) (C-21)	Food Fermentation	3	1	4
	DSC/Core (Major) (C-22)	Food Packaging	3	1	4
	DSC/Core (Major) (C-23)	Functional Food and Nutraceuticals	3	1	4

PROGRAMME OUTCOMES (POs)

Upon successful completion of the B.Sc. (Hons./Major) in Food and Nutrition, graduates will be able to:

PO1: Fundamental Knowledge

Demonstrate comprehensive knowledge of food science, human nutrition, physiology, biochemistry, food microbiology, dietetics, and food processing.

PO2: Scientific Reasoning

Apply scientific principles and analytical thinking to solve nutrition-, food safety-, and health-related problems.

PO3: Nutritional Assessment

Assess nutritional status using dietary, anthropometric, biochemical, and clinical methods and interpret the results appropriately.

PO4: Food Quality and Safety

Evaluate food quality, food safety hazards, quality assurance systems, and regulatory standards for consumer protection.

PO5: Diet Planning and Therapeutic Care

Plan balanced and therapeutic diets for individuals and groups across different physiological and pathological conditions.

PO6: Research and Innovation

Design, conduct, analyze, and communicate research in food science and nutrition using appropriate methodologies and statistical tools.

PO7: Community Engagement

Develop, implement, and evaluate nutrition education and community nutrition intervention programmes for public health improvement.

PO8: Entrepreneurship and Professional Skills

Apply entrepreneurial, managerial, communication, and leadership skills in food industries, healthcare institutions, and community settings.

PO9: Lifelong Learning

Engage in lifelong learning and adapt to emerging developments in food science, nutrition, functional foods, and health sciences.

PO10: Ethics and Sustainability

Demonstrate ethical conduct, professional responsibility, environmental awareness, and commitment to sustainable food systems.

FIRST SEMESTER

DSC/Core(Major)-C1-TH:BASIC FOOD SCIENCE-I

3 CREDITS

COURSE OUTCOMES (COs)

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

CO1: Explain the concepts of food, nutrition, nutrients, and food classification.

CO2: Describe the structure, properties, digestion, absorption, and functions of carbohydrates.

CO3: Explain lipid chemistry, fatty acids, and their nutritional significance.

CO4: Analyse protein structure, quality evaluation, digestion, absorption, and bioavailability.

CO5: Discuss the composition, sources, and physiological significance of dietary fibre.

1. Basic concept of Food, Nutrition and Nutrients. Classification of Food, Classification of Nutrients.
2. Carbohydrates-Definition, Classification, Structure and properties.
Monosaccharides - glucose, fructose, galactose.

Disaccharides-Maltose,lactose, sucrose

Polysaccharides-Dextrin,starch,glycogen,resistantstarch.

Carbohydrates- Sources, dailyrequirements, functions. Effects of too high and too low carbohydrates on health. Digestion and absorption of carbohydrate.

3. Lipids-Definition, Classification & Properties. Fatty acids- composition, properties, types. Lipids-sources, dailyrequirements, functions .Digestion &Absorptionof nutrients. Role & nutritional significances of PUFA, MUFA, SFA, W-3fatty acid.
4. Proteins-Definition,Classification,Structure&properties.AminoacidsClassification,types, functions. Proteins - Sources, dailyrequirements, functions. Effect of too high- too low proteins on health. Digestion & absorption. Assessment ofProtein quality (BV, PER, NPU). Factors affecting protein bio-availability including anti-nutritional factors.
5. Dietary Fibre-Classification, sources, composition, properties & nutritional significance.

DSC/Core (Major)C1-P:BASIC FOOD SCIENCE-I (PRACTICAL)1CREDIT

1. Identification of Mono, Di and polysaccharides
2. Identification of Proteins
3. Identification of glycerol

SEC1- TH: NUTRITION AND HEALTH EDUCATION

4 CREDITS

COURSE OUTCOMES (COs)

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

CO1: Explain concepts and principles of nutrition and health education.

CO2: Identify target groups and educational needs in the community.

CO3: Apply communication methods and educational tools in nutrition programmes.

CO4: Plan nutrition and health education interventions.

CO5: Evaluate the effectiveness of nutrition education programmes.

1. Concept, objectives and importance of nutrition and health education.
2. Principles of conducting nutrition and health education.
3. Nutrition Educators'-criteria. Target groups for Nutrition and Health education: Infants, preschooler, school children, adults, and elderly.
4. Nutrition and health education communication process.
5. Steps in planning health and nutrition education.
6. Channels for nutrition education in the community
7. Methods involved in nutrition and health education

8. Barriers & Evaluation of nutrition and health education programmes

SECOND SEMESTER

DSC/Core(Major)C-2-TH: BASIC FOOD SCIENCE-II

3CREDITS

COURSE OUTCOMES (COs)

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

CO1: Explain biochemical and physiological functions of major minerals and trace elements.

CO2: Describe the role, sources, requirements, and deficiency manifestations of vitamins.

CO3: Explain water balance and physiological functions of water.

CO4: Assess nutritional implications of nutrient deficiencies and excesses.

CO5: Perform basic nutrient estimation techniques in foods.

1. Minerals & Trace Elements, Bio-Chemical and Physiological Role, bio-availability & requirements, sources, deficiency & excess (Calcium, Sodium, Potassium Phosphorus, Iron, Fluoride, Zinc, Selenium, Iodine, Chromium)

2. Vitamins - Biochemical and Physiological role, Bio-availability and requirements, sources, deficiency & excess (Fat soluble and water-soluble vitamins), Provitamin, Antivitamin, Pseudo vitamin and Vitamers.

3. Water-Functions, daily requirements, Effect of excess and deficiency. Water balance.

DSC/Core(Major) C-2-P: BASIC FOOD SCIENCE-II(PRACTICAL)1CREDIT

1. Determination of Ash content in food
2. Determination of Moisture content in food
3. Determination of calcium, iron, and Vitamin C content in foods.

SEC2-TH: NUTRITIONAL EPIDEMIOLOGY & PUBLIC HEALTH

4 CREDITS

COURSE OUTCOMES (COs)

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

CO1: Explain determinants and indicators of health.

CO2: Apply epidemiological concepts and study designs in public health investigations.

CO3: Interpret community health statistics and demographic indicators.

CO4: Describe immunization programmes and disease prevention strategies.

CO5: Analyse public health hazards related to food, water, and communicable diseases.

1. Definition of Health, Dimension of Health: Positive health versus Absence of disease, Determinants of Health, Indicators of health – Mortality, Morbidity, Disability, Nutritional Status, Health care Delivery, Environmental, Socioeconomics, Health care Policy

2. Epidemiology: Definition, Aims, Tools of Measurement – Rates, Ratios and Proportions. Study designs in epidemiology, Descriptive epidemiology, Analytical epidemiology, Data Collection and sources of data.
3. Secondary Sources of Community Health data: Sources of relevant vital statistics of infant, child & maternal mortality rates, Under- 5 mortality, Birth Rate, Crude death rate.
4. Immunization: Importance and National Immunization schedule for children and adults
5. Water and Waste Management: Importance of water to the community, etiology and effects of toxic agents, water borne infectious agents like Viral (Viral hepatitis, rotavirus diarrhea); Bacterial (Bacillary dysentery, Cholera); protozoal (Amoebiasis); Helminthic (Roundworm). Sources of water, safe drinking water, potable water, waste and waste disposal, sewage disposal and treatment, solid waste and disposal, liquid waste disposal.
6. Communicable and infective disease control: Nature of communicable and infectious diseases (Measles, Influenza, Tuberculosis, Dengue, SARS), infection, contamination, disinfections, decontamination, transmission-direct & indirect, vector borne disease (Malaria, Typhoid, Hookworm infestation, Chikungunya fever) infecting organisms and positive agents, environmental agents and epidemiological principles of disease control.
7. Public health hazards due to contaminated foods: Food borne infections (Botulism, Salmonellosis, Shigellosis, Staphylococcal intoxication) and intoxications (Lathyrism, Aflatoxicosis, Mercury poisoning and pesticide residue DDT poisoning): symptoms, mode of transmission and methods of prevention.

THIRD SEMESTER

DSC/Core (Major) C-3-TH: HUMAN NUTRITION-I

3 CREDITS

COURSE OUTCOMES (COs)

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

- CO1:** Explain concepts of nutrition, malnutrition, and health.
- CO2:** Calculate energy requirements using RDA and nutritional guidelines.
- CO3:** Describe growth and development from infancy to adulthood.
- CO4:** Assess factors affecting growth and nutritional status.
- CO5:** Apply growth monitoring techniques using standard growth charts.

1. Concept and definition of terms-Nutrition, Malnutrition and Health: Scope of Nutrition.
2. Minimum Nutritional Requirement and RDA: formulation of RDA and Dietary Guidelines Reference Man and Reference Woman, Adult consumption unit.
3. Energy in Human Nutrition: Idea of Energy and its unit, Energy Balance, Assessment of Energy Requirements—deficiency and excess, Determination of Energy in food, B.M.R. and its regulation, S.D.A.
4. Growth & Development from infancy to adulthood: Somatic, physical, brain and mental development, puberty, menarch, pre-pubertal and pubertal changes, Factors affecting growth and development. Importance of Nutrition for ensuring adequate development.

5. Growth monitoring and promotion: Use of growth charts and standards, Prevention of growth faltering

DSC/Core(Major)C-3-P: HUMAN NUTRITION-I (PRACTICAL)1CREDIT

1. Process involved in cooking: pressure cooking, microwave, steaming, grilling, deep fat frying.
2. General concepts of weights and measures. Eye estimation of raw and cooked foods.
3. Preparation of food from different food groups and their significance in relation to health.
4. Preparation of supplementary food for different age group and their nutritional significance.
5. Planning and preparation of low-cost diet for Grade I and Grade II malnourished child

DSC/Core(Major)C-4-TH:HUMAN PHYSIOLOGY-I

3 CREDITS

COURSE OUTCOMES (COs)

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

CO1: Describe structure and functions of cells and cellular organelles.

CO2: Explain digestive processes and nutrient absorption.

CO3: Analyse blood composition and cardiovascular functions.

CO4: Describe respiratory physiology and gaseous exchange.

CO5: Explain musculoskeletal functions and body composition.

1. Overview of cell Biology • Structure and functions of animal cell with special reference to Plasma membrane (Fluid Mosaic Model), Mitochondria, Ribosome, Endoplasmic reticulum. Nucleus (nuclear membrane, nuclear chromatin and nucleolus).
2. Digestive system: • Structure and functions of G.I. tract. • Structure and functions of Stomach, liver, gallbladder and pancreas. • Composition and function: Salivary juice, Gastric juice, Pancreatic juice, Bile juice and Intestinal juice. • Digestion and absorption of carbohydrates, Protein and fats • Gastrointestinal hormones
3. Circulatory and Cardiovascular system: • Blood components, Plasma Protein -Composition and Function, Blood groups • Erythropoiesis and factors controlling erythropoiesis, Mechanism of blood coagulation. • Structure and functions of heart. • Cardiac cycle, cardiac output, Blood pressure and its regulation, Hypertension.
4. Respiratory system: • Structure of Lungs and gaseous exchange (oxygen and carbon dioxide transport), Brief idea on Acclimatization.
5. Musculoskeletal System: • Types and functions of muscles, bones (osteoclasts and osteoblasts) and teeth (Brief idea).
6. Body composition: • Generalized structural makeup of human body

DSC/Core(Major) C-4-P:HUMANPHYSIOLOGY-I (PRACTICAL)1CREDIT

1. TheCompoundMicroscope-parts,function
2. PeakExpiratoryFlowRate(PEFR)usingPeakflowmeter
3. Cardiac Efficiency test, Effect of Posture, Gravity and Muscular Exercise on Heart Rate
4. Squamousepithelialcells-preparationoffilmandstaining

SEC-3-TH:FOOD SERVICE MANAGEMENT

4 CREDITS

COURSE OUTCOMES (COs)

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

CO1: Explain principles and organization of food service systems.

CO2: Design food service layouts and workflow patterns.

CO3: Plan menus for institutional food service operations.

CO4: Apply sanitation and hygiene principles in food establishments.

CO5: Demonstrate personnel management and supervisory skills.

1. Organizationoffoodservicemanagement:Definition,VarioustypesofFood

Service institutions, their characteristics and functions.

2. Planning a food service unit, layout design, planning of different work areas–preparation, cleaning, storing, serving and dining areas. Lighting and ventilation, working heights in relation to equipment.

3. Institutional Menu Planning : Factors influencing menu planning, principles of menu planning, different kinds of menus.

4. Quality food Service–types-Centralized, de-centralized objectives. Types of service (Silver service, American service, French service, Russian service, Self service).

5. Importance of sanitation and hygiene in food, kitchen hygiene, Hygienic handling of Food, employee's health, hygiene of food service unit.

6. Personnel Management-selection, training and supervision of personnel, criteria for selection of Dietitian and Food Service staff

FOURTHSEMESTER

DSC/Core(Major)C-5-TH: HUMAN NUTRITION-II

3 CREDITS

COURSE OUTCOMES (COs)

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

CO1: Explain nutritional requirements during pregnancy and lactation.

CO2: Describe infant feeding and weaning practices.

CO3: Assess nutritional needs of children and adolescents.

CO4: Plan diets for different physiological stages.

CO5: Manage common nutritional problems during pregnancy and infancy.

1. Nutrition During Pregnancy: Factors (non-nutritional) affecting pregnancy outcome, importance of adequate weight gain during pregnancy, antenatal care and its schedule, Nutritional requirements during pregnancy and modification of existing diet and supplementation, Deficiency of nutrients, specially energy, iron folic acid, protein, calcium, iodine. Common problems of pregnancy and their managements, specially -nausea, vomiting, pica, food aversions, pregnancy induced hypertension, obesity, diabetes. Adolescent pregnancy.

2. Nutrition during Lactation: Nutritional requirements during lactation, dietary management, food supplements, galactogogues, preparation for lactation. Care and preparation of nipples during breast feeding.

3. Nutrition during Infancy: Infant physiology relevant to feeding and care, Breast feeding colostrum, its composition and importance in feeding, Initiations of breast feeding. Advantages of exclusive breast feeding. Basic principles of breast feeding. Introduction of supplementary foods, initiation and management of weaning, Baby-led weaning. Bottle feeding-circumstances under which bottle feeding is to be given. Care & sterilization of bottles. Preparation of formula. Mixed feeding, breast feeding and artificial feeding.

4. Management of pre-term and low birth weight babies.

5. Nutritional needs of toddlers, preschool, school going children-and adolescents- Dietary management

DSC/Core(Major)C-5-P:HUMAN NUTRITION-II(PRACTICAL) 1 CREDIT

Planning and preparation of adequate meal for different age groups with special reference to different physiological conditions: infants, preschooler, school children, adolescents, adults, pregnancy, lactation and old age.

DSC/Core(Major)C-6-TH:HUMAN PHYSIOLOGY-II 3 CREDITS

COURSE OUTCOMES (COs)

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

CO1: Explain structure and functions of nervous and endocrine systems.

CO2: Describe hormonal regulation of body processes.

CO3: Explain reproductive physiology and associated processes.

CO4: Describe kidney functions and urine formation.

CO5: Explain thermoregulation and skin physiology.

1. Nervous System: • Concept of sympathetic and parasympathetic nervous system. • Brief anatomy and functions of cerebrum, cerebellum, hypothalamus and neuron • Concept on synapse and synaptic transmission

2. Endocrine system: Types of hormones • Location, anatomy, functional morphology and hormones of pituitary, thyroid and adrenal gland. • Structure and functions of pancreas • Functions of parathyroid, hypothalamic hormones

3. Reproductive system: • Structure and functions of gonads, concept on menstrual cycle. • Brief idea of pregnancy, parturition, lactation and menopause. • Brief concept on spermatogenesis and Oogenesis process.

4. Excretory system: • Structure and functions of kidney- structure of nephron. endocrine function of kidney • Physiology of urine formation • Structure and function of skin. • Regulation of temperature of the body.

DSC/Core(Major) C-6-P:HUMANPHYSIOLOGY-II(PRACTICAL) 1CREDIT

1. Preparing a Peripheral Blood Film- Staining with Leishman stain, Identification of different types of WBCs

2. Identification of tissues, with two characteristics of each – lungs, small intestine, pancreas, liver, kidney,

3. Recording of Systemic Arterial Blood Pressure

4. Effect of Posture, Gravity, and Muscular Exercise on Blood Pressure

DSC/Core(Major) C-7-TH:FOOD COMMODITIES-I 3 CREDITS

COURSE OUTCOMES (COs)

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

CO1: Classify major food commodities and their nutritional importance.

CO2: Evaluate processing, storage, and quality characteristics of cereals, pulses, milk, eggs, meat, fish, fruits, and vegetables.

CO3: Identify factors affecting food quality and shelf life.

CO4: Assess nutritional value and cost considerations of food commodities.

CO5: Perform quality evaluation and adulteration detection tests.

1. Cereals and Millets: Structure, processing, storage, use in various preparation, variety, selection and cost. Cereal products, breakfast cereals, fast food.

2. Pulses and Legumes: Structures, Selection and variety. Storage, Processing and use in different preparations, Nutritional aspects and cost.

3. Milk and Milk products: Composition, Classification, Selection Quality and Cost, Processing, Storage and uses in different preparations, Nutritional aspects, shelf life and spoilage.

4. Eggs: Production, grade, quality selection, storage and spoilage, cost nutritional aspects and use in different preparations.

4. Meat, Fish and Poultry: Types, Selection, Purchase, Storage, Uses, preparations Cost, Spoilage of fish Poultry and meat.
5. Vegetables and Fruits: Variety, Selection, purchase, storage, availability causes and nutritional aspects of raw and processed products and use in different preparations.

DSC/Core(Major)C-7-P:FOODCOMMODITIES-I(PRACTICAL)1CREDIT

1. Estimation of gluten content in cereal products
2. Detection of urea in puffed rice
3. Determination of hydration capacity and swelling index of pulses and legumes
4. Evaluation of cooking time and texture on pulses and legumes.
5. Detection of Khesari flour in besan
6. Determination of Specific gravity (Lactometer test), Acidity, pH in milk
7. Detection of starch, sucrose, formalin, boric acid, and urea in milk
8. Effect of acid and alkali on milk proteins
9. Candling of eggs
10. Determination of the freshness of an egg by the floatation test
11. Study of functional properties in Egg: Emulsification, Coagulation, Foaming properties
12. Effects of Heat, acid, alkali and metals on pigments of fruits and vegetables
13. Methods to prevent enzymatic browning using salt, sugar, Ascorbic acid, lemon juice in fruits and vegetables

DSC/Core(Major)C-8-TH:NUTRITIONALBIOCHEMISTRY-I 3 CREDITS

COURSE OUTCOMES (COs)

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

CO1: Explain biomolecules and their biological functions.

CO2: Describe enzyme kinetics and factors affecting enzyme activity.

CO3: Explain carbohydrate metabolism and energy production.

CO4: Describe lipid metabolism and related disorders.

CO5: Apply biochemical techniques for analysis of carbohydrates and lipids.

1. Biomolecules: Types of biomolecules- Carbohydrates, lipids, amino acids, proteins and nucleic acids. Digestion and absorption of biomolecules.
2. Enzymes : Definition, types and classification of enzymes, Types and functions of coenzymes and cofactors, Specificity of enzymes, Isozymes, Enzyme kinetics study including factors affecting enzyme action, Velocity of enzyme catalyzed reactions, Regulations of enzyme activity, Zymogen, Allosteric enzymes, Enzyme inhibition.
3. Carbohydrates and their Metabolism: Classification, structure and physico-chemical properties, Metabolisms of carbohydrates and Energy production: Glycolysis, Citric acid cycle, Glycogenesis, Glycogenolysis, Gluconeogenesis, Hexose monophosphate shunt pathway.
4. Lipids and their Metabolism : Classification, structure and physico-chemical properties, Metabolic Oxidation of fatty acids and Energy production, Biosynthesis of fatty acids and ketone bodies, Ketosis and fatty livers, Essential Fatty acids, Cholesterol and its clinical

significance.

DSC/Core(Major)C-8-P:NUTRITIONAL BIOCHEMISTRY –I (PRACTICAL)1 CREDIT

1. Determination of Enzyme activity and study on effect of pH, Temperature, Substrate and Enzyme concentration on Enzyme activity: Amylase
2. Quantitative estimation of Sugars: Glucose, Lactose, Starch
3. Estimation of Acid value, Iodine value, Saponification value, Peroxide Value of fats
4. Estimation of serum Glucose
5. Estimation of serum Triglyceride, Cholesterol

DSC/Core(Major) C-9-TH:COMMUNITY NUTRITION

3 CREDITS

COURSE OUTCOMES (COs)

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

CO1: Explain concepts and determinants of community nutrition.

CO2: Conduct nutritional assessment using anthropometric, biochemical, and clinical methods.

CO3: Perform dietary surveys and interpret nutritional data.

CO4: Assess nutritional deficiencies and growth patterns.

CO5: Evaluate national and international nutrition programmes.

1. Concept of Community, types of Community, Factors affecting health of the Community.
2. Nutritional Assessment and Surveillance: Meaning, need, objectives and importance
3. Nutritional assessment of human: Clinical findings, nutritional anthropometry, biochemical tests, biophysical methods.
4. Diet survey: Need and importance, methods of dietary survey, Interpretation - concept of consumption unit, individual and total distribution of food in family, adequacy of diet in respect to RDA, concept of family food security.
5. Clinical Signs: Need & Importance's, identifying signs of PEM, Classification of PEM, Classification based on IAP, clinical sign of SAM and MAM children. Management Guideline in NRC, Prevention –POSHAN 2.0
6. vitamin A deficiency and iodine deficiency, Iron deficiency. Interpretation of descriptive list of clinical signs.
7. Nutritional anthropometry :Need and importance, standard for reference, techniques of measuring height, weight, head, chest and arm circumference, interpretation of these measurements. Use of growth chart.
8. International, national, regional agencies and organizations. Nutritional intervention programmes to combat malnutrition.

DSC/Core(Major)C-9-P: COMMUNITY NUTRITION (PRACTICAL) 1 CREDIT

1. Anthropometric Measurement of infant - Length, weight, circumference of chest, mid-

upper arm circumference, precautions to be taken.

2. Comparison with norms and interpretation of the nutritional assessment data and its significance. Weight forage, height forage, weight for height, Body Mass Index (BMI), Waist-Hip Ratio (WHR), Skinfold thickness.

3. Growth charts-plotting of growth charts, growth monitoring and promotion.

4. Clinical assessment and signs of nutrient deficiencies specially PEM (Kwashiorkor, marasmus) I vitamin A deficiencies, Anaemia, Rickets, B-Complex deficiencies.

5. Estimation of food and nutrient intake: Household food consumption data, adult consumption unit, 24 hours dietary recall 24 hours record, Weighment method, food diaries, food frequency data, use of each of the above, information available through each individual, collection of data, estimation of intakes. Interpretation of data.

DSC/Core(Major) C-10-TH:FOOD COMMODITIES-II

3 CREDITS

COURSE OUTCOMES (COs)

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

CO1: Explain characteristics and uses of sugars, fats, oils, spices, and beverages.

CO2: Evaluate food adjuncts and convenience foods.

CO3: Assess quality and storage characteristics of food commodities.

CO4: Detect common adulterants in food products.

CO5: Perform laboratory evaluation of selected food commodities.

1. Sugar and sugar Products: Types of natural, sweeteners, manufacture, selection, storage and use as preserves, stages in sugar cookery.

2. Fats and Oils: Types and sources (animal and vegetable), Processing, uses in different preparations, storage, cost and nutritional aspects.

3. Food Adjuncts: Spices, condiments, herbs, extracts; concentrates essences, food colours, origin, classification, description, uses, specifications, procurements and storage.

4. Beverages: Tea; Coffee. Chocolate and Cocoa Powder-Processing, cost and nutritional aspects, other beverages-Aerated beverages, juices.

5. Raising and Leavening agents: Types, constituents, uses in cookery and bakery, storage.

6. Convenience Foods: Role, types, advantages, uses, cost and contribution to diet.

7. Salt: Types and uses.

DSC/Core(Major) C-10-P:FOOD COMMODITIES-II (PRACTICAL)

1 CREDIT

1. Estimation of sugars, TSS in Degree Brix

2. Estimation of Total solids in Jams and Jellies

3. Detection of Metanil yellow in coloured sweet products
4. Detection of Argemone oil in edible oil
5. Detection of Vanaspati in Ghee/Butter
6. Detection of artificially colour/foreign matter in tea (dust/leaves)
7. Detection of Metanil yellow in turmeric powder
8. Detection of Adulterants in spices (Cumin seed powder, chilli powder)
9. Determination of Smoke point, Melting point for Fats and Oils
10. Study of food colour stability of Spices, Condiments, and herbs under heating
11. Determination of Total Soluble Solids (TSS) in fruit juices
12. Detection of iodine in iodized salt
13. Osmosis experiment using salt solutions

DSC/Core(Major)C-11-TH: NUTRITIONAL BIOCHEMISTRY-II 3CREDITS

COURSE OUTCOMES (COs)

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

CO1: Explain molecular transport mechanisms across biological membranes.

CO2: Describe nucleic acid structure, replication, transcription, and translation.

CO3: Explain amino acid metabolism and protein biochemistry.

CO4: Analyse biochemical roles of vitamins and minerals.

CO5: Apply biochemical laboratory methods for nutrient estimation.

1. Transport of Biomolecules: Brief introduction of biological membranes to understand molecular transport, Transport of large molecules, Receptor mediated endocytosis, exocytosis, Molecular aspects of transport; Passive diffusion, facilitated diffusion, active transport.

2. Nucleic acids, Nucleotides and their Metabolisms :Nucleic acids, nucleotides and nucleosides- Classification, structure and functions, Structure of DNA and RNA, Types of RNA and their functions, DNA: replication, transcription and translation, Role of nucleic acids in protein synthesis, elementary knowledge of genetic code.

3. Proteins and amino acids :Classification, structure and physico-chemical properties, General reaction of amino acid metabolism, Urea cycle, Lipoproteins: Types, composition, role and significance in diseases (in brief).

4. Vitamins and Minerals :Chemistry and biochemical role of fat-soluble vitamins (A, D, E, K) and Water-soluble vitamins (B1, B2, B3, B6 and C), Role of Vitamins as antioxidants and cofactors, Biochemical role of minerals in biological system and their importance – Sodium, Potassium, Calcium, Phosphorus, Iron, Iodine, Copper, Zinc, Manganese.

DSC/Core(Major)C-11-P:NUTRITIONAL BIOCHEMISTRY-II (PRACTICAL) 1 CREDIT

1. Study of Diffusion through a Semi-permeable Membrane
2. Effect of Solute Concentration on Osmotic Pressure
3. Qualitative analysis of amino acids
4. Study on the properties of proteins
5. Quantitative estimation of protein by Lowry and Biuret methods
6. Qualitative Test for DNA and RNA
7. Estimation of serum Creatinine and Urea
8. Estimation of Vitamin C
9. Detection of Riboflavin (Vitamin B2) by Fluorescence Test
10. Estimation of serum Calcium, Magnesium, Zinc, Copper

DSC/Core(Major)C-12-TH:DIET THERAPY-I

3 CREDITS

COURSE OUTCOMES (COs)

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

CO1: Explain principles of diet therapy and therapeutic diets.

CO2: Assess patient nutritional needs and hospital diets.

CO3: Plan diets for gastrointestinal and liver disorders.

CO4: Formulate dietary interventions for anaemia and febrile diseases.

CO5: Prepare therapeutic diets for specific disease conditions.

1. Basic concepts of diet therapy: Definition, objectives and principles of diet therapy.
2. Team approach to healthcare. Assessment of Patient's needs.
3. Modification of normal diet into therapeutic diets. Routine Hospital Diets: Regular, light, soft, fluid diet, parenteral and enteral feeding.
4. Metabolic changes in acute and chronic fever. Diets for different febrile conditions: influenza, malaria, dengue, typhoid and tuberculosis.
5. Etiological factors, symptoms, and management of common diseases of stomach-Gastritis and Peptic ulcer.
6. Etiology, symptoms, and management of intestinal diseases: Diarrhoea, steatorrhoea, Diverticular disease, inflammatory bowel disease, Ulcerative Colitis, Flatulence, Constipation, Irritable Bowel Syndrome, Celiac disease and lactose intolerance.
7. Diseases of the liver and Biliary System: Liver function tests. Etiology, symptoms, dietary care and general management of Viral Hepatitis and Cirrhosis of liver. Dietary care and management of Gall Bladder diseases –Cholecystitis and Cholelithiasis.
8. Anemia: General concept, etiology, classification, and dietary management of Nutritional anemia.

DSC/Core (Major)C-12-P: DIET THERAPY-I(PRACTICAL)

1 CREDIT

1. Planning and preparation of normal diets.
2. Planning and preparation of fluid diets.
3. Planning and preparation of soft/semisolid diets.
4. Planning and preparation of Diets for the following diseases:
 - i) Peptic ulcer
 - ii) Viral hepatitis
 - iii) Anemia

SIXTH SEMESTER

DSC/Core(Major)C-13-TH: FOOD PRESERVATION

3 CREDITS

COURSE OUTCOMES (COs)

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

CO1: Explain principles and methods of food preservation.

CO2: Compare preservation techniques and their applications.

CO3: Describe processing of fruits and vegetable products.

CO4: Explain food standards and regulatory requirements.

CO5: Prepare preserved food products using standard procedures.

1. Introduction of Food preservation: definition, objectives and principles of food preservation. Scopes of fruit and vegetable preservation in India.
2. Principles and methods of food preservation: Principles of preservation, Methods of preservations and their advantages& disadvantages: High temperature; low temperature-sharp freezing, quick freezing, Cryogenic freezing; Preservation by - Chemicals, Drying, Filtration, Carbonation, Sugar, Fermentation, Salt, acids, Oil and spices, Antibiotics, Irradiation.
3. Canning and bottling of fruits and vegetables and their principles.
4. Enzymes in the Food industry: Important properties of enzymes in fruit and vegetable technology, Enzymes used in food industry, immobilized enzymes
5. Preserved Products: Method of preparation of Jam, Jelly, Marmalade. Problems in jam production, important considerations in jelly making like –pectin, acid, sugar, judgement of end point. Sauces, Pickles, Squashes, Syrups-types, composition, Preparation and Processing, selection, storage, uses and nutritional aspects.
6. Food Standards: ISI, Agmark, FPO, MPO, PFA, FSSAI, MFPO

DSC/Core(Major)C-13-P: FOOD PRESERVATION (PRACTICAL) 1 CREDIT

1. Different methods of Food preservation–Drying, Freezing, Frying, canning, bottling etc.
2. Aseptic handling : Sources of contamination of foods.
3. Preparation of Pickles, Tomato sauce, Jam, Jelly, Tomato puree, Squashes, RTS etc.

4. Visit to Food Processing Industries: Observe various preservation techniques, quality assurance and quality control procedures and Report Writing

DSC/Core(Major)C-14-TH:DIET THERAPY-II

3 CREDITS

COURSE OUTCOMES (COs)

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

CO1: Explain dietary management of obesity and underweight.

CO2: Plan nutrition therapy for diabetes mellitus.

CO3: Formulate diets for cardiovascular diseases and hypertension.

CO4: Plan therapeutic diets for renal disorders and gout.

CO5: Apply evidence-based nutrition interventions in chronic diseases.

1. Energy modifications and nutritional care for weight management:Assessment,etiology, complications, prevention and treatment of obesity and underweight
2. Diet in disease of the endocrine pancreas: Diabetes Mellitus: Classification, symptoms, diagnosis, management -insulin therapy, oral hypoglycemic agents, glucose monitoring at home, dietary care and nutrition therapy, meal plan (with and without insulin), special diabetic foods and artificial sweeteners.
3. Hypertension: classification, etiology, symptoms and dietary management-DASH Diet,Sodium restriction<200mg. Diseases of the cardiovascular system: Definition of infarct, ischemia, angina pectoris, myocardial infarction, heart attack and stroke. Atherosclerosis and hyperlipidemia – classification, symptoms, dietary management-Fat modifications,SFA, MUFA, PUFA, trans fat,omega 3, Mediterranean diet and lifestyle management.Congestive heart failure-sodium and fluid restriction. Prevention of cardiovascular diseases.
4. Renal Diseases: Etiology, symptoms and dietary management of acute and chronic Glomerulonephritis. Nephrotic syndrome,CKD,Uremia. Nephrolithiasis(Renal stone)–Types, etiology and dietary management. Use of sodium and potassium exchange list.
5. Gout: Etiology,symptoms and dietary management.

DSC/Core(Major) C-14-P:DIET THERAPY-II(PRACTICAL)

1 CREDIT

Planning and preparation of Diets for the following diseases:

- i) Obesity and Under weight
- ii) Diabetes mellitus
- iii) Hypertension and Atherosclerosis
- iv) Acute and chronic glomerulonephritis

COURSE OUTCOMES (COs)

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

CO1: Explain food microorganisms and factors affecting microbial growth.

CO2: Describe cultivation and isolation techniques.

CO3: Apply methods for microbial control in foods.

CO4: Identify microorganisms involved in food spoilage.

CO5: Perform microbiological analyses of food and water samples.

1. Food and Microorganisms: Brief history and scope of food microbiology, important microorganisms in foods – Bacteria, Yeast, Mold, Factors affecting the growth of microorganisms in food: Extrinsic and intrinsic parameters.
2. Cultivation of microorganisms: Nutritional requirements of microbial growth, Types of media, Methods of isolation, Bacterial growth curve.
3. Control of growth of microorganism: Physical methods for removal of microbes - heat, irradiation, filtration, Chemical methods for removal of microbes - alcohol, aldehydes, dyes, halogens, phenols, gases, Primary sources of micro organisms in foods, Fundamental methods for control of microorganism in foods – Pasteurization, dehydration, freezing, freeze-drying, irradiation and preservatives.
4. Spoilage and contamination of different foods: Cereal and cereal products, vegetable and fruits, fish and sea foods, meat and meat products, eggs and poultry, milk and milk products, canned foods.

DSC/Core(Major) C-15-P:FOOD MICROBIOLOGY (PRACTICAL) 1CREDIT

1. Study of apparatus used in microbiology lab: Compound Microscope, Autoclave, Inoculation Chamber, Incubator
2. Microscopic identification of microbes: Fungi, Bacteria, Yeast
3. Preparation of liquid and solid media for culture of microorganisms
4. Pure culture isolation techniques: Spread plate, Pour plate and Streak plate
5. Staining Techniques to study of Morphology of microbial cells: Simple staining of bacteria, yeast and fungi, Differential staining with Gram stain technique
6. Microbial Examination of Milk: Methylene Blue Reduction Test (MBRT)
7. Microbial Examination of Water: IMViC Test
8. Visit to Dairy Processing Unit: Observation of pasteurization techniques and Report Writing
9. Visit to Food Processing Industries/Laboratory: Observation of Hygienic practices and sanitation and Report Writing

SEVENTH SEMESTER**DSC/Core (Major) C-16-TH:MATERNAL AND CHILD NUTRITION 3 CREDITS****COURSE OUTCOMES (COs)**

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

- CO1:** Explain physiological and nutritional aspects of pregnancy and lactation.
CO2: Assess nutritional needs of infants and young children.
CO3: Identify and manage childhood malnutrition and micronutrient deficiencies.
CO4: Plan balanced diets for maternal and child health.
CO5: Conduct growth monitoring and nutrition counselling.

1. Maternal Nutrition(Pregnancy and Lactation):
 - i) Physiological changes: Metabolic adaptation, weight gain recommendation, Hormonal changes. Role of Nutrition during Pregnancy: Regulation of nutrient supply to the foetus. The energy cost of Pregnancy. Birth Weight- the effect of maternal age, maternal weight and energy intake. Nutrient requirements during pregnancy. High risk pregnancy: Management of Adolescence pregnancy, Gestational diabetes, pregnancy induced hypertension and anemia. Lifestyle factors that impact on pregnancy outcome
 - ii) Lactation and breast feeding: Hormonal regulation of milk production and secretion, let down reflex, Role of Nutrition during Lactation: Compositions of breast milk and implications of maternal nutrition. Energy conversion from food energy to milk energy during lactation. Factors improving lactation performance- Breast feeding techniques and benefits.
2. Infant and young child nutrition: Plotting and interpretation of WHO growth chart to track stunting and wasting. Pediatric micronutrient deficiencies: Vitamin-A, Iron, Zinc, Iodine
3. Child Nutrition: Nutritional requirement during preschool age with special emphasis to support brain development. Causes and nutritional management of growth faltering, SAM and MAM children – diagnosis, nutritional care and rehabilitation, obesity.
4. Nutrition for school age: Growth spurt, RDA, Importance of breakfast, school lunch and tiffin. Problems and management: Obesity, underweight, skipping meals, junk food.
5. Nutrition for adolescent: Puberty, growth spurt, increased nutrient need. Anaemia in adolescent girls. Iron and Calcium needs of adolescent. Eating disorders, obesity, PCOS. Nutrition education for adolescent.

DSC/Core(Major) C-16-P: MATERNAL AND CHILD NUTRITION(PRACTICAL) 1 CREDIT

1. Anthropometric assessment of infants, children, pregnant and lactating women.
2. Homemade cereal mix for infants, Millet based weaning food
3. Diet Planning and preparation: Calculation of nutrient needs and balanced diet for Pregnant women-2nd and 3rd trimester, Calculation of nutrient needs and balanced diet for lactating women-0-6 months and 6-12 months.
4. Complementary food preparation: cereal, pulse, millets, malted ragi, etc.
5. Low-cost weaning mixes.
6. Breastfeeding counseling: role play, position and attachment demo using dolls.

DSC/Core (Major) C-17-TH: ENTREPRENEURSHIP DEVELOPMENT IN FOOD INDUSTRY 3 CREDITS

COURSE OUTCOMES (COs)

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

- CO1:** Explain entrepreneurship concepts and opportunities in food industries.
CO2: Identify viable food-based business opportunities.
CO3: Prepare business plans and feasibility reports.
CO4: Apply legal, regulatory, and financial requirements for food enterprises.
CO5: Develop sustainable and innovative food business models.

1. Fundamentals of Entrepreneurship: Concept, nature, and importance of entrepreneurship, Entrepreneurial traits and competencies, Types of entrepreneurs and enterprises, Entrepreneurship ecosystem in India, Role of entrepreneurship in economic and rural development
2. Food Industry and Entrepreneurial Opportunities: Structure and scope of the food industry, Opportunities in food processing, preservation, packaging, and value addition, Emerging sectors: functional foods, organic foods, Nutraceuticals, street foods, Start-ups and innovation in the food sector, Case studies of successful food entrepreneurs
3. Business Planning and Project Formulation: Identification and evaluation of business ideas, Market survey and demand analysis, Technical feasibility and site selection, Project cost estimation and pricing strategies, Preparation of detailed project report (DPR)
4. Legal, Regulatory, and Financial Framework: Food Safety and Standards Act (FSSA), 2006 and FSSAI licensing, Company registration and legal compliances, Intellectual Property Rights (IPR) and branding, Sources of finance: banks, venture capital, angel investors, Government schemes for food entrepreneurs (MSME, PMFME, Start-up India)
5. Marketing, Quality, and Supply Chain Management: Marketing concepts and consumer behaviour, Branding, labelling, and packaging strategies, Distribution channels and logistics, Quality assurance, food safety, and certification, Role of digital marketing and e-commerce
6. Sustainability, Ethics, and Growth Strategies: Sustainable entrepreneurship and circular economy, Waste management and by-product utilization, Ethical business practices and consumer protection, Scaling up, diversification, and export opportunities, Challenges and risk management in food enterprises

**DSC/Core (Major) C-17-P: ENTREPRENEURSHIP DEVELOPMENT IN FOOD INDUSTRY
1 CREDIT**

The practical component shall focus on hands-on entrepreneurial skill development through the following activities:

1. Identification of entrepreneurial opportunities in food processing and allied sectors
2. Market survey and consumer preference analysis for selected food products
3. Preparation of a business model using Business Model Canvas
4. Development of a detailed business plan for a food-based enterprise
5. Cost analysis, break-even analysis, and pricing strategy
6. Study of FSSAI licensing and regulatory requirements for start-ups
7. Branding, labelling, and packaging design exercise
8. Case study analysis of successful food start-ups or food MSMEs
9. Interaction with food entrepreneurs / incubation centres (wherever feasible)

- ❖ Each student shall submit a Practical File/ Project Report containing - Market survey questionnaire and findings, business design or model and business plan, financial analysis and feasibility report, Regulatory compliance checklist, Case study report and conclusions

- ❖ **Submission of the practical record is mandatory for appearing in the practical examination**

DSC/Core (Major) C-18-TH: GERIATRIC NUTRITION 3 CREDITS

COURSE OUTCOMES (COs)

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

- CO1:** Explain physiological and nutritional changes associated with aging.
CO2: Assess nutritional status of elderly individuals.
CO3: Identify nutritional problems and chronic diseases in older adults.
CO4: Plan therapeutic diets for geriatric disorders.
CO5: Provide nutrition counselling and health promotion strategies for the elderly.

1. Introduction to Geriatric Nutrition: Definition of Gerontology, Geriatrics, Senescence. Scope, importance of Geriatric nutrition and demographic profile of elderly in India, changing family structure.
2. Theories of aging: Genetic theory, Free radical theory, Wear-and – tear theory, Somatic mutation theory.
3. Physiological changes with aging: Body composition, Taste and smell, Hearing, Eye sight (ADM, Glaucoma, cataract), immune competence, oral, GI (Dysphagia, achlorhydria, constipation), renal, neurologic, Pressure ulcer
4. Quality of life: Physical functioning, malnutrition, depression, cognitive impairment.
5. Nutritional Requirements: ICMR current RDA for elderly 60+ yrs.: Energy, protein, calcium, Vitamin D, B₁₂, fiber
6. Chronic Non-Communicable Diseases and its dietary management: Cardiovascular Problems, Diabetes Mellitus, neuropathy, retinopathy, Kidney disease COPD, pneumonia, osteoarthritis, osteoporosis, sarcopenia, anemia, underweight, overweight, dehydration, Alzheimer's, Parkinson's and sleep disorders.
7. Risk factors and health hazards: Smoking, alcohol, sedentary life, poor diet Poverty, lack of caregivers, elder abuse, Poor lighting, and slippery floors → falls
8. Prevention & Management Focus:
 - i. Regular Screening: BP, sugar, cancer, bone density, vision, hearing
 - ii. Balanced Diet: High protein, calcium, vitamin D, B₁₂, fiber. Small frequent meals
 - iii. Physical Activity: Walking, yoga, strength training to prevent sarcopenia & falls
 - iv. Medication Review: Every 6 months to avoid polypharmacy.
 - v. Vaccination: Annual flu, pneumococcal, shingles vaccine.
 - vi. Social Engagement: Clubs, hobbies, family time to prevent depression.

DSC/Core (Major) C-18-P: GERIATRIC NUTRITION 1 CREDIT

1. Assessment of elderly: Measuring BMI, MUAC, CC of elderly. Conduct MNA-SF on 2 subjects
2. Diet Planning: Balanced diet for elderly
3. Therapeutic Diets for geriatric disease: Diabetes mellitus, Hypertension & Atherosclerosis/

- osteoporosis
4. DASH diet, Dysphagia (thickened liquids, pureed diets using thickeners,
 5. Recipe Development: Iron-rich, calcium-rich, high fiber, soup, thickened fluids, Low sodium, Low fat texture modification.
 6. Visit to old- age Homes.

DSC/Core (Major) C-19-TH:FOOD SAFETY AND QUALITY CONTROL 3 CREDITS

COURSE OUTCOMES (COs)

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

CO1: Explain food safety concepts, hazards, and quality attributes.

CO2:Analyse food safety risks and regulatory requirements.

CO3: Apply quality assurance and HACCP principles.

CO4: Evaluate food safety management systems and analytical methods.

CO5: Assess food safety issues and recommend corrective measures.

1. Foundations of Food Safety and Quality:Concepts: food safety, food quality, food security, food defense, food fraud, Quality attributes: sensory, nutritional, physicochemical, microbiological, Foodborne diseases: types, causes, epidemiology, Global food safety challenges and emerging risks, Consumer awareness and public health perspective.
2. Food Safety Hazards and Risk Analysis:Biological hazards: bacteria, viruses, parasites, Chemicalhazards: pesticides, veterinary drugs,mycotoxins, heavy metals, Physical hazards and allergen management, Risk analysis framework:risk assessment, management, communication, Predictive microbiology and quantitative microbial risk assessment (QMRA).
3. Food Laws, Regulations, and Standards:Food Safety and Standards Act (FSSA), 2006, Role and structure of FSSAI, Codex AlimentariusCommission, International agencies: FAO, WHO, FDA, EFSA, Food labelling, claims, traceability, and recall systems.
4. Quality Control and Assurance Systems: Quality control vs quality assurance, GMP, GHP, SSOPs, Total Quality Management (TQM),Statistical Quality Control (SQC): control charts, acceptance sampling, Internal quality audits and Documentation.
5. Food Safety Management Systems: HACCP principles and application, Hazard analysis fordifferent food sectors,Validation, verification, and record keeping, ISO 22000 and FSMS, Food safety culture and certification audits
6. Analytical and Rapid Detection Techniques: Sampling and sample preparation, Physicochemical and microbiological analysis, Rapid methods: ELISA, PCR, biosensors, Instrumental techniques: HPLC, GC, FTIR. Detection of adulterants, residues, and contaminants.
7. Emerging Trends and Multidisciplinary Applications: Nanotechnology in food safety, Artificial intelligence in quality control,Block chain and digital traceability, Food safety in functional and novel foods,sustainability, ethics, and future challenges.

DSC/Core (Major) C-19-P: FOOD SAFETY AND QUALITY CONTROL 1 CREDIT

Option A: Survey-Based Practical

Design and preparation of a structured questionnaire on food safety and quality, Field survey on food hygiene, sanitation practices, labelling awareness, or food adulteration, Data collection, tabulation, and graphical representation, Interpretation of survey findings with reference to FSSAI guidelines, Preparation and submission of survey report.

Option B: Lab-Based Practical

Detection of food adulterants through qualitative tests in food commodities, Data collection, tabulation, and graphical representation, Interpretation of experimental findings with reference to FSSAI guidelines, Preparation and submission of lab report.

Option C: Case-Study Based Practical

Case study on a national or international food safety incident or recall, covering causes of the incident, regulatory actions taken, preventive measures adopted and key lessons learned. Preparation and submission of the case study report.

Option D: Field Visit Based Practical

The field visit shall involve guided visits to one or more of the following establishments, depending on availability:

- Food processing industries (dairy, bakery, meat, beverage, cereal, or ready-to-eat foods)
- Quality control or analytical laboratories
- Cold storage facilities and warehouses
- Food retail outlets and distribution centers
- Street food clusters, markets, or food service establishments
- Food safety regulatory or inspection offices

Collection of observational data using structured checklists. Tabulation and graphical representation. Identification of food safety hazards and preventive measures, linking observed practices with reference to FSSAI guidelines. Preparation and submission of the field visit report.

Format for the Field Visit Report

- Each student shall submit a Field Visit Report containing:
 - i) Introduction and objectives of the visit
 - ii) Description of the establishment visited
 - iii) Observations on hygiene, safety, and quality practices
 - iv) Evaluation of compliance with food safety regulations
 - v) Identification of gaps and suggested improvements
 - vi) Conclusion and learning outcomes
- **For the practical paper, students are permitted to opt for any one of the aforementioned options, provided that the selected option is offered and approved by the college**
- **Submission of the practical record is mandatory for appearing in the practical examination**

COURSE OUTCOMES (COs)

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

CO1: Explain roles and responsibilities of dietitians in healthcare settings.

CO2: Apply the Nutrition Care Process in patient management.

CO3: Conduct nutrition assessment and diagnosis.

CO4: Develop nutrition intervention and monitoring plans.

CO5: Demonstrate patient counselling and communication skills.

1. **Introduction to Dietary Counseling:** Definition, Expectations, goals, scope and limits .Counseling Responsibilities and Role of Nutrition Counselor. Ethical code and responsibility. Characteristics of an effective counselor Skills and attributes of the nutrition educator or counselor.
2. **Stages of Diet Counseling:** Stage I: problem exploration and clarification Stage II: Developing new perspectives and setting goals, Stage III: Implementation follow up and evolution
3. **Different types of counseling methods:** a. Multicultural counseling b. Motivational counseling c. Directive counseling d. Guided counseling.
4. **Introduction to term Dietician:** Definition of Dietician, Difference between registered dietician & Nutritionist.Role of dietician in hospital: work area of hospital dietician, role of dietician in hospital Role of dietician in community: work area of community dietician, role of community dietician.
5. **Introduction to Nutrition Care Process:** Definition of Nutrition Care Process .Steps of Nutrition Care Process : a) Assessment- Height,Weight,body frame, body composition b) Diagnosis c) Intervention d)Monitoring and evaluation
6. **Nutrition counseling in the management of diseases/disorders:** Obesity,Diabetes mellitus, Renal diseases, Hypertension, Cardiovascular diseases, Liverdisease.

DSC/Core (Major) C-20-P: DIET COUNSELING AND PATIENT CARE (PRACTICAL) 1CREDIT

1. Planning and preparation of different therapeutic diets (by using the Exchange list)
2. Visit and training to hospitals/nursing homes for 7-15 days:
 - Takingthe case history of the patient and studying
 - Routine Hospital diet
 - Distribution of food from the kitchen to the individual patient with a specific diet.
 - Dietary management of patients with different diseases and a diet chart for the particular patient.
 - Role of dietitian /nutritionist in diet counselling

EIGHTH SEMESTER (WITH RESEARCH)

RM1/Core (Major) TH: RESEARCH METHODOLOGY I

3 CREDITS

COURSE OUTCOMES (COs)

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

CO1: Explain principles and types of research.

CO2: Formulate research problems, objectives, and hypotheses.

CO3: Design appropriate research methodologies and sampling strategies.

CO4: Apply ethical principles and intellectual property concepts.

CO5: Prepare research proposals and scientific reports.

1. Fundamentals of Research: Meaning, objectives, and types of research: Descriptive vs. Analytical,

Applied vs. Fundamental, Qualitative vs. Quantitative, Conceptual vs. Empirical, Concept of Research methods and research methodology, Research Process, Research in food science and nutrition: scope and applications

2. Research Problem and Literature Review: Identification and formulation of research problems, Hypothesis: concept, types, and testing, Review of literature: sources and methods, Use of databases (PubMed, Scopus, Google Scholar), Reference management and citation styles
3. Research Design and Sampling: Research design: exploratory, descriptive, experimental, Variables and controls, Sampling methods: probability and non-probability, Sample size determination, Validity and reliability of research tools.
4. Data Collection Methods: Tools and Techniques of data collection, pre-testing and pilot study, Editing and Coding of Data, Analysis and interpretation of data, Guidelines for presentation of Data-Tables, Graphs and illustrations
5. Research Ethics and Intellectual Property: Ethics in research involving humans and animals, Informed consent and confidentiality, Plagiarism and academic integrity, Intellectual Property Rights (IPR), Research misconduct and good research practices
6. Scientific Writing and Research Communication: Research proposal writing, Thesis and dissertation writing format: Presentation of data (tables, graphs, figures), Oral and poster presentations

RM1/Core (Major) TU: RESEARCH METHODOLOGY I 1 CREDIT

1. The practical component shall focus on developing research skills and hands-on experience in scientific investigation through the following activities:
 - Identify a research problem and review relevant literature.
 - Formulate objectives and hypotheses and select suitable research design and tools.
2. Each student shall submit a Project Report containing: Research problem and objectives, review of literature, research design and methodology, data collection tools, statistical analysis and interpretation, research proposal or mini project report, and conclusions with references.

Evaluation Pattern – Research Methodology Tutorial 1 Credit (25 Marks)

- Identification of research problem and literature review – 5 marks
- Research design, objectives, hypothesis, and tools – 5 marks
- Data collection tools and statistical analysis – 5 marks
- Interpretation, presentation, and record submission – 10 marks
- **Submission of the practical record is mandatory for appearing in the practical examination**

RM2/Core (Major) TH: RESEARCH METHODOLOGY II (FUNDAMENTALS OF BIOSTATISTICS AND COMPUTER APPLICATION) 3 CREDITS

COURSE OUTCOMES (COs)

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

CO1: Apply statistical concepts in food and nutrition research.

CO2: Organize, analyse, and present research data.

CO3: Perform hypothesis testing and ANOVA.

CO4: Interpret correlation and regression analyses.

CO5: Use statistical software and computer applications for research.

1. Introduction to Biostatistics: Meaning, scope & relevance in food science and nutrition research, Types of data: qualitative vs. quantitative; discrete & continuous
2. Data Collection & Presentation: Sampling design: probability and non-probability methods, Frequency tables, histograms, bar charts, box plots, ogives, Descriptive statistics: central tendency (mean, median, mode); measures of variation (variance, SD, CV)
3. Probability & Sampling Distributions: Basic probability concepts, Normal distribution & its importance in inferential statistics, Central limit theorem overview
4. Hypothesis Testing: Null & alternative hypotheses, Parametric tests: Z-test, t-test (independent, paired), non-parametric alternatives (chi-square, Wilcoxon signed Rank Test)
5. Analysis of Variance (ANOVA): One-way ANOVA and post-hoc tests, Two-way ANOVA concepts.
6. Correlation & Regression: Correlation coefficient (Pearson & Spearman), Simple linear regression, interpretation of coefficients
7. Multivariate Basics: Conceptual introduction to MANOVA
8. Role of Computers in Biostatistics: Computer systems for research, Overview of statistical packages (Excel, SPSS/R/Python), Data security, file management, backup practices

RM2/Core (Major) P:RESEARCH METHODOLOGY II (FUNDAMENTALS OF BIOSTATISTICS AND COMPUTER APPLICATION) 1 CREDIT

The practical component emphasizes hands-on training in the following areas:

1. Data Entry and Management: Data coding, validation, and handling of missing data using MS Excel and statistical software (SPSS/R/Python).
2. Descriptive Statistics: Computation of mean, median, mode, standard deviation, variance, and coefficient of variation for food and nutrition datasets.
3. Graphical Presentation: Preparation and interpretation of bar diagrams, histograms, box plots, and scatter plots.
4. Statistical Tests: Application of t-test, chi-square test, and one-way ANOVA using real nutrition and food science data.
5. Computer Applications: Use of Excel functions, pivot tables, and statistical software for data analysis, interpretation, and reporting in food and nutrition research.

Practical Evaluation Pattern (Total: 25 Marks) 1 Credit

Practical Lab Performance – 10 marks

(Accuracy of data entry, statistical calculations, graphs, and software use)

Practical Examination – 10 marks
(Execution of statistical tests, use of Excel/SPSS/R/Python, interpretation)

Viva Voce – 5 marks
(Conceptual understanding, interpretation of results, applications in food and nutrition)

**RI/Core (Major):RESEARCH INTERNSHIP 4CREDITS (PROJECT REPORT–
3CREDITS, VIVA-VOCE - 1CREDIT)**

COURSE OUTCOMES (COs)

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

CO1: Identify and formulate research problems in food science, nutrition, and allied fields through field exposure and literature review.

CO2: Design and implement appropriate research methodologies using suitable sampling, data collection, and analytical techniques.

CO3: Collect, analyse, and interpret research data using scientific methods to generate evidence-based findings.

CO4: Develop practical solutions or recommendations for food, nutrition, public health, and sustainable food systems.

CO5: Prepare and present a scientific research internship report demonstrating ethical research practices and professional communication.

The Research Internship shall be carried out in two phases:

Phase I: Field Exposure and Problem Identification

(To be undertaken during vacation / semester break after VII Semester)

Field visits to villages, rural sites, urban slums, community centers, NGOs, or development organizations, Interaction with community members, local authorities, and stakeholders, Identification of a relevant societal problem, Preliminary needs assessment and background study, Selection of a researchable problem aligned with thematic areas

Phase II: Research Internship (VIII Semester)

Allocation of Faculty Supervisor / Research Mentor, Preparation and submission of a Research Internship Proposal, Field-based or laboratory-based data collection, Application of appropriate research methodology, Data analysis and interpretation

Note: Students can opt for Research Internship within the Department or outside the department

Suggested Thematic Areas

Students shall undertake the Research Internship in any one of the following thematic areas:

1. Sustainable Agriculture, Food Security and Risk Management – Focuses on climate-resilient agriculture, reduction of post-harvest losses, sustainable food systems, and improvement of farmer livelihoods to ensure food and nutrition security.
2. Nutrition, Public Health and Food-Based Interventions – Addresses community nutrition challenges, malnutrition, dietary diversity, and food-based strategies for improving public health outcomes.

3. Food Processing, Preservation and Value Addition – Emphasizes development and optimization of food processing and preservation technologies to enhance shelf life, nutritional quality, and value-added food products.
4. Food Safety, Quality and Risk Assessment – Involves assessment and management of foodborne hazards, adulteration, hygiene practices, and regulatory compliance to ensure consumer safety.
5. Food Entrepreneurship, Livelihood and Skill Development – Focuses on promoting food-based enterprises, MSMEs, and skill development for sustainable livelihoods and employment generation.
6. Water, Sanitation and Hygiene (WASH) in Food and Nutrition Systems – Examines the role of water quality, sanitation, and hygiene practices in safe food preparation, processing, and nutrition-related health.
7. Food Waste Management and Sustainable Food Systems – Deals with reduction, utilization, and recycling of food waste through sustainable and circular economy approaches in food systems.
8. Functional Foods, Nutraceuticals and Health Promotion – Explores development and evaluation of functional foods and nutraceuticals aimed at health promotion and disease prevention.

Activities to be undertaken by the student

- Community survey and baseline data collection
- Literature review relevant to the selected theme
- Research design and methodology formulation
- Use of tools such as questionnaires, interviews, observations, or experiments
- Development of a prototype, model, intervention, or policy suggestion (where ever applicable)
- Documentation and reporting

Research Internship Report

Each student shall submit a Research Internship Report, which shall include:

- Title and objectives of the study
- Background and review of literature
- Methodology
- Results and discussion
- Proposed solution / intervention / recommendations
- Conclusion and societal relevance
- References

Submission of the report is mandatory for appearing in the practical examination

Evaluation Pattern (75 + 25 Marks)

- Research Proposal & Synopsis – 15 marks
- Field Work / Data Collection – 20 marks
- Data Analysis & Interpretation – 15 marks
- Internship Report – 25 marks
- Presentation & Viva-Voce – 25 marks

DIS/Core (Major) DISSERTATION (THESIS – 4 CREDITS, PRESENTATION – 2 CREDITS, VIVA-VOCE – 2 CREDITS)

COURSE OUTCOMES (COs)

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

CO1: Formulate a novel and relevant research problem in food science and nutrition through critical review of scientific literature and identification of research gaps.

CO2: Design and execute an independent research study using appropriate experimental, survey-

based, laboratory-based, or review-based methodologies while adhering to research ethics and scientific standards.

CO3: Analyse, interpret, and critically evaluate research findings using appropriate statistical tools and scientific reasoning to draw valid conclusions.

CO4: Prepare a well-structured dissertation following accepted scientific writing conventions, including proper citation, data presentation, interpretation, and discussion of results.

CO5: Communicate research findings effectively through oral presentation and viva-voce, demonstrating subject knowledge, critical analysis, problem-solving ability, and professional competence

The dissertation shall be any one of the following types, relevant to the field of Food Science and Nutrition, as approved by the Department/Research Supervisor:

Option A: Survey-Based Study

Studies related to dietary assessment, nutritional status, food habits, food security, or consumer behaviour that employ tools such as questionnaires, interviews, anthropometric measurements, and dietary recall methods.

Option B: Laboratory-Based Study

Experimental work involving food analysis, nutrient estimation, product development, quality evaluation, or shelf-life studies, carried out using standard laboratory procedures and appropriate experimental designs.

Option C: Review-Based Study

Systematic or narrative reviews on contemporary topics in food science and nutrition, involving critical analysis of published research using standard scientific databases.

Evaluation Pattern (Dissertation – 8 Credits - 200 Marks)

Thesis (4 Credits – 100 Marks)

Relevance and originality of topic – 25 marks

Research design and methodology – 25 marks

Data analysis and interpretation – 25 marks

Quality of writing, presentation, and references – 25 marks

Presentation (2 Credits – 50 Marks)

Content organization and clarity – 25 marks

Visuals, communication, and time management – 25 marks

Viva-Voce (2 Credits – 50 Marks)

Subject knowledge and justification of work – 25 marks

Responses to questions – 25 marks

Submission of the thesis is mandatory for appearing in the practical examination

EIGHTH SEMESTER (WITHOUT RESEARCH)

RM1/Core (Major): RESEARCH METHODOLOGY I (TH 3 CREDITS + P 1 CREDIT)

Same Syllabus as mentioned in the Eighth semester with Research

RM2/Core(Major): RESEARCH METHODOLOGY II(FUNDAMENTALS OF

BIostatistics and Computer Application) (TH 3 CREDITS + P 1 CREDIT)

Same Syllabus as mentioned in the Eighth semester with Research

DSC/Core (Major) C-21-TH: FOOD FERMENTATION 3 CREDITS

COURSE OUTCOMES (COs)

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

CO1: Explain principles and microbiology of food fermentation.

CO2: Describe fermentation technologies and processing methods.

CO3: Evaluate quality and safety aspects of fermented foods.

CO4: Explain functional benefits of fermented foods.

CO5: Develop and evaluate fermented food products.

1. Fundamentals of Food Fermentation: Definition, history and scope of fermentation, Types of fermentation: lactic, alcoholic, acetic, alkaline fermentation, Microorganisms in food fermentation (LAB, yeasts, molds), Biochemical changes and nutritional enhancement

2. Fermented Foods of Plant and Animal Origin: Dairy: curd, yogurt, kefir, cheese, Cereals & pulses: idli, dosa, dhokla, sourdough, Vegetables & soy: pickles, kimchi, sauerkraut, tempeh, Fermented beverages: kombucha, buttermilk, traditional drinks

3. Fermentation Technology & Processing: Starter cultures: selection and maintenance, Process parameters: temperature, pH, oxygen, Batch and continuous fermentation basics, Aerobic and Anaerobic Fermentation, Solid State Fermentation, Fermentation equipment's (bioreactor, fermenter etc) and study of their hygienic maintenance

4. Quality Control, Safety & Regulations of Fermented Foods: Spoilage and contamination in fermented foods, GMP, GHP, HACCP in fermentation, FSSAI standards and Codex guidelines, Shelf-life evaluation

5. Functional & Emerging Aspects: Probiotics and health benefits, Prebiotics and symbiotics, Fermented foods as functional foods, recent innovations and research trends

DSC/Core (Major) C-21-P: FOOD FERMENTATION 1 CREDIT

1. Preparation of fermented dairy products – cottage cheese, curd and yogurt with or without flavors
2. Fermentation of cereal-pulse products – idli, dosa, dhokla, etc.
3. Vegetable fermentation – sauerkraut, pickle
4. Preparation of fermented beverage – kombucha, buttermilk, traditional drinks
5. Determination of pH and titratable acidity of the prepared fermented foods
6. Sensory evaluation of the prepared fermented products
7. Preparation of different food items from fermented raw materials
8. HACCP plan preparation for one fermented food process
9. Mini project: Development of a functional fermented food (group activity)

DSC/Core (Major) C-22-TH: FOOD PACKAGING 3 CREDITS

COURSE OUTCOMES (COs)

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

- CO1:** Explain principles and functions of food packaging.
- CO2:** Compare packaging materials and packaging systems.
- CO3:** Evaluate packaging effects on shelf life and food quality.
- CO4:** Apply food packaging regulations and labelling requirements.
- CO5:** Select suitable packaging systems for different food products.

1. Fundamentals of Food Packaging: Objectives, convenience, Role of packaging in preserving nutritional quality of perishable and processed foods

2. Packaging Materials: Paper and paperboard, Glass and metal containers, Plastics in food packaging (PE, PP, PET, multilayer films), Biodegradable and edible packaging materials, Food–package interactions, Factors affecting packaged food stability: light, oxygen, moisture, temperature etc

3. Packaging Techniques: Modified atmosphere packaging (MAP), Controlled Atmospheric Packaging (CAP), Vacuum packaging, Aseptic and retort packaging, Active and intelligent packaging (oxygen scavengers, freshness indicators)

4. Shelf-Life and Storage Stability: Shelf-life definition and influencing factors, Methods for shelf-life evaluation (sensory, chemical, microbiological), Role of packaging in extending shelf-life, Nutrient losses during storage

5. Food Safety, Labeling & Sustainability: Packaging hazards and safety issues, FSSAI and Codex standards for food packaging and labeling, Nutritional labeling requirements, Environmental impact of packaging waste, Sustainable packaging trends and circular economy concepts

DSC/Core (Major) C-22-P: FOOD PACKAGING 1 CREDIT

1. Types of common packaging materials
2. Study of package labeling as per FSSAI guidelines
3. Demonstration of headspace and seal integrity
4. Comparison of shelf-life of packaged vs. unpackaged food (short study)
5. Estimation of moisture gain/loss in packaged foods
6. Sensory evaluation of packaged foods
7. Packaging of Vegetables and Fruits
8. Case study: selection of suitable packaging for a functional food
9. Mini project: Study of a sustainable package for a food product (group activity)

DSC/Core (Major) C-23-TH: FUNCTIONAL FOODS AND NUTRACEUTICALS 3 CREDITS

COURSE OUTCOMES (COs)

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

- CO1:** Explain concepts and classifications of functional foods and nutraceuticals.
- CO2:** Describe bioactive components and their health benefits.
- CO3:** Evaluate the role of functional foods in disease prevention and health promotion.
- CO4:** Develop functional food products using appropriate ingredients and technologies.
- CO5:** Interpret regulatory requirements, labelling, and market trends of nutraceuticals.

1. Introduction to Functional Foods and Nutraceuticals: Definitions, history and scope, Classification: conventional functional foods, fortified foods, designer foods, nutraceuticals,

Difference between functional foods, dietary supplements and pharmaceuticals, Role in public health nutrition

2. Bioactive Components in Functional Foods: Probiotics, prebiotics and symbiotics, Dietary fiber, resistant starch and oligosaccharides, Phytochemicals: polyphenols, flavonoids, carotenoids, Bioactive peptides, omega-3 fatty acids, plant sterols, Antioxidants and their health implications

3. Functional Foods and Health: Functional foods in gastrointestinal health, Role in cardiovascular diseases, diabetes and obesity, Functional foods and immunity, Functional foods for bone and mental health, Mechanisms of action of bioactive compounds

4. Development and Processing of Functional Foods: Selection of ingredients and formulation, Stability of bioactive components during processing and storage, Encapsulation and delivery systems (basic concept), Fortification and value addition

5. Safety, Regulations and Market Trends: Safety evaluation and recommended intake levels, FSSAI regulations for nutraceuticals and health supplements, Labeling and health claims, Global regulatory overview (Codex principles), Current trends: personalized nutrition, plant-based nutraceuticals

DSC/Core (Major) C-23-P: FUNCTIONAL FOODS AND NUTRACEUTICALS 1 CREDIT

1. Identification of functional ingredients from food labels
2. Demonstration / Estimation of antioxidant activity in foods
3. Preparation of a probiotic food product (curd, yogurt drink)
4. Development of a high-fiber or fortified food product (cereal/pulses)
5. Formulation of a functional beverage (herbal/probiotic)
6. Sensory evaluation of the prepared functional food products
7. Preparation of nutrition and health claim label for a functional food
8. Mini project: Development and sensory evaluation of a functional food product (group activity)

Minor Course Syllabus

Minor-1-Basic Food Science I (Either in semester I/semester III)

MINOR-1-TH: BASIC FOOD SCIENCE-I

3 CREDITS

1. Basic concept of Food, Nutrition and Nutrients. Classification of food, classification of nutrients.
2. Carbohydrates-Definition, Classification, Structure and properties.
Monosaccharides -glucose, fructose, galactose.
Disaccharides-Maltose, lactose, sucrose
Polysaccharides-Dextrin, starch, glycogen, resistant starch.
Carbohydrates-Sources, daily requirements, functions. Effects of too high and too low carbohydrates on health. Digestion and absorption of carbohydrate.
3. Lipids-Definition, Classification & Properties. Fatty acids-composition, properties, types. Lipids - sources, daily requirements, functions. Digestion & Absorption of nutrients. Role & nutritional significances of PUFA, MUFA, SFA, W-3 fatty acid.

4. Proteins- Definition, Classification, Structure & properties. Amino acids
Classification, types, functions. Proteins - Sources, daily requirements, functions.
Effect of too high-too low protein on health. Digestion & absorption. Assessment of
Protein quality (BV, PER, NPU). Factors affecting protein bio-availability including
anti- nutritional factors.
5. Dietary Fibre- Classification, sources, composition, properties & nutritional significance

MINOR1-P: BASIC FOOD SCIENCE-I (PRACTICAL) 1 CREDIT

1. Identification of Mono ,Di and polysaccharides
2. Identification of Proteins
3. Identification of glycerol

Minor-2-Basic Food Science II (Either in semester II /semester IV)

MINOR2-TH: BASIC FOOD SCIENCE-II

3 CREDITS

1. Minerals & Trace Elements, Bio-Chemical and Physiological Role, bio-availability & requirements, sources, deficiency & excess (Calcium, Sodium, Potassium Phosphorus, Iron, Fluoride, Zinc, Selenium, Iodine, Chromium)
2. Vitamins - Biochemical and Physiological role, Bio-availability and requirements, sources, deficiency & excess (Fat soluble and water-soluble vitamins), Provitamin, Antivitamin, Pseudo vitamin and Vitamers.
3. Water-Functions, daily requirements, Effect of excess and deficiency. Water balance.

MINOR2-P:BASIC FOOD SCIENCE-II (PRACTICAL)

1 CREDIT

1. Determination of Ash content in food
2. Determination of Moisture content in food
3. Determination of calcium, iron, and Vitamin C content in foods.

Minor-3-Human Nutrition I (Semester-V/ Semester VI)

Minor-3-TH: HUMAN NUTRITION-I

3 CREDITS

1. Concept and definition of terms-Nutrition, Malnutrition and Health: Scope of Nutrition.
2. Minimum Nutritional Requirement and RDA: formulation of RDA and Dietary Guidelines Reference Man and Reference Woman, Adult consumption unit.
3. Energy in Human Nutrition: Idea of Energy and its unit, Energy Balance, Assessment of Energy Requirements—deficiency and excess, Determination of Energy in food, B.M.R. and its regulation, S.D.A.
4. Growth & Development from infancy to adulthood: Somatic, physical, brain and mental development, puberty, menarche, pre-pubertal and pubertal changes, Factors affecting growth and development. Importance of Nutrition for ensuring adequate development.

5. Growth monitoring and promotion: Use of growth charts and standards, Prevention of growth faltering

Minor-3-P: HUMAN NUTRITION-I (PRACTICAL) 1 CREDIT

1. Process involved in cooking: pressure cooking, microwave, steaming, grilling, deep fat frying.
2. General concepts of weights and measures. Eye estimation of raw and cooked foods.
3. Preparation of food from different food groups and their significance in relation to health.
4. Preparation of supplementary food for different age group and their nutritional significance.
5. Planning and preparation of low-cost diet for Grade I and Grade II malnourished child

Minor-4-HumanNutritionII(Semester-V/ Semester -VI)

Minor-4-TH: HUMAN NUTRITION-II 3 CREDITS

1. Nutrition During Pregnancy: Factors (non-nutritional) affecting pregnancy outcome, importance of adequate weight gain during pregnancy, antenatal care and its schedule, Nutritional requirements during pregnancy and modification of existing diet and supplementation, Deficiency of nutrients, specially energy, iron folic acid, protein, calcium, iodine. Common problems of pregnancy and their managements, specially -nausea, vomiting, pica, food aversions, pregnancy induced hypertension, obesity, diabetes. Adolescent pregnancy.
2. Nutrition during Lactation: Nutritional requirements during lactation, dietary management, food supplements, galactogogues, preparation for lactation. Care and preparation of nipples during breast feeding.
3. Nutrition during Infancy: Infant physiology relevant to feeding and care, Breast feeding colostrum, its composition and importance in feeding, Initiations of breast feeding. Advantages of exclusive breast feeding. Basic principles of breast feeding. Introduction of supplementary foods, initiation and management of weaning, Baby-led weaning. Bottle feeding-circumstances under which bottle feeding is to be given. Care & sterilization of bottles. Preparation of formula. Mixed feeding, breast feeding and artificial feeding.
4. Management of preterm and low birth weight babies.

5. Nutritional needs of toddlers ,preschool ,school going children-and adolescents-Dietary management

Minor-4-P: HUMAN NUTRITION-II (PRACTICAL)1CREDIT

Planning and preparation of adequate meal for different age groups with special reference to different physiological conditions: infants, preschooler, school children, adolescents, adults, pregnancy, lactation and old age.

SYLLABUS for IDC OFFERED by FOOD AND NUTRITION under CCF2022

BASICNUTRITIONANDFOODSCIENCE (THEORY) (2CREDITS)

1. Definition of Food, Nutrition, Nutrient, Nutritional status, Dietetics ,Balanced diet, Malnutrition, Energy (Units of energy – Joule, Kilocalorie).
2. Carbohydrate, Protein, Fat, Vitamins and Minerals (calcium, phosphorus, sodium, potassium, iron, iodine, fluorine) -sources, classification, functions, deficiencies of these nutrients. Functionsof water and dietary fiber.
3. B.M.R:Definition, factorsaffectingB.M.R.andTotalEnergyRequirement (Calculation of energy of individuals).
4. Basic five food groups: Nutritional significance of cereals, pulses, milk, meat,fish, vegetable, egg, nuts, oils, sugar.
5. Principles and objectives of meal planning and balanced diet.
6. Diet for a pregnant woman and Lactating mother
7. Diet for an infant, preschool child , school child, Normal male and female of different occupation.

BASIC NUTRITION AND FOOD SCIENCE (PRACTICAL) (1CREDIT)

1. Elementary idea of weight and measure.
2. Planning and preparation of Balanced diet for an adult.
3. Preparation of different types of nutritious tiffin for preschooler and school going Children.

SUGGESTED BOOKS AND JOURNALS

BASIC FOOD SCIENCE

1. Srilakshmi B(2017):NutritionScience,6thMulticolourEd.NewAgeInternational(P)Ltd.
2. RodayS(2012):FoodScienceandNutrition,2nd Ed. Oxford University Press.
3. Mann J and Truswell S(2017):Essentials of Human Nutrition, 5th Ed. Oxford University Press.
4. Wilson K and Walker J (2000):Principles and Techniques of Practical Biochemistry, 5th Ed. Oxford University Press.
5. SadasivanSandManikamK(2007):BiochemicalMethods,3rdEd.NewAgeInternational (P)Ltd.
6. OserBL(1965).Hawk'sPhysiologicalChemistry,14thEd.McGraw-HillBook
7. Nath RL and Nath RK(1990). Practicalbiochemistryinclinicalmedicine, 2ndEd. Academic Publishers.
8. Sen AR, Pramanik NK and Roy SK(2001):Atreatiseonanalysisoffoodfat and oil, Oil Technologists Association of India (EZ), Kolkata, 76, 119.
9. PlummerD(2017):AnintroductionofPracticalBiochemistry,3rdEd.McGrawHill Education.
10. SwaminathanM(2007):EssentialsofFoodandNutrition(Vol.I&II),2ndEd.Bappco.
11. MeyerLH(2004):FoodChemistry,CBSPublishers&Distributors

NUTRITIONANDHEALTHEDUCATION

1. ParkK(2017):TextbookofPreventiveandSocialMedicine,24thEd.
BanarsidasBhanotPublishers
2. MahajanBK, RoyRN, SahaI,Gupta, MC(2013):Text bookofPreventiveandSocial
Medicine, 4th Ed. Japee Brothers
3. PandyaR(2010):CommunityHealthEducation,RawatPublications.

NUTRITIONALEPIDEMIOLOGY&PUBLICHEALTH

1. Smith, G. W.: Preventive Medicine and public health. 2nd edition. McMillan Co. New York.
2. Park: Park's Textbook of preventive and Social Medicine. 23rd edition. M/s. Banarasidas Bhanot. Jabalpur.
3. Seshubabu VVR (2011): Review in Community Medicine, 2nd Ed, Paras Medical Books Pvt Ltd.
4. Mahajan BK, Roy RN, Saha I, Gupta, MC (2013): Textbook of Preventive and Social Medicine, 4th Ed. Jaypee Brothers.
5. Vir SC (2011): Public Health Nutrition in Developing Countries, Woodhead Publishing India.
6. Willett W (2012): Nutritional Epidemiology, 3rd Ed. Oxford University Press, USA

HUMAN NUTRITION

1. Srilakshmi B (2014): Dietetics, 7th Multicolour Ed. New Age International (P) Ltd.
2. Guthrie AH (1986): Introductory Nutrition, 6th Revised Ed., McGraw-Hill Inc., US.
3. Robinson CH and Lawler M (1990): Normal and Therapeutic Nutrition. 17th Revised Ed. Macmillan USA.
4. Swaminathan M (2007): Essentials of Food and Nutrition (Vol. I & II), 2nd Ed. Bappa Co
5. Gopalan C, Rama Sastri BV and Balasubramanian SC (2016): Nutritive value of Indian Foods, Indian Council of Medical Research.
6. Nutrient Requirements and Recommended Dietary Allowance for Indians, Indian Council of Medical Research : New Delhi
- .
7. FAO/WHO/UNO: Technical Report Series, 724 (1985). Energy and Protein Requirement, Geneva.
8. Ghosh S (2007): Nutrition and Child Care, 2nd Ed. Jaypee Brothers Medical Publishers Private Limited.

9. WHO:AgrowthchartforInternationaluseInMaternalandChildrenHealthCare, Geneva.
10. MannJandTruswellS(2017) :EssentialsofHumanNutrition, 5thEd. OxfordUniversity Press.
11. Worthington-Roberts B and Williams SR(1999): Nutrition Throughout the Life Cycle ,4th Ed. McGraw-HillHigher Education.
12. ElizabethKE(2015);NutritionandChildDevelopment,5thEd.ParasMedicalPublishers.
13. GeisslerCandPowersH(2005):HumanNutrition, 11thEd. ChurchillLivingston.
14. ZimmermannM(2001):Burgerstein'sHandbookofNutrition: Micronutrientsinthe Prevention AndTherapyofDiseaseThiemeStuttgart.
15. SamourPQandKingK(2010):PediatricNutrition,4tEd.Jones&BartlettLearning.
16. InselP, RossD,McMahonKandBernsteinM(2016):Nutrition, 6thEd.Jones&Bartlett Learning.
17. MudambiSR(2018):FundamentalsofFoods,NutritionandDietTherapy,6thEd.New Age International(P)Ltd.
18. WilliamsSR(2001):BasicNutritionandDietTherapy, 11thEd.Elsevier.
19. ProudfitFTandRobinsonCH(1967):NormalandTherapeuticNutrition,13thEd. Mamillan.
20. GuthrieHandPiccianoMF(1994):HumanNutrition,WCBMcGraw-Hill,
21. SmithAandColleneA(2015);Wardlaw'sContemporaryNutrition, 10thEd.McGraw-Hill Education.
22. SharlinJandEdelsteinS(2010):EssentialsofLifeCycleNutrition,1stEd.Jones&Bartlett Learning.
23. IndianNationalCodefor ProtectionofBreast Feeding:Govt.ofIndia. MinistryofSocial Welfare, New Delhi.

HUMANPHYSIOLOGY

1. ChatterjeeCC (1988).TextBookofPhysiology–Vol .I&II.
2. Chaudhuri SK (2000). Concise Medical Physiology.New Central Book Agency (P) Ltd.
3. GanongW.F.(2003)-ReviewofMedicalPhysiology.21sted. McGraw Hill.
4. Guyton AC, Hall JE (2000). Text book of Medical Physiology. 9th Ed. Prism Books (Pvt.) Ltd. Bangalore.
5. HadleyME(2000).Endocrinology.5thed.PearsonEducation.
6. Harrison’sEndocrinology(2010) J.LarryJamesonsecondedition,McGraw-Hill

FOODSERVICEMANAGEMENT

1. KhanMA(1987):FoodServiceOperations,AviPublication Co.
2. TompkinsD(1969):TableLayoutandDecoration, WardLockCo.Ltd.
3. KintonRandCaseraniV(1989):TheTheoryofCatering,6thEd. ELBS.
4. EdwardK(1997):FoodServiceFacilitiesPlanning3rdEd,JohnWiley&Sons.
5. SethiM(2015):CateringManagement:AnIntegratedApproach,3rdEd.NewAge International(P) Ltd.
6. RodayS(2017):FoodHygieneandSanitationwithCaseStudies,2ndEd.McGraw Hill Education.

FOOD COMMODITIES

- 1.SwaminathanMSFoodScience,ChemistryandExperimentalFoods,BangalorePrint &Publishing Company.
- 2.SrilakshmiB(2018):FoodScience, 7thColourEd.NewAgeInternational(P) Ltd.
- 3.Lavies,S(1998):FoodCommoditiesLtd. London.
4. HughesOandBennionM(1970):IntroductoryFoods,5thEd.Macnillan&Co.,New York.
- 5.ParkerRandPaceM(2016):IntroductiontoFoodScienceandFoodSystems,2ndEd. Delmar

Cengage Learning.

6. Meyer LH (2004): Food Chemistry, 1st Ed. CBS Publishers and Distributors, New Delhi.
7. Mudambi SR, Rao SM and Rajagopal MV (2006): Food Science, 2nd Ed. New Age International (P) Ltd.
8. Manay SN and Shadaksharaswamy M (2008): Foods: facts and principles, 3rd Ed. New Age International (P) Ltd.
9. Potter NN and Hotchkiss JH (1999): Food science, 5th Ed, Springer.
10. Pruthi JS (2011): Spices and Condiments, National Book Trust, New Delhi.
11. Pyke M and Murrey J (1974): Catering Service and Technology, John Murrey Pube, London

NUTRITIONAL BIOCHEMISTRY

1. Murray RK, Bender DA, Botham KA, Mayes PA and Rodwell VW (2015): Harper's Biochemistry, 30th Ed. Lange Medical Book.
2. Handler P, Smith EI, Stelten DW: Principles of Biochemistry, McGraw Hill Book Co.
3. Nelson DL and Cox MM (2017): Lehninger Principles of Biochemistry. 7th Ed. WH Freeman.
4. Devlin TM (2010): Text Book of Biochemistry with Clinical Correlations. John Wiley and Sons.
5. Berg JM, Tymoczko JL, Gatto GJ and Stryer L (2015): Biochemistry, 8th Ed WH Freeman and Co

COMMUNITY NUTRITION

1. Jelliffe DB. Assessment of the Nutritional Status of the Community; World Health Organization.
2. Sahn DE, Lockwood R, Scrimshaw NS (1988): Methods for the Evaluation of the Impact of Food and Nutrition Programmes, 2nd Printing, United Nations University.

3. Ritchie, JAS (1979): Learning Better Nutrition, Nutritional Studies number 20, FAO, Rome.
4. Gopaldas T and Seshadri S (1988): Nutrition Monitoring and Assessment, Oxford University Press.
5. Mason JB, Habicht JP, Tabatabai H and Valverde V (1984): Nutritional Surveillance, World Health Organization.
6. Park K (2017): Textbook of Preventive and Social Medicine, 24th Ed. Banarsidas Bhanot Publishers.
7. King MH, King PMA, Morley D and AP Burgess (2015): Nutrition for Developing Countries, ELBS Oxford University Press.
8. Passmore R and Eastwood MA (1986): Davidson and Passmore's Human Nutrition & Dietetics, 8th Revised Ed. Churchill Livingstone.
9. Seshubabu VVR (2011): Review in Community Medicine, 2nd Ed, Paras Medical Books Pvt Ltd.
10. Mahajan BK, Roy RN, Saha I, Gupta MC (2013): Textbook of Preventive and Social Medicine, 4th Ed. Japee Brothers.
11. Vir SC (2011): Public Health Nutrition in Developing Countries, Woodhead Publishing India.
12. Bamji MS, Krishnaswamy K and Brahmam GNV (2017): Textbook of Human Nutrition, 4th Ed. Oxford & IBH Publishing Co. Pvt. Ltd.

DIET THERAPY

1. Anderson L, Dibble MV, Turkki PR, Mitchall HS, and Rynbergin HJ (1983): Nutrition in Health and Disease, 17th Ed. J. B. Lipincott & Co. Philadelphia.
2. Anita F P and Abraham P: Clinical Dietetics and Nutrition, 4th Ed. Oxford University Press, Delhi.
3. Mahan L K and Escott-Stump S (2007): Krause's Food and Nutrition Therapy. 12th Ed. WB Saunders Company, London.

4. Robinson.CH, LawlerMR, ChenowethWL and Garwick, AE(1986): Normal and Therapeutic Nutrition. 17th Ed., Macmillan Publishing Co.
5. Williams SR(1989): Nutrition & Diet Therapy, 6th Ed. Times Mirror/Mosby College Publishing, St. Louis.
6. Begum RM(2009): A textbook of Food, Nutrition and Dietetics, 3rd Ed. Sterling Publishers, New Delhi.
7. Joshi SA(2017): Nutrition and Dietetics, 4th Ed. Tata McGraw Hill Publications, New Delhi.
8. Hutchison, R(2010) Food And The Principles Of Dietetics, Kessinger Publishing, LLC

FOOD PRESERVATION

1. Subalakshmi, G and Udipi, SA(2006): Food processing and preservation, 1st Ed. New Age International (P) Ltd.
2. Srilakshmi B(2018): Food Science, 7th Colour Ed. New Age International (P) Lt
3. Potter NN and Hotchkiss JH(1999): Food science, 5th Ed, Springer.
4. Srivastava RPO and Kumar S(2014): Fruit and Vegetable Preservation Principles and Practices, 3rd Ed. International Book distribution Company.
5. McWilliams M and Paine H(1984): Modern Food preservation. Surjeet Publications,.
6. Cruess WV(2004): Commercial Fruits and Vegetable Products, Agrobios India.
7. Desrosier NW and Desrosier JN(2006): The Technology Of Food Preservation, 4th Ed. CBS Publishers and Distributors, New Delhi.
8. Adams M and Nout MJR(2001): Fermentation and Food Safety, Springer

FOOD MICROBIOLOGY

1. Frazier WC and Westhoff DC and Vanitha NM(2017): Food Microbiology, 5th Ed. McGraw Hill Education..
2. Jay JM(2005): Modern Food Microbiology, 3rd Ed. CBS Publishers & Distributors.
3. Pelczar M, Chan ECS, Krieg N(2009): Microbiology: Application Based Approach, Tata McGraw Hill Education.
4. Benson HJ(2001): Microbiological Applications: Complete Version: A Laboratory Manual in General Microbiology, 8th Ed. McGraw-Hill Publishing Co.
5. Colling CE and Lyne PM(1976): Microbiological Methods, Butterworth. London.
6. Bamrart G(2012): Basic food Microbiology, 2nd Ed. (Reprint), Springer.

7. WoodBJ(1998):MicrobiologyofFermentedFoods, Voll&II,2nd Ed.Spinger.
8. JoshiVK(2009):Biotechnology:FoodFermentationMicrobiology,Biochemistry& Technology, Vol I &Vol II , Educational Publishers & Distributors.
9. TortoraGJ,FunkeBRandCaseCL(2016):Mocrobiology,11thEd.PearsonEducation India.
10. BlackJG(2008):Microbiology:PrinciplesandExplorations,7thEd.JohnWiley& Sons.

MATERNAL AND CHILD NUTRITION

1. Nutrition Across the Life Span, Mary Kay Mitchell,2nd Ed, 2015,Chapter 13:Ageing and older adults
2. Krause's Food & the Nutrition Care Process
Edited by L.K. Mahan, J.L. Raymond , 15th Ed, 2020,chapter-15,16,&17.
3. Text Book of Human Nutrition, M.Swaminathan,4th eeEd,2022, Chapter12-15
4. Pediatric Nutrition, B.Koletzkoet.al., 3rd Ed,2019
5. Public Health Nutrition in Developing Countries, S.Shekar,R.Heaver,2nd Ed,2020,Chapter 3-first 1000 days, chapter 4-IYCF
6. WHO Child Growth Standards,WHO,2006
7. Standard for Maternal & Neonatal Care,WHO,2022
8. IYCF Counseling Card: MoHFW+UNICEF,2013-for role Play
9. MCPPP card : Mother &Child Protection Card,MoHFW-Growth Monitoring Tools
10. NFHS-5 Data

ENTREPRENEURSHIP DEVELOPMENT IN FOOD INDUSTRY

1. Desai, V. Dynamics of Entrepreneurial Development and Management
2. Khanka, S.S. Entrepreneurial Development
3. Peter Drucker. Innovation and Entrepreneurship
4. FSSAI Manuals and Guidelines
5. Government of India – MSME &Startup India Reports
6. Arya Kumar, Entrepreneurship
7. David H. Holt, Entrepreneurship: New Venture Creation
8. C B Gupta, Entrepreneurship Development in India 38
9. E.H. McGraw, S. J.; Basic Managerial Skills for All. Fourth Edition, Prentice Hall of India Pvt. Ltd., New Delhi.
10. Stephen R. Covey; The seven habits of highly effective people
11. Entrepreneurship Development by DilipGangopadhyay

GERIATRIC NUTRITION

1. Nutrition Across the Life Span, Mary Kay Mitchell, 2nd Ed, 2015, Chapter 13: Ageing and older adults.
2. Basic Nutrition and Diet Therapy, 13th Ed, 2009, Chapter 12: The ageing Process and Nutrition Needs.
3. Krause's Food & the Nutrition Care Process
Edited by L.K. Mahan, J.L. Raymond, 15th Ed, 2020, Chapter-22: Nutrition in Aging
4. Modern Nutrition in Health & Disease, A.C. Ross et al., 11th Ed, 2014, Chapter -53: Nutrition and Aging
5. Clinical Nutrition in Practice, N.K. Sharma, 2nd Ed, 2022, Ch-14: Geriatric Nutrition
6. Geriatric Nutrition: The Health Professional's Handbook, R.N. Seel, 5th Ed, 2019
7. Nutrition and Aging, I.H. Rosenberg, A. Sastre, 2nd Ed, 2017
8. Textbook of Geriatric Medicine, P.K. Sethi, 3rd Ed, 2021
9. Nutrient Requirements for Indians, RDA & TUL, ICMR-NIN, 2024, RDA for 60+ yrs: Energy, Protein, Ca, Vit D, B12
10. Dietary Guidelines for Indians, ICMR-NIN, 2024, Table 14: Guidelines for elderly
11. National Programme for Health Care of Elderly – NPHCE, MoHFW, GOI 2023, Operational guidelines, screening tools
12. India Aging Report, UNFPA + IIPS | 2023, Demography, nutrition status data
13. Longitudinal Aging Study in India – LASI Wave 1, MoHFW + IIPS, 2020 Anemia, BMI, malnutrition prevalence
14. WHO & International Guidelines:
 - a) Integrated Care for Older People, ICOPE, WHO | 2023 | Nutrition domain, MNA screening
 - b) ESPEN Guidelines on Clinical Nutrition in Geriatrics, 2022
 - c) Mini Nutritional Assessment – MNA User Guide, Nestlé Nutrition, 2021
 - d) Global Report on Ageism, WHO, 2021 Psychosocial aspects of nutrition
15. Websites & Tools ICMR-NIN: <https://www.nin.res.in> – Download RDA 2024
 WHO ICOPE: <https://www.who.int/publications/i/item/9789241515704> – Handbook + app
 MNA Official: <https://www.mna-elderly.com> – Forms in Hindi, English
 IDDSI: <https://iddsi.org> – Flow test videos, diet levels
 POSHAN Abhiyaan: <https://poshanabhiyaan.gov.in> –

DIET COUNSELING AND PATIENT CARE

1. Mahan LK and Escott-Stump S (2007): Krause's Food and Nutrition Therapy. 12th Ed. WB Saunders Company, London.
2. Robinson. CH, Lawler MR, Chenoweth WL and Garwick, AE (1986): Normal and Therapeutic Nutrition. 17th Ed., Macmillan Publishing Co.
3. Williams SR (1989): Nutrition & Diet Therapy, 6th Ed. Times Mirror/Mosby College Publishing, St. Louis

FOOD SAFETY AND QUALITY CONTROL

1. Frazier, W.C. & Westhoff, D.C. Food Microbiology. McGraw Hill
2. Lawley, R., Curtis, L., & Davis, J. The Food Safety Hazard Guidebook. RSC
3. Mortimore, S. & Wallace, C. HACCP: A Practical Approach. Springer

4. Adams, M.R. & Moss, M.O. Food Microbiology. RSC
5. Fellows, P.J. Food Processing Technology. Woodhead
6. FAO/WHO Codex Alimentarius Documents

RESEARCH METHODOLOGY I

1. Kothari, C.R. Research Methodology: Methods and Techniques
2. Creswell, J.W. Research Design
3. Montgomery, D.C. Design and Analysis of Experiments
4. AOAC Official Methods of Analysis
5. ICMR Guidelines and Ethical Standards

RESEARCH METHODOLOGY II

1. Daniel, W. W., & Cross, C. L. Biostatistics: A Foundation for Analysis in the Health Sciences. 11th ed., John Wiley & Sons, 2018.
2. Rosner, B. Fundamentals of Biostatistics. 8th ed., Cengage Learning, Boston, 2016.
3. Rao, K. Surya. Biostatistics for Health and Life Sciences. Himalaya Publishing House, Mumbai, Latest edition.
4. Pandey, M. Biostatistics. 1st ed., MV Learning, New Delhi, 2015.
5. Mansoori, M. F., & Ahangar, R. Research Methodology and Biostatistics. Ink Freedom Publication, New Delhi, Latest edition.
6. Ghosh, M. Business Statistics Using Excel, SPSS, and R. Cengage Learning India, Latest edition.
7. Pallant, J. SPSS Survival Manual: A Step-by-Step Guide to Data Analysis Using IBM SPSS Statistics. Open University Press / McGraw-Hill, Latest edition.
8. Gupta, S. P., & Gupta, A. Using SPSS for Windows. S. Chand & Company, New Delhi, Latest edition.
9. Shahbaba, B. Biostatistics with R: An Introduction to Statistics through Biological Data. Springer, New York, 2012.
10. MacFarland, T. W., & Yates, J. M. Using R for Biostatistics. Springer, Cham, 2016.
11. Irizarry, R. A. Introduction to Data Science: Data Analysis and Prediction Algorithms with R. CRC Press, Boca Raton, 2020.

FOOD FERMENTATION

1. Joshi, V.K. – Food Fermentation Microbiology & Technology
2. Tamang, J.P. – Fermented Foods and Beverages of the World
3. FSSAI Manuals on Food Safety & Fermented Products

4. Wang F.Y., Modern Food Fermentation Technology
5. Stanbury & Whitaker, Principles of Fermentation Technology
6. Codex and FSSAI Fermented Foods standards for regulatory perspectives

FOOD PACKAGING

1. Robertson, G.L. – Food Packaging: Principles and Practice
2. Coles, R. – Food Packaging Technology
3. FSSAI Manuals on Packaging & Labeling
4. Codex Alimentarius Packaging Guideline

FUNCTIONAL FOODS AND NUTRACEUTICALS

1. Wildman, R.E.C. – Handbook of Nutraceuticals and Functional Foods
2. Gibson & Williams – Functional Foods: Concept to Product
3. Bagchi, D. – Nutraceutical and Functional Food Regulations
4. FSSAI Regulations on Health Supplements & Nutraceuticals

IDC paper: BASIC NUTRITION AND FOOD SCIENCE

1. Guthrie, Hele, Andrews, Introductory Nutrition, 6th ed. St. Louis, Times Mirror/Mosby College, 1988.
2. Mudambi S.R, M.V Rajgopal Fundamentals of Foods and Nutrition (2nd Ed) Wiley Eastern Ltd, 1990.
3. Swaminathan S.: Advanced textbook on Foods Nutrition Vol. I, II (2nd ed revised and enlarged) B. app C. 1985.
4. Willson, E.V AD Principles of Nutrition, 4th ed. New York John Wiley and Sons, 1979.
5. Textbook of Nutrition - Ravinder Chadha & Pulkrit Mathur, Orient Blackswan Pvt. Ltd. Telangana.
6. Srilakshmi B. (2018). Nutrition Science. New Delhi New Age International.
7. Clinical Nutrition & Dietetics - F. P. Antia and Philip Abraham, Oxford University Press
8. Nutrition Science by B. Srilakshmi, latest ed.

COURSE STRUCTURE-MDC

	CC1	CC2	Minor	IDC	AEC	SEC	CVAC	Summer Internship	Total Credit
Semester	8x4= 32	8x4= 32	6x4= 24	3x3=9	4x2= 8	3x4=12	4x2=8	1x3= 3	124
1	1x4= 4 3TH+1P/TU	1x4= 4 3TH+1P/TU		1x3=3 2TH+1P/TU	1x2= 2 2TH+0P/TU	1x4= 4	2x2=4		21
2	1x4= 4 3TH+1P/TU	1x4= 4 3TH+1P/TU		1x3=3 2TH+1P/TU	1x2= 2 2TH+0P/TU	1x4= 4	2x2=4		21
3	1x4= 4 (3TH+ P/TU)	1x4= 4 3TH+1P/TU	1x4= 4 3TH+1P/TU	1x3=3 2TH+1P/TU	1x2= 2 2TH+0P/TU	1x4= 4			21
4	2x4=8 4x(3TH+1P/TU)	2x4= 8 2x(3TH+1P/TU)	1x4= 4 (3TH+1P/TU)		1x2= 2 2TH+0P/TU				22
5	2x4= 8 2x(3TH+1P/TU)	1x4= 4 3TH+1P/TU	2x4= 8 2x(3TH+1P/TU)						20
6	1x4= 4 (3TH+1P/TU)	2x4= 8 2x(3TH+1P/TU)	2x4= 8 2x(3TH+1P/TU)						20
Credits	8x4= 32	8x4= 32	6x4= 24	3x3= 9	4x2= 8	3x4= 12	4x2=8		125+3 =128
Marks	8x100=800	8x100=800	6x100=600	3x75=225	4x50=200	3x100=300	4x50=200		Total Marks =3200

Marks= 25 marks per credit.

Total credit=125+3 (for summer internship) = 128

Summer Internship: As mentioned in clause no. 8 (G)

**SYLLABUS FOR THREE YEAR B.A/B.Sc. MULTIDISCIPLINARY COURSE (MDC)
OF STUDIES in FOOD and NUTRITION UNDER CCF, 2022**

Semester	Category of Course	Course Title	Credits		
			Theory	Practical/OP/TU	Total
I	DSC/Core (CC1-1)	Basic Food Science I	3	1	4
II	DSC/Core (CC1-2)	Basic Food Science II	3	1	4
III	DSC/Core (CC1-3)	Human Nutrition I	3	1	4
IV	DSC/Core (CC1-4)	Human Nutrition-II	3	1	4
	DSC/Core (CC-1-5)	Advanced Food Science	3	1	4
V	DSC/Core (CC1-6)	Fundamentals of Community Nutrition	3	1	4
	DSC/Core (CC1-7)	Clinical Nutrition and Dietetics	3	1	4

VI	DSC/Core (CC1-8)	Food Preservation	3	1	4
	SEC offered*	Food Safety and Quality Control	3	1	4

***Students can opt SEC in First/Second/Third Semester**

Notes: Students those who wants to opt Food and Nutrition as **CC2-**

- ❖ The syllabus of Food and Nutrition from Semester I to Semester IV will be same as CC1.
- ❖ In semester V the CC2 students will opt only one paper i.e., CC1-6
- ❖ In semester VI the CC2 students will opt two papers of CC1 that is CC1-7 and CC1-8
- ❖ Those who opt Food and Nutrition as **Minor** in MDC will read total six papers of CC1 from Semester III to Semester VI as given below
 - Semester III: CC1-1
 - Semester IV : CC1-2
 - Semester V: CC1-3 & CC1-4
 - Semester VI: CC1-5 & CC1-6

FIRST SEMESTER

CC1-1-TH: BASIC FOOD SCIENCE-I

3 CREDITS

1. Basic concept on Food, Nutrition and Nutrients. Classification of Food, Classification of Nutrients.
2. Carbohydrates-Definition, Classification, Structure and properties.
Monosaccharides -glucose, fructose, galactose.
Disaccharides-Maltose, lactose, sucrose
Polysaccharides-Dextrin, starch, glycogen, resistant starch.
Carbohydrates-Sources, daily requirements, functions. Effects of too high and too Low carbohydrates on health. Digestion and absorption of carbohydrate.
3. Lipids-Definition, Classification & Properties. Fatty acids -composition, properties, types.
Lipids-sources, daily requirements, functions. Digestion & Absorption of nutrients. Role & nutritional significances of PUFA, MUFA, SFA, W-3 fatty acid.
4. Proteins-Definition, Classification, Structure & properties. Amino acids Classification, types, functions. Proteins - Sources, daily requirements, functions. Effect of too high- too low proteins on health. Digestion & absorption. Assessment of Protein quality (BV, PER, NPU). Factors affecting protein bio-availability including anti-nutritional factors.
5. Dietary Fibre-Classification, sources, composition, properties & nutritional significance

CC1-1-P: BASIC FOOD SCIENCE- I (PRACTICAL)

1 CREDIT

1. Identification of Mono, Di and polysaccharides
2. Identification of Proteins
3. Identification of glycerol

SECOND SEMESTER

CC1-2-TH: BASIC FOOD SCIENCE-II

3 CREDITS

1. Minerals & Trace Elements, Bio-Chemical and Physiological Role, bio-availability & requirements, sources, deficiency & excess (Calcium, Sodium, Potassium, Phosphorus, Iron, Fluoride, Zinc, Selenium, Iodine, Chromium)
2. Vitamins - Biochemical and Physiological role, Bio-availability and requirements, sources, deficiency & excess (Fat soluble and water-soluble vitamins), Provitamin, Antivitamin, Pseudo vitamin and Vitamers.

3. Water-Functions,dailyrequirements,Effectofexcessanddeficiency.Water balance.

CC1-2- P: BASIC FOOD SCIENCE-II (PRACTICAL)

1 CREDIT

1. Determination of Ash content in food
2. Determination of Moisture content in food
3. Determination of calcium, iron, and Vitamin C content in foods.

THIRD SEMESTER

CC1-3-TH: HUMAN NUTRITION-I

3 CREDITS

1. Concept and definition of terms-Nutrition, Malnutrition and Health: Scope of Nutrition.
2. Minimum Nutritional Requirement and RDA: formulation of RDA and Dietary Guidelines Reference Man and Reference Woman, Adult consumption unit.
3. Energy in Human Nutrition: Idea of Energy and its unit, Energy Balance, Assessment of Energy Requirements—deficiency and excess, Determination of Energy in food, B.M.R. and its regulation, S.D.A.
4. Growth & Development from infancy to adulthood: Somatic, physical, brain and mental development, puberty, menarche, pre-pubertal and pubertal changes, Factors affecting growth and development. Importance of Nutrition for ensuring adequate development.
5. Growth monitoring and promotion: Use of growth charts and standards, Prevention of growth faltering

CC1-3-P: HUMAN NUTRITION-I (PRACTICAL)

1 CREDIT

1. Process involved in cooking: pressure cooking, microwave, steaming, grilling, deep fat frying.
2. General concepts of weights and measures. Eye estimation of raw and cooked foods.
3. Preparation of food from different food groups and their significance in relation to health.
4. Preparation of supplementary food for different age group and their nutritional significance.
5. Planning and preparation of low-cost diet for Grade I and Grade II malnourished child

FOURTH SEMESTER

CC1- 4-TH:HUMAN NUTRITION-II

3 CREDITS

1. Nutrition During Pregnancy: Factors (non-nutritional) affecting pregnancy outcome, importance of adequate weight gain during pregnancy, antenatal care and its schedule, Nutritional requirements during pregnancy and modification of existing diet and supplementation, Deficiency of nutrients, specially energy, iron folic acid, protein, calcium, iodine. Common problems of pregnancy and their managements, specially -nausea, vomiting, pica, food aversions, pregnancy induced hypertension, obesity, diabetes. Adolescent pregnancy.

2. Nutrition during Lactation: Nutritional requirements during lactation, dietary management, food supplements, galactagogues, preparation for lactation. Care and preparation of nipples during breast feeding.

3. Nutrition during Infancy: Infant physiology relevant to feeding and care, Breast feeding colostrum, its composition and importance in feeding, Initiations of breast feeding. Advantages of exclusive breast feeding. Basic principles of breast feeding. Introduction of supplementary foods, initiation and management of weaning, Baby-led weaning. Bottle feeding-circumstances under which bottle feeding is to be given. Care & sterilization of bottles. Preparation of formula. Mixed feeding, breast feeding and artificial feeding.

4. Management of preterm and low birth weight babies.

5. Nutritional needs of toddlers, preschool, school going children and adolescents- Dietary management

CC1-4-P:HUMAN NUTRITION-II(PRACTICAL)

1 CREDIT

Planning and preparation of adequate meal for different age groups with special reference to different physiological conditions: infants, preschoolers, school children, adolescents, adults, pregnancy, lactation and old age

CC1-5-TH:ADVANCED FOOD SCIENCE

3 CREDITS

1. Basic five food groups: Nutritional significance, composition and different products of cereal, millets, pulses, fruits and vegetables

2. Milk and milk products: Composition, types, processing (clarification, pasteurization, homogenization), storage, spoilage, uses, nutritional aspects of milk, curds, butter milk, paneer, khoa, cheese, ice-cream, kulfi and various kinds of processed milk.
3. Eggs: Composition, grade, quality, nutritional aspects.
4. Fish, Poultry and Meat: composition and nutritional importance of fish, poultry and meat.
5. Food additives and adulterants: Definition, purpose and types. Basic concept of different types of additives and adulterants present in food.
6. Nutritional significance of spices and herbs.

CC1-5-P: ADVANCED FOOD SCIENCE (PRACTICAL)

1 CREDIT

1. Preparation of Milk based products like Flavoured Yoghurt, Flavoured curd, Butter milk, Custard, Pudding, etc.
2. Preparation of dehydrated Cereals, Millets and Pulses products like Chips, Papad etc.
3. Detection of adulterants in Milk and milk products (Starch, Sugar, Detergent), Spices like Turmeric powder (Metanil yellow, Starch), Chili powder (Metanil yellow, Brick powder), etc.

FIFTH SEMESTER

CC1-6-TH: Fundamentals of Community Nutrition

3 CREDITS

1. Concept and types of Community. Concept of community nutrition.
2. Nutritional Assessment: Meaning, need, objectives and importance. A brief idea on methods of nutritional assessment. Concept of ABCD method
3. Malnutrition: Definition, causes, classification, sign and symptoms of kwashiorkor, marasmus and marasmic kwashiorkor and their preventive measures.
3. Elementary idea of health agencies- FAO, WHO, ICMR, ICAR, NIN and CFTRI.
4. Nutritional Intervention programmes to combat malnutrition: ICDS, Mid- Day Meal Programme, SNP, ANP, NNAPP, National Prophylaxis programme for prevention of blindness due to Vitamin A deficiency, IDD control programme

5. Nutrition Education: Definition, objectives of nutrition education. Methods of imparting nutrition education.

CC1-6-P: Fundamentals of Community Nutrition

1 CREDIT

1. Preparation of homemade ORS.
2. Preparation of weaning foods for infants.
3. Preparation of low cost and medium cost school tiffin
4. Growth charts-plotting of growth charts, growth monitoring and promotion.
5. Diet survey by 24 hours recall method.

CC1-7-TH: CLINICAL NUTRITION AND DIETETICS

3 CREDITS

1. Definition of Dietetics, dietitian, Goals of Diet Therapy.
2. Basic concepts of Diet Therapy: Therapeutic adaptations of the normal diet. Routine hospital diets – Regular, soft, full fluid, clear fluid diet. Specially modified therapeutic diets.
3. Obesity and underweight: Causes, risk factors, dietary and general management of overweight and underweight.
4. Diarrhoea, Constipation and Hepatitis: Causes, symptoms and dietary management.
5. Anaemia: Definition, causes, classification, and dietary management of Nutritional anaemia.
6. Hypertension, Atherosclerosis and Diabetes Mellitus: Definition, Causes, Types, risk factors, signs, symptoms and dietary Management.
7. Fever: Definition, causes, types, symptoms and dietary management.

CC1-7-P: CLINICAL NUTRITION AND DIETETICS (PRACTICAL)

1 CREDIT

1. Preparation of soft, full fluid and clear fluid diet
2. Planning and preparation of Therapeutic Diets for the following diseases:
 - i) Diabetes mellitus
 - ii) Hepatitis

iii) Hypertension

iv) Obesity

v) Fever

SIXTH SEMESTER

CC1-8-TH:FOOD PRESERVATION

3 CREDITS

1. Food preservation: definition, objectives and principles of food preservation. Different methods of food preservation.
2. Preserved Products: Jam, Jelly, Marmalade, Sauces, Pickles, Squashes, Syrups-types, composition and manufacture, selection, cost, storage, uses and nutritional aspects.
3. Food Standards: ISI, Agmark, FPO, MPO, PFA, FSSAI

CC18-P:FOOD PRESERVATION(PRACTICAL)

1 CREDIT

1. Different methods of Food preservation–Drying, Freezing, Frying, Canning, Bottling, etc.
2. Aseptic handling: Sources of contamination of foods.
3. Preparation of pickles, tomato sauce, tomato puree, jam, jelly, squashes etc.

SECOffered

SEC:FOOD SAFETY AND QUALITY CONTROL

3 CREDITS

1. Food Quality: Meaning and definition of food quality, Quality factors in foods, indicators of food quality, importance and ways of Food Quality Assessment
2. Introduction to Food Hazards: Definition, types of hazard-physical, chemical (naturally occurring, environmental and intentionally added) and biological, factors affecting (food borne pathogens bacteria, viruses and eukaryotes; sea food and shellfish poisoning and mycotoxins)
3. Hygiene and Sanitation: Principles of food hygiene, personal hygiene, kitchen hygiene and sanitation. water quality assessment, insect and pest control, waste treatment and disposal, food vending and packaging standards, employees' health
4. Food Safety Management Tools: Basic concept, prerequisites-GHPs, GMPs. HACCP, ISO series. National Food Standards (BIS, AGMARK) and Food Laws (PFA and FSSAI).

SEC:FOODSAFETYANDQUALITYCONTROL(PRACTICAL) 1CREDIT

Detection of adulterants in the following Foods-Milk, Edible Oil, Sugar, Spices, honey, Flours, Ghee, Beverages (one method of detection for each food item).

1. To detect the adulterants like dyes and argemone in the fats, oils and ghee.
2. To detect the presence of adulterants like water, urea, formalin, detergent, sugar and starch in the milk.
3. To detect the adulteration of insoluble substance, chalk powder and washing soda in sugar.
4. To detect the adulteration of brick powder in chilli powder, Metanil yellow in turmeric.
5. To detect colouring agents in fruit juices and sweets.

SUGGESTED BOOKS AND JOURNALS BASIC

FOOD SCIENCE

1. Srilakshmi B (2017): Nutrition Science, 6th Multicolour Ed. New Age International (P) Ltd.
2. Roday S (2012): Food Science and Nutrition, 2nd Ed. Oxford University Press.
3. Mann J and Truswell S (2017): Essentials of Human Nutrition, 5th Ed. Oxford University Press.
4. Wilson K and Walker J (2000): Principles and Techniques of Practical Biochemistry, 5th Ed. Oxford University Press.
5. Sadasivan S and Manikam K (2007): Biochemical Methods, 3rd Ed. New Age International (P) Ltd.
6. Oser BL (1965). Hawk's Physiological Chemistry, 14th Ed. McGraw-Hill Book
7. Nath RL and Nath RK (1990). Practical biochemistry in clinical medicine, 2nd Ed. Academic Publishers.
8. Sen AR, Pramanik NK and Roy SK (2001): A treatise on analysis of food fat and oil, Oil Technologists Association of India (EZ), Kolkata, 76, 119.
9. Plummer D (2017): An introduction of Practical Biochemistry, 3rd Ed. McGraw Hill Education.
10. Swaminathan M (2007): Essentials of Food and Nutrition (Vol. I & II), 2nd Ed. Bappa co.
11. Meyer LH (2004): Food Chemistry, CBS Publishers & Distributors

HUMAN NUTRITION

1. Srilakshmi B(2014):Dietetics, 7th Multicolour Ed. New Age International (P) Ltd.
2. Guthrie AH(1986):Introductory Nutrition, 6th Revised Ed., McGraw-Hill Inc., US.
3. Robinson CH and Lawler M(1990):Normal and Therapeutic Nutrition. 17th Revised Ed. Macmillan USA.
4. Swaminathan M(2007):Essentials of Food and Nutrition (Vol. I & II), 2nd Ed. Bappa Co
5. Gopalan C, Rama Sastri BV and Balasubramanian SC(2016):Nutritive value of Indian Foods, Indian Council of Medical Research.
6. Nutrient Requirements and Recommended Dietary Allowance for Indians, Indian Council of Medical Research: New Delhi.
7. FAO/WHO/UNO: Technical Report Series, 724(1985). Energy and Protein Requirement, Geneva.
8. Ghosh S(2007):Nutrition and Child Care, 2nd Ed. Jaypee Brothers Medical Publishers Private Limited.
9. WHO: A growth chart for international use in maternal and children health care, Geneva.
10. Mann J and Truswell S(2017):Essentials of Human Nutrition, 5th Ed. Oxford University Press.
11. Worthington-Roberts B and Williams SR(1999): Nutrition Throughout the Life Cycle , 4th Ed. McGraw-Hill Higher Education.
12. Elizabeth KE(2015);Nutrition and Child Development, 5th Ed. Paras Medical Publishers.
13. Geissler C and Powers H(2005):Human Nutrition, 11th Ed. Churchill Livingstone.
14. Zimmermann M(2001):Burgerstein's Handbook of Nutrition: Micronutrients in the Prevention and Therapy of Disease Thieme Stuttgart.

15. Samour PQ and King K (2010): Pediatric Nutrition, 4th Ed. Jones & Bartlett Learning.
16. Insel P, Ross D, McMahon K and Bernstein M (2016): Nutrition, 6th Ed. Jones & Bartlett Learning.
17. Mudambi SR (2018): Fundamentals of Foods, Nutrition and Diet Therapy, 6th Ed. New Age International (P) Ltd.
18. Williams SR (2001): Basic Nutrition and Diet Therapy, 11th Ed. Elsevier.
19. Proudfit FT and Robinson CH (1967): Normal and Therapeutic Nutrition, 13th Ed. Mamillan.
20. Guthrie H and Picciano MF (1994): Human Nutrition, WCB McGraw-Hill,
21. Smith A and Collene A (2015): Wardlaw's Contemporary Nutrition, 10th Ed. McGraw-Hill Education.
22. Sharlin J and Edelstein S (2010): Essentials of Life Cycle Nutrition, 1st Ed. Jones & Bartlett Learning.
23. Indian National Code for Protection of Breast Feeding: Govt. of India. Ministry of Social Welfare, New Delhi.

COMMUNITY NUTRITION

1. Jelliffe DB. Assessment of the Nutritional Status of the Community; World Health Organization.
2. Sahn DE, Lockwood R, Scrimshaw NS (1988): Methods for the Evaluation of the Impact of Food and Nutrition Programmes, 2nd Printing, United Nations University.
3. Ritchie, JAS (1979): Learning Better Nutrition, Nutritional Studies number 20, FAO, Rome.
4. Gopaldas T and Seshadri S (1988): Nutrition Monitoring and Assessment, Oxford University Press.

5. Mason JB, Habicht JP, Tabatabai H and Valverde V (1984): Nutritional Surveillance, World Health Organisation.
6. Park K (2017): Textbook of Preventive and Social Medicine, 24th Ed. Banarsidas Bhanot Publishers.
7. King MH, King PMA, Morley D and AP Burgess (2015): Nutrition for Developing Countries, ELBS Oxford University Press.
8. Passmore R and Eastwood MA (1986): Davidson and Passmore's Human Nutrition & Dietetics, 8th Revised Ed. Churchill Livingstone.
9. Seshubabu VVR (2011): Review in Community Medicine, 2nd Ed, Paras Medical Books Pvt Ltd.
10. Mahajan BK, Roy RN, Saha I, Gupta MC (2013): Textbook of Preventive and Social Medicine, 4th Ed. Japee Brothers.
11. Vir SC (2011): Public Health Nutrition in Developing Countries, Woodhead Publishing India.
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FOOD PRESERVATION

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