SNDT Women's University, Mumbai

Master of Science
(Home Science- Food Science & Nutrition)

M.Sc. (FSN)

As per NEP 2020

Syllabus

(w. e. f. Academic Year 2023-24)

SNDT Women's University, Mumbai

NEP Syllabus for Postgraduate Programme

M.Sc. (Food Science & Nutrition)

2023-24

Programme Degree		M.Sc.
Faculty		Science & Technology
Specialization		(Food Science and Nutrition)
Preamble		This programme is aimed at creating skilled and sensitized individuals who understand interrelationship of food science, human nutrition and methods of investigation for public health. It is design to obtain competencies and capabilities for learners to be able to contribute towards healthy human society. At the end of this Programme, the learners obtain skill sets to work in food industry/ food testing Labs/ R & D units, Food Science & Nutrition Research, and Academics.
Programme Specific Outcomes		After completing this programme, Learner will be able to:
	1.	Have updated knowledge and develop capacities in the areas of Human Nutrition and Food Science, Food Safety and Quality, Food Product Development.
	2.	Have obtained sound understanding of Food Science and Nutrition as well as various sciences and disciplines with understanding about the inter disciplinary nature of Food Science and Nutrition.
	3.	Develop abilities including analysis, critical reasoning and use their creativity to become professionals in these and related areas to work effectively and efficiently in academics, research, food industry, training, extension and community service.
	4.	Have the necessary capacities and abilities and enable them to Pursue higher education and research in Food Science and Human Nutrition.
	5.	Undertake state of the art, cutting edge research in their chosen fields.
	6.	Participate effectively as responsible and ethical professionals who can contribute substantially to national development and quality of life of citizens.
Eligibility Criteria for the Programme	Any student who has passed 12th Standard/H.Sc./10+2 with Science and successfully completed graduation in Nutrition related subjects with minimum 50%/B Grade from UGC/AICTE recognized institution is eligible to apply for this programme. Students having Graduation in Bio-Technology/Microbiology/Zoology/Botany and other Life Science subjects with 55% are eligible to apply provided they	

	have studied minimum eight credits of nutrition/Physiology/ Biochemistry related subjects in their graduation. Students with Commerce/Arts/Pure Science, B.Sc. Composite Home Science/ BA Home Economics/ Home Science/ BSc. Hospitality/ Institutional/ Food Service Management are not eligible.
Intake (For SNDTWU Departments and Conducted Colleges)	20

RM: Research Methodology * OJT: On-Job Training * RP: Research Project

Structure for Four Semesters

M.Sc. (Food Science and Nutrition)

Semester I						
SN	*Courses*	*Type of Course*	*Credits*	*Marks*	*Int*	*Ext*
114311	Physiological Biochemistry (Th.)	Major (Core)	4	100	50	50
114312	Food Chemistry (Th.)	Major (Core)	4	100	50	50
114313	Human Nutrition I (Macro nutrients & water) (Th.)	Major (Core)	4	100	50	50
114324	Methods of Investigations in Foods & Nutrition (Pr.)	Major (Core)	2	50	-	50
124321 124312	Food Science & Chemistry (Pr.) OR Public Nutrition & Health (Th.)	Major (Elective)	4	100	50	50
134311	Methods of Research (Th.)	Minor Stream (RM)	4	100	50	50
End of Semester I			**22**	**550**	**250**	**300**
Semester II						
214311	Food Microbiology I (Th. & Pr.)	Major (Core)	4 (2 + 2)	100	50	50
214312	Human Nutrition II (Micro nutrients) (Th.)	Major (Core)	4	100	50	50
214313	Food Safety & Quality Control (Th. & Pr.)	Major (Core)	4 (1 + 3)	100	50	50
214324	Food Product Development, Modification & Sensory Evaluation (Pr.)	Major (Core)	2	50	-	50
224321 224312 224313 224314	Food Processing & Technology (Pr.) OR Food Quality Standards & Regulations (Th.) OR Functional Foods, Biodynamic Principles, Nutraceuticals OR Food Entrepreneurship	Major (Elective)	4	100	50	50
244341	Internship*	OJT	4	100	50	50
Exit with PG Diploma in Food Science Nutrition (FSN)			**22**	**550**	**250**	**300**

(* Internship at Research & Development Laboratory/Food Analysis Laboratory/ Nutrition Research)

Semester III						
Code	***Courses***	***Type of Course***	***Credits***	***Marks***	***Int***	***Ext***
314311	Research and Statistical Application	Major (Core)	4	100	50	50
314312	Maternal & Child Nutrition (Th.)	Major (Core)	4	100	50	50
314313	Food Microbiology II (Th. & Pr.) (2 +2)	Major (Core)	4	100	50	50
314324	Assessment of Nutritional Status (Pr.)	Major (Core)	2	50	-	50
324321 324312 324313 324314 324315 324316	Food Product Development (Pr.) OR Genetics OR Research from Molecular Level to Human OR Recent Methods in Food Processing, Preservation and Packaging OR Understanding Metabolic and Cardiovascular Health OR Advances in Food Microbiology and Safety	Major (Elective)	4	100	50	50
354331	Research Project	Research Project	4	100	50	50
End of Semester III			**22**	**550**	**250**	**300**
Semester IV						
414311	Nutrigenetics & Nutrigenomics (Th.)	Major (Core)	4	100	50	50
414312	Nutrition Human Microbiome & Health (Th.)	Major (Core)	4	100	50	50
414323	Nutrition in Society (Pr.)	Major (Core)	4	100	50	50
424311 424312 424313 424314 424315 424316 424317	Environment Sustainability, Food and Nutrition Security for Health OR Integrated Lifestyle Health Management OR Integrated Diet and Musculoskeletal Health OR Food Product Development for Special population OR Indian Knowledge Systems in Diet, Food & Health OR Nutritional Epidemiology	Major (Elective)	4	100	50	50
454331	Dissertation	Research Project	6	150	100	50
End of Semester IV			**22**	**550**	**300**	**250**

Semester I

Syllabus Contents

1.1 Major (Core)

114311	**Physiological Biochemistry** *Major Core (4+0)*	4
Course Objective	This course enables students to: 1. Learn the anatomy of human body. 2. Understand the metabolism of nutrients in human body. 3. Comprehend the metabolism of genetic components, purine and pyrimidines.	
Course Outcomes	After going through the course, learners will be able to -	
	1.Understand the mechanisms adopted by the human body for regulation of metabolic pathways	
	2.Describe biochemical pathways relevant in nutrient metabolism.	
	3. Develop an insight into interrelationships between various metabolic pathways.	
	4.Understand integration of cellular level metabolic events to nutritional disorders and imbalances.	
	5. Review biochemical techniques that are relevant for the investigation of nutrient metabolism.	
Module 1		1
Learning Outcomes	After learning the module, learners will be able to -	
	1. Define and differentiate the structure, composition of membrane.	
	2. Recognize cell signaling pathways.	
Content Outline	● Membrane structure, composition and transport of metabolites across membranes ● Acid base balance and its regulation ● Enzymes ● Kinetics of monosubstrate and bisubstrate catalysed reactions (including inhibition) ● Enzyme specificity, regulation of enzyme activity and synthesis ● Enzymes in clinical diagnosis. Detoxification in the body-metabolism of xenobiotics (Phase I and Phase II enzymes) ● Cell Signalling pathways- Overview of extracellular cell signalling, G protein couple receptors and their effectors, enzyme linked receptors and their effectors, second messengers, map kinase pathways ● Free radicals, ROS and oxidative damage	
Module 2		1
Learning Outcomes	After learning the module, learners will be able to -	
	1. Understand the metabolism of carbohydrates, lipids and protein	

Content Outline	○ Carbohydrate Metabolism- a. Intestinal transport of carbohydrates, Transport of glucose across various cells, Cellular metabolism of carbohydrates Glycogen metabolism, Regulation of carbohydrate metabolism at substrate level, enzyme level, hormonal level and organ level, b. Disorders of carbohydrate metabolism. c. Definition, classification, structure and properties of glycoproteins and proteoglycans ○ Metabolism of Lipids- a. Metabolism is to be discussed with reference to: Intestinal transport of lipids, Cellular uptake and metabolism of lipids (beta-oxidation, de novo synthesis of fatty acids, synthesis and breakdown of unsaturated fatty acids, cholesterol, phospholipids and triacylglycerol) Lipoprotein metabolism, VLDL and LDL ('Forward' Cholesterol transport) VLDL and LDL (Endogenous TAG transport), HDL ('Reverse' Cholesterol transport), b. Regulation of lipid metabolism at substrate level, enzyme level, hormonal level and organ level, Disorders of lipid metabolism, Dyslipidaemias, Lipid storage diseases ○ Protein Metabolism- a. Metabolism of amino acids- biosynthesis and catabolism - energy, glucose and ketone bodies, protein amino acids, non-protein amino acids (including urea cycle, transamination, one-carbon metabolism), b. Creatine and creatinine, c. Plasma proteins – Nature, properties and functions, d. Biologically active peptides, polypeptides and transport proteins, Inborn errors of amino acid metabolism
Module 3	1
Learning Outcomes	After learning the module, learners will be able to - 1. Examine the intermediary metabolism of human body. 2. Define biological oxidation.
Content Outline	▪ Intermediary Metabolism- ○ Review of regulation of intermediary metabolism- equilibrium and non-equilibrium reactions, committed steps, allosteric modifications, covalent modulation, hormonal induction and repression, crossover theorem, starve-feed cycle, caloric homeostasis and futile cycles, Tricarboxylic acid cycle ▪ Biological Oxidation: Electron transport chain and oxidative phosphorylation
Module 4	1
Learning Outcomes	After learning the module, learners will be able to - 1. Define the metabolism of purine and pyrimidines. 2. Recognise the metabolism of DNA, RNA.
Content Outline	○ Biochemical aspects of purine and pyrimidines- ○ Metabolism of purines ○ Metabolism of pyrimidines ○ Role of purine and pyrimidine nucleotides in metabolism.

	○ Biochemistry of Nucleic Acids- ○ Metabolism of DNA ○ Metabolism of RNA ○ DNA replication, mutation, repair and recombination concepts ○ Disorders of nucleic acid metabolism ○ Protein Biosynthesis- ○ Gene expression and its regulation, transcription, translation, post-translational modification ○ Inhibitors of protein biosynthesis ○ Gene expression in mitochondria ○ Systems Biology including Metabolomics and Proteomics
Assignments/Activities towards Comprehensive Continuous Evaluation (CCE): - Summarise the pathways of specific nutrient metabolism n human body. - Present a project on physical structure and composition of each nutrients.	

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Major (Core)

Semester I		
114312	**Food Chemistry** *Major core (4+0)*	4
Course Objective	This course enables students to: 1. Learn the basic concepts of nutrients that compose the food. 2. Understand the structure and role of nutrients in food. 3. Comprehend the effects of processing on food and its composing nutrients.	
Course Outcomes	Be familiar with composition of food stuffs	
	Understand the properties and significance of various food constituents.	
	Understand changes occurring in various food stuffs after harvest, during storage and transportation, as a result of processing and cooking.	
	Apply this knowledge for food product development, food analysis and quality control.	
Module		1

Learning Outcomes	After learning the module, learners will be able to -
	1. Define water and its properties. 2. Distinguish between classifications of carbohydrates.
Content Outline	○ Water, Ice and Food Dispersions a: Structure and properties of water and ice - types of water, solutions and colligative properties - Water activity and Food spoilage, Sorption phenomena - Phase transition of foods containing water - Relation between viscosity and temperature - WLF equation - Water-solute interactions -Heat transfer during processing b: Colloidal salts, stabilization of colloidal systems, Rheology of food dispersions c: Gels: Structure, formation, strength, types and permanence d: Foams: Structure, formation and stabilization
	○ Carbohydrates: Polysaccharides, Sugars and Sweeteners a. Reactions of mono and oligosaccharides b. Use of Polysaccharides in foods: Non-starch Polysaccharides: Cellulose, hemicelluloses, pectins, Gums (gum Arabic, guar gum, xanthan gum), animal polysaccharides, agar, alginates, carageenan. c. Starch: Structure, Properties of amylose and amylopectin, effect of processing -gelatinization, methods for following gelatinization. Characteristics of some food starches. Effects of ingredients and conditions on gelatinization. Retrogradation d: Polysaccharide hydrolysis e: Modified food starches: mechanically damaged starches, extruded starches, pre-gelatinized, thin boiling starch, cross-linked starches, starch ethers and esters, oxidized starches f: Sugars and Sweeteners: Sugars, syrups, sugar alcohols, potent sweeteners, sugar products, Caramelization. Confectionery, chocolates, jams and jellies, synthetic and natural beverages
Module 2	1.5
Learning Outcomes	After learning the module, learners will be able to
	1. Define Proteins and its properties. 2. Distinguish between classifications of Amino Acids.
Content Outline	**A: Chemistry of Amino acids, peptides, proteins and Science of Protein Foods** a: Review of structure, physicochemical properties, functional properties of amino acids, peptides and proteins b: Chemical and enzymatic modifications- denaturation, non-enzymatic browning, and other chemical changes c: Processing induced physical, chemical and nutritional changes d: Texturized proteins e: Protein isolates, concentrates f: Protein hydrolysate **B. Enzymes:** a. Review of nomenclature, properties and isolation Nature of enzymes, stability and action. b: Factors influencing enzymes- enzyme inactivation and control c: Enzymes in food processing and modification- Proteolytic enzymes, oxidases, lipases, enzymes decomposing carbohydrates and applications d: Immobilised enzymes in food processing. e. Enzymes in waste management

	f Enzymes and health/nutrition/food issues C. **Milk and Milk Products:** a. Composition. Physical and functional properties. b. Denaturation c. Effects of processing and storage. d. Cultured milk, yogurt, butter, whey, cheese, concentrated and dried products, frozen desserts, dairy product substitutes. **D. Meat and Poultry:** a. Muscle composition, characteristics and structure. b. Post mortem changes. c. Processing, preservation and their effects. Heat-induced changes in meat. d Variables in meat preparation. Tenderizers. e. Meat Products. **E. Eggs:** a. Structure and Composition. Changes during storage. b. Functional properties of eggs, use in cookery. c. Egg processing. d. Low cholesterol egg substitutes. **F.Fish and Sea Food:** a. Types and Composition b. Storage and changes during storage. Changes during processing. c. By-products and newer products. **G. Pulses and Legumes**: a. Structure, composition b. Processing. c. Toxic constituents.
Module 3	1
Learning Outcomes	After learning the module, learners will be able to -
	1. Define lipids and its properties and classifications. 2. Distinguish between aroma compounds.
Content Outline	**A. Lipids: Fats, Oils and Related Products** a. Review of nomenclature, classification, sources, composition, and properties b. Role of lipids in food flavour. Effects of processing on chemical structure and physical properties- Precursors of aroma compounds c: Functional properties of fat and uses in food preparations, inter-esterification of fats. d: Lipids exposed to frying conditions, hydrogenated fat and irradiated foods e: Lipid-protein complexes, emulsions: formation, stability, surfactants and emulsifiers f. Fat deterioration and antioxidants g. Fat substitutes **B. Nuts and Oilseeds:** Composition, Oil extraction and by-products **C. Flavors:** a: Individual aroma compounds- vegetable, fruit and spice/condiment flavors, flavors from lactic acid/ethanol fermentation, flavors volatiles from fats and oils, flavor volatiles in muscle foods and milk b. Composition, flavorings extracts – natural and synthetic c: Thermally induced process flavors

	d: Natural and synthetic flavors d: Interactions with other constituents	
Module 4		0.5
Learning Outcomes	After learning the module, learners will be able to -	
	1. Designing the processing of fruits and vegetable products.	
Content Outline	**Fruits, Vegetables and Processed Products** a. Plant anatomy, gross composition, structural features and activities of living systems. b. Enzymes in fruits and vegetables. Flavour constituents. Plant phenolics. Pigments. c. Post-harvest changes. Texture of fruits and vegetables. d. Effects of storage, processing and preservation **Processed Foods:** Squashes, Pickles, fruit/vegetable–based, vinegar, pickles. b. Beverages: Synthetic and natural, alcoholic and non-alcoholic, carbonated and non-carbonated, coffee, tea, cocoa. Malted drinks. c., bakery products, dehydrated products.	
Assignments/Activities towards Comprehensive Continuous Evaluation (CCE): - Present a report on effect of industrial processing on food. - Summarise the effects of transportation on nutrients in food.		

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Journals:

- Advances in Food Research
- Journal of Agricultural and Food Chemistry
- Journal of Food Science
- Journal of Food Science and Technology

1.2 Major (Core)

Semester I		
114313	**Human Nutrition I (Macronutrients)** *Major Core (4+0)*	4
Course Objective	This course enables students to: 1. Learn the basic principles of human nutritional requirements 2. Understand the composition of nutrients of food and its application in detail. 3. Calculate the estimated requirement of nutrients for humans	
Course Outcomes	After going through the course, learners will be able to -	
	1. Gain in-depth knowledge of the physiological and metabolic role of macronutrients and their importance in human nutrition.	
	2. Enable the understanding of basis of human nutritional requirements and recommendations through the life cycle and translate the knowledge into practical guidelines for dietary needs.	
	3. Familiarize with the recent advances in nutrition and apply this knowledge in planning for public health programmes.	
Module 1		1
Learning Outcomes	After learning the module, learners will be able to -	
	1. Define RDA, EAR, etc,	
	2. Understand the components of energy expenditure	
Content Outline	• Human Nutritional Requirements – Development and Recent Concepts. a. Methods of determining human nutrient needs b. Description of basic terms and concepts in relation to human nutritional requirements. c. Guidelines and Recommendations - Development of International and National Nutritional Requirements - Translation of nutritional requirements into Dietary • Body Composition a. Significance of body composition and changes through the life cycle	

	b. Methods for assessing body composition (both classical and recent) and their applications. ● Nutrition in Special Conditions: Space Travel, High Altitudes, Low Temperature, Submarines. ● Energy a.Components of energy requirements: BMR, RMR, thermic effect of feeding, physical activity. Factors affecting energy requirements, methods of measuring energy expenditure. b.Estimating energy requirements of individuals and groups. c.Regulation of energy metabolism and body weight: Control of food intake – role of leptin and other hormones.
Module 2	1
Learning Outcomes	After learning the module, learners will be able to - 1. Define Glycemic index, glycemic load and differentiate between the types of dietary fiber and their mechanism of action. 2. Relate carbohydrates with gene expression.
Content Outline	○ Carbohydrates a.Review of nutritional significance of carbohydrates and changing trends in dietary intake of different types of carbohydrates and their implications b.Dietary fibre: Types, sources, role and mechanism of action c.Resistant starch, fructo-oligosaccharides, other oligosaccharides: Chemical composition and physiological significance d.Glycemic Index and glycemic load e.Carbohydrates and gene expression
Module 3	1
Learning Outcomes	After learning the module, learners will be able to - 1. Understand the role of protein & its metabolism.
Content Outline	○ Proteins a.Overview of role of muscle, liver and G.I. tract in protein metabolism b.Amino acid and peptide transporters c.Therapeutic applications of specific amino acids d.Peptides of physiological significance e.Proteins, amino acids and gene expression.
Module 4	1
Learning Outcomes	After learning the module, learners will be able to - 1. Understand the role and metabolism of lipids.
Content Outline	○ Lipids a.Nutritional significance of fatty acids – SFA, MUFA, PUFA: functions and deficiency b.Role of n-3 and n-6 fatty acids c.Prostaglandins d.Trans Fatty Acids e.Conjugated linoleic acid

	f.Nutritional Requirements and dietary guidelines (International & National) for visible and invisible fats in diets. g.Lipids and gene expression.
Assignments/Activities towards Comprehensive Continuous Evaluation (CCE): - Conduct a practical for estimation of nutrient requirement based on anthropometric assessments in the neighbourhood. - Present a report summarising role of specific nutrients in human body	

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- Indian Council of Medical Research. Recommended Dietary Intakes for Indians - Latest Recommendations.
- International Life Sciences Institute Present Knowledge in Nutrition – latest edition
- WHO Technical Report Series.
- World Reviews of Nutrition and Dietetics.

1.4 Major (Core)

Semester I		
114324	**Methods of Investigation in Foods & Nutrition** *Major Core (2+0)*	2
Course Objective	This course enables students to: 1. Learn the basic techniques of food assessment 2. Understand the principles of food composition. 3. Demonstrate the various techniques and tests to assess the food composition.	
Course Outcomes	1. Examine the principals involved in different methods of investigation.	
	2. Apply the principles of analytical techniques available for research in food science and nutrition.	
	3. Classify the applications, strengths and limitations of different methods	
	4. Recognise with the applications of the above techniques.	
	5. Become efficient in the use of some of the most commonly used techniques and instruments in High quality research.	
Module 1		1
Learning Outcomes	After learning the module, learners will be able to	
	1. Analyse basic physiochemical principles related to food. 2. Recognize colourimetric and spectrometric techniques.	

Content Outline	1. Electrolytic dissociation – Acids, bases, salts, buffers, Hendersen- Hasselbach equation. Theory of indicators and principles of measurement of pH. Acid and Alkalis: Preparation of dilute solutions of common acids and alkalis and determining their exact normalities. Buffers: Preparation of phosphate, carbonate-bicarbonate, boric acid, acetate, chloride and pthalate buffers and determination of their pH by the use of indicators and pH meters. Bioassays – Animal studies, Human Studies, Microbiological assays. **Radiochemical Methods** Use of Isotopes – Radioactive and stable isotopes. **Basics of Instrumentation**– Physico-chemical principles and methodology – 1:Colorimetry, Spectrometry: Beer Lambert law, absorption maximum, Preparation of standard curve and nutrient estimations in UV and visible range 2:Photometry 3:Fluorimetry 4: flame photometry 5: Atomic absorptiometry. AAS, AES 6: Infrared spectrometry
Module 2	1
Learning Outcomes	After learning the module, learners will be able to - 1. Know the rheological properties of food items. 2. Apply varied separation techniques of food.
Content Outline	**Separation Techniques** Chromatography – Principles and application in chromatographic techniques: 1:Paper (circular, ascending and descending) 2:Ion-exchange 3: column 4:Thin layer 5:Gas liquid 6:high performance liquid chromatography 7: Supercritical fluid extraction Electrophoresis and Centrifugation Principle and applications in paper and gel electrophoresis. NMR and its applications Immunological Methods – RIA, ELISA. Viscosity and Consistency Measurements of Food. Unit 1. Measurements of Rheological properties Measurement of specific gravity, freezing point, melting point, refractive index, gel strength, Brix, Densitometry, Refractometry, Polarimetry, Measurement of Colour. Instrumental Measurement of Texture of Foods Dough, Pasta, Baked Products, Fruits and Vegetables, Dairy Products, Meat, Starch. Relative Humidity and Water Activity Aeration / Over run Measurement

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- Demonstrate a visual representation for pathway of assessment of food.
- Prepare a report on scope and applications of food assessment techniques.

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1.5.1 Major (Elective)

Semester I		
124321	**Food Science and chemistry (Practical)** *Major Elective (0+4)*	4
Course Objective	This course enables students to: 1. Learn the basic principles of food science. 2. Understand the applications and techniques of different food groups in cooking. 3. Understand the scope of food production for commercial purposes.	
Course Outcomes	1. To understand principles of food science involved in bringing changes in foods.	
	2. To observe and identify physical and chemical changes underlying the preparation of diverse foods.	
Module 1		1
Learning Outcomes	After learning the module, learners will be able to -	
	1. Understand the process of sugar cookery. 2. Able to make formulation of candies.	

Content Outline	**A. Solutions and Ice crystallization**: a) Effect of formula and procedure on crystal size of frozen desserts **B. Sugar cookery** a) Tests for stages of sugar cookery b) Effect of dry heat on sucrose. c) Crystalline and Non crystalline candies	
Module 2		1.5
Learning Outcomes	After learning the module, learners will be able to -	
	1. Know applications of processing of cereals and flours. 2. Examine sensorial characteristics related food items.	
Content Outline	**A. Cereals and Flours** a) Gelatinization of Starch (different types) b) Comparison of different cereals for water absorption and consistency c) Comparison of - different methods of cooking rice, different varieties of rice d) Starches as thickening agents (potato, corn and other) **B. Temporary and Permanent emulsions** a) Salad Dressings b) Effect of Stabilizers and Emulsifiers in salad dressings c) Comparisons of low fat and high fat French dressing d) Preparation and Comparison of Mayonnaise with variations (with and without egg) **C. Principles that maintain high quality fried foods** a) Smoke point of different fats and oils b) Effect of Temperature on fat absorption c) Effect of Formulation on fat absorption d) Effect of Coating and binding agents on fat absorption e) Comparison of Texture, flavor and mouth-feel of food products using fat substitutes.	
Module 3		1.5
Learning Outcomes	After learning the module, learners will be able to	
	1. Understand role of protein in food processing. 2. Able to examine properties of various food items.	
Content Outline	**. Effect of different conditions on properties of proteins** **e.g milk** a) Effect of acids (citric acid, lactic acid and acetic acid) on coagulation of milk proteins b) Effect of gums on gelation c) Effect of fat content, pH stabilizers in cream and whipped toppings d) Difference between natural and processed Cheese **B. Examination of properties of egg/meat** a) Denaturation and Coagulation b) Egg white foams – volume and stability c) Effect of acid and alkalies on meat/poultry **C. Factors affecting Gelatin gel** a) Temperature of liquid b) Proteolytic enzymes c) Whipping **D. Factors affecting vegetable pigments** a) Temperature b) Acid, c) Alkalies **E. Pectin gel** a) Determination of pectin content, development of a fruit jam, using natural and commercial pectin.	
Assignments/Activities towards Comprehensive Continuous Evaluation (CCE): Relate the principles of food science and preparation of different recipes.		

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- McWilliam, M. (2001). Foods – Experimental Perspectives (4th Ed.), New Jersey: Prentice Hall Inc.
- Weaver, C. (1996), Food Chemistry Laboratory – A manual for Experimental Foods

1.5.2 Major (Elective)

<table>
<tr><th colspan="3">Semester I</th></tr>
<tr><td>124312</td><td>Public Nutrition and Health
Major Elective (4+0)</td><td>4</td></tr>
<tr><td>Course Objective</td><td colspan="2">This course enables students to:
1. Learn the basic principles of public nutrition.
2. Understand the major nutritional concerns in community.
3. Understand the application of nutritional intervention at a community level.</td></tr>
<tr><td rowspan="3">Course Outcomes</td><td colspan="2">Develop a holistic knowledge base and understanding of the nature of important nutritional problems and their prevention and control for the disadvantaged and upper socio-economic strata in society</td></tr>
<tr><td colspan="2">Understand the causes /determinants and consequences of nutritional problems in society</td></tr>
<tr><td colspan="2">Be familiar with various approaches to nutrition and health interventions, programmes and policies.</td></tr>
<tr><td colspan="2">Module 1</td><td>1</td></tr>
<tr><td rowspan="2">Learning Outcomes</td><td colspan="2">After learning the module, learners will be able to -</td></tr>
<tr><td colspan="2">1. Know the concepts associated with public health and nutrition.
2. Understand the concepts of food and nutrition security.</td></tr>
<tr><td>Content Outline</td><td colspan="2">Concept of public nutrition
a. Relationship between health and nutrition
b. Role of public nutritionists in the health care delivery
Sectors and Public Policies relevant to nutrition and health.

Primary Health Care of the Community
a. National Health Care Delivery System
b. Determinants of Health Status
c. Indicators of Health

Population Dynamics
a. Demographic transition
b. Population structure
c. Fertility behavior
d. Population policy
e. Fertility
f. Interrelationship between Nutrition and Quality of Life

Food and Nutrition Security
a. Food production
❖ Access
❖ Distribution
❖ Availability
❖ Losses
❖ Consumption
b. Food Security
c. Socio-cultural aspects and Dietary Patterns:
Their implications for Nutrition and Health</td></tr>
<tr><td colspan="2">Module 2</td><td>1</td></tr>
<tr><td rowspan="2">Learning Outcomes</td><td colspan="2">After learning the module, learners will be able to -</td></tr>
<tr><td colspan="2">1. Understand influence of determinates of nutritional status.
2. Critically examine relationship of nutrient deficiencies amongst population.</td></tr>
</table>

Content Outline	**Nutritional Status** a. Determinants of nutritional status of individual and populations b. Nutrition and Non-nutritional indicators ❖ Socio-cultural ❖ Biologic ❖ Environmental ❖ Economic c. Assessment of nutritional status of individuals of different ages- MUAC, Weight for age, Height for age, Weight for Height, Ponderal index, BMI Applications and limitations in different field situations- choice of an indicator **Major Nutritional Problems** – etiology, prevalence, clinical manifestations, preventive and therapeutic measures for: a. Macro and micro nutrient deficiencies b. Other nutritional problems like lathyrism, dropsy, aflatoxicosis, alcoholism and fluorosis. c. Overweight, obesity and chronic degenerative diseases
Module 3	2
Learning Outcomes	After learning the module, learners will be able to -
	1. Able to implement approaches and strategies for community nutrition. 2. Design interventions for improving malnutrition and public health.
Content Outline	**Approaches and Strategies for improving nutritional status and health:** a. National Food, Nutrition and Health Policies - Plan of action and programmes b. Programmatic options- their advantages and demerits. Feasibility Political support Available resources (human, financial, infrastructural) c. Case studies of selected strategies and programmes: their rationale and context, how to select interventions from a range of possible options: d. Health-based interventions, Food-based interventions including fortification and genetic improvement of foods, supplementary feeding, Nutrition education for behaviour change. Health economics and economics of malnutrition a. Its impact on productivity and national development b. Cost-Benefit Cost effectiveness Cost efficiency
Assignments/Activities towards Comprehensive Continuous Evaluation (CCE): - Demonstrate a working principle of a health and nutrition based non-profit organisation. - Conduct a community survey for health assessment techniques	

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- Park, K. (2021): Park's textbook of preventive and social medicine, 26 th Edition, M/s. Banarasidas Bhanot, Jabalpur.
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1.6.1 Minor Stream

Semester I		
134311	**Research Methodology (Th.)** *Minor stream (4+0)*	4
Course Objective	This course enables students to: 1. Learn the basic principles of clinical research and its types. 2. Understand the scientific process of conducting research. 3. Understand the tools and systems available for collecting data for research purposes.	
Course Outcomes	After learning the module, learners will be able to -	
	1. Develop a scientific approach and know the processes of research	
	2. Develop the competence for selecting methods and tools appropriate for research topics	
	3. Understand concepts of statistical measures of central tendency, dispersion, variability and probability	
Module 1		1
Learning Outcomes	After learning the module, learners will be able to -	
	1. Understand process of research and its relationship to knowledge and science. 2. Identify research process based on actual researches conducted. 3. Recognise process of research problem formulation.	
Content Outline	**The Research Process** a. Scientific approach to enquiry in comparison to native, common sense approach b. Knowledge, theory and research c. Role, need and scope of research in the discipline of Home Science **Steps in Research Process and Elements of Research** a. Identifying interest areas and prioritizing Selection of topic and considerations in selection b. Review of related literature and research c.Variables- types of variables including discrete and continuous variables Conceptual definitions and operational definitions d. Concepts, hypotheses and theories e Hypothesis- meaning, attributes of a sound hypothesis, Stating the hypothesis and types of hypothesis Hypothesis testing**-** null hypothesis, sample distribution, level of significance, critical regions, Type I and Type II errors f. Research Design Research questions, objectives and assumptions **Ethics in Research**	
Module 2		1
Learning Outcomes	After learning the module, learners will be able to -	
	1. Understand and apply different types of research procedures. 2. Able to design research studies by knowing methods of research.	
Content Outline	**Types of Research** a. Basic and Applied research, Qualitative and Quantitative research (brief review of differences) b. Historical research c. Descriptive research methods – survey, case study, correlational study, content analysis, causal-comparative research d. Analytic studies- pre-experimental, experimental research, quasi experimental research	

	e. Qualitative research, Ethnography f. Evaluative research- general characteristics, use of qualitative methods in enquiry Scope and importance in Home Science.
Module 3	1
Learning Outcomes	After learning the module, learners will be able to - 1. Understand different techniques of sampling. 2. Apply sampling procedures for specific research problems.
Content Outline	**Sampling** a. Rationale, characteristics- meaning, concept of population and sample, and utility b. Types of sampling and generalizability of results c. Probability sampling - simple random sample, systematic random sample, stratified random sampling etc - random and non-random samples, random numbers and use d. Non-probability sampling - purposive samples, incidental samples, quota samples, snowball samples e. General consideration in determination of sample size
Module 4	1
Learning Outcomes	After learning the module, learners will be able to - 3. Know different tools of data collection. 4. Design different tools of data collection.
Content Outline	**Tools for Data Collection** a. Primary and secondary methods of data collection b. Different types of questionnaires, rating scales, check lists, schedules, attitude scales, inventories, standardized tests, interviews, observation c. Development of tools, estimation of reliability and validity of tools d. Procedure for preparation of the tool, administration of tools for data collection e. Procedure for data collection f. Planning for data analysis-coding of responses

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- Recognize different Types of variables.
- Hypothesis formations and research questions from Research readings – students identify hypothesis/research questions – Discussion
- Construction of tools for data collection a) types of questions b) Questionnaire c) interview schedule d) observation d) scales
- For a given topic, student to frame and discuss the different possibilities of methods and tools
- Differentiate between (a) basic and applied research (Exercise to be based on actual research papers published in accredited journals) (b) qualitative and quantitative research
- Based on Journal contents undertake a critical appraisal of studies/research papers and discuss types of Research with examples.

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- Pande, G.C. (1999): Research Methodology in Social Sciences, Anmol Publication, New Delhi.

END OF SEMESTER 1

Semester Two

Syllabus Contents

2.1 Major Core

<table>
<tr><th colspan="3">Semester II</th></tr>
<tr><td>214311</td><td>Food Microbiology
Major Core (2+2)</td><td>4</td></tr>
<tr><td>Course Objective</td><td colspan="2">This course enables students to:
1. Learn the basic principles of food microbiology.
2. Understand the factors affecting microbial growth in foods.
3. Comprehend the techniques used for food preservation.</td></tr>
<tr><td rowspan="4">Course Outcomes</td><td colspan="2">After going through the course, learners will be able to</td></tr>
<tr><td colspan="2">1. Distinguish the role of micro-organisms in humans and environment.</td></tr>
<tr><td colspan="2">2. Analyse the importance of micro-organisms in food spoilage and to learn advanced techniques used in food preservation.</td></tr>
<tr><td colspan="2">3. Explore the recent procedures adopted in various food operations to prevent food- borne disorders and legal aspects involved in these areas.</td></tr>
<tr><td colspan="2">Module 1</td><td>1</td></tr>
<tr><td rowspan="3">Learning Outcomes</td><td colspan="2">After learning the module, learners will be able to</td></tr>
<tr><td colspan="2">1. Recognize the importance of food microbiology, spoilage, preservation & fermentation.</td></tr>
<tr><td colspan="2">2. Explore the factors affecting the survival & growth of micro-organisms.</td></tr>
<tr><td>Content Outline</td><td colspan="2">A) History, scope, and importance of food microbiology
B) Food spoilage, food preservation, fermentation, QA/QC
C) Micro-organisms and food:
a. Their primary sources in foods, morphology, cultural characteristics, and biochemical activities.
b. Airborne bacteria, fungi
c. Microorganisms found in soil
d. Microorganisms in water
e. Normal flora of skin, nose, throat, GI tract
D) Factors affecting the survival and growth of microorganisms in food.
a. Intrinsic and Extrinsic parameters that affect microbial growth.
b. Intrinsic factors required for growth- Overview, Nutrient effect, pH, Buffer, Anaerobic/aerobic conditions, Moisture content, Temperature, Gaseous atmosphere
c. Implicit factors- properties of microorganisms, its response to external conditions.
E) Food Preservation techniques and its application to different types of foods:
a. Physical methods – Drying, freeze-drying cold storage, heat treatments (pasteurization), TDT, TDP Irradiation (UV, microwave, ionization), high pressure processing, Aseptic packaging, modified atmosphere
b. Chemical preservatives and Natural antimicrobial compounds.</td></tr>
</table>

	c. Biologically based preservation systems and Probiotic bacteria. **F) Beneficial Uses of Microorganisms**: a. Fermented foods, (Yeast, lactobacillus) b. Fermented milk, Cheese, vegetables, beer, vinegar c. Genetically modified foods, marine foods
Module 2	1
Learning Outcomes	After learning the module, learners will be able to
	1. Recognise various methods of microbial examinations
	2. Analyse the spoilage of different food groups
Content Outline	**A) Microbiological examination -Methods of Isolation and detection of microorganisms or their products in food.** a. Conventional methods b. Rapid methods (Newer techniques) c. Immunological methods: Fluorescent, antibody, Radio immunoassay, ELISA etc. d. Chemical methods: Thermostable nuclear, ATP measurement and PCR (Polymers chain reactions) - only principles in brief. **B) Spoilage of different food groups:** a. Cereal and cereal products b. Vegetables & fruits c. Meat & meat products d. Eggs and poultry e. Fish and other seafoods f. Milk and milk products g. Canned food
Course Title	**Food Microbiology (Pr)**
Course Outcomes	After going through the course, learners will be able to
	1. Formulate common laboratory media & special media for cultivation of micro-organisms.
	2.Undertake bacteriological analysis of food
Module 1	1
Learning Outcomes	After learning the module, learners will be able to
	1.Isolate micro-organisms.
Content Outline	**Preparation of common laboratory media and special media for cultivation of bacteria, yeast & Molds.** **Staining of Bacteria**: Gram's staining, acid-fast, spore, capsule and flagellar staining, Motility of bacteria, Staining of yeast and molds. **Cultivation and Identification of important molds and yeasts.** (slides and mold culture). **Study of environment around us as sources of transmission of microorganisms in foods. Assessment of surface sanitation of food preparation units - swab and rinse techniques**. **Isolation of microorganisms:** Different methods and maintenance of cultures of microorganisms.
Module 2	1

Learning Outcomes	After learning the module, learners will be able to
	1.Analyse various foods bacteriologically.
Content Outline	**Bacteriological analysis of Foods**: Both processed and unprocessed like vegetables and fruits, cereals, spices, and canned foods, using conventional methods, yeast, and mold count in foods. Bacteriological analysis of water and milk, Total count, MPN Coliform (Count) and MBRT, IMVIC etc.
Assignments/Activities towards Comprehensive Continuous Evaluation (CCE): - Demonstrate the growth of microbes on specified media and list the factors affecting its growth. - Summarise/ Present a report on various food preservation techniques employed at the industrial level.	

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- Journal of Food Science and Technology published by Association of Food Scientists and Technologists (India) CFTRI – MYSORE.
- Food Technology published by the Institute of Food Technologists, Chicago, U.S.A.

2.2 Major Core

<table>
<tr><th colspan="3">Semester II</th></tr>
<tr><td>214312</td><td>Human Nutrition II (Micronutrients) (Th)</td><td>4</td></tr>
<tr><td>Course Objective</td><td colspan="2">This course enables students to:
1. Learn the basic principles of Vitamins and Minerals in the human body.
2. Understand the factors affecting requirements and availability of vitamins and minerals.
3. Comprehend the implications of deficiency of micronutrients on human body.</td></tr>
<tr><td>Course Outcomes</td><td colspan="2">After going through the course, learners will be able to</td></tr>
<tr><td></td><td colspan="2">1. Recognize the physiological and metabolic role of vitamins and minerals in human nutrition.</td></tr>
<tr><td></td><td colspan="2">2. Evaluate the pharmacological actions of various vitamins & minerals along with their implications.</td></tr>
<tr><td colspan="2">Module 1</td><td>1</td></tr>
<tr><td>Learning Outcomes</td><td colspan="2">After learning the module, learners will be able to</td></tr>
<tr><td></td><td colspan="2">1. Acknowledge the metabolism of fat-soluble vitamins</td></tr>
<tr><td></td><td colspan="2">2. Explore the pharmacological & therapeutic role of fat-soluble vitamins.</td></tr>
<tr><td>Content Outline</td><td colspan="2">For each vitamin & mineral, the following will be discussed:
❖ Historical background
❖ Structure and chemistry
❖ Food sources
❖ Metabolism (digestion, absorption, transport, storage, and elimination), Bioavailability and factors affecting bioavailability.
❖ Biochemical and physiological functions
❖ Assessment of status
❖ Interaction with other nutrients, regulation of gene expression (wherever applicable)
❖ Pharmacological and therapeutic effects
❖ Requirements, methods for estimating requirements and recommended daily allowance.
❖ Deficiency, overload, and toxicity.

Fat Soluble Vitamins
● Vitamin A and Beta Carotene
● Vitamin D
● Vitamin E
● Vitamin K</td></tr>
<tr><td colspan="2">Module 2</td><td>1</td></tr>
<tr><td>Learning Outcomes</td><td colspan="2">After learning the module, learners will be able to</td></tr>
<tr><td></td><td colspan="2">1. Acknowledge the metabolism of water-soluble vitamins</td></tr>
<tr><td></td><td colspan="2">2. Explore the pharmacological & therapeutic role of water-soluble vitamins.</td></tr>
<tr><td>Content Outline</td><td colspan="2">Water Soluble Vitamins
● Ascorbic acid
● Thiamin
● Riboflavin
● Niacin
● Pyridoxine
● Folic acid
● Vitamin B_{12}</td></tr>
</table>

	● Biotin
Module 3	1
Learning Outcomes	After learning the module, learners will be able to 1. Acknowledge the metabolism of macro-minerals 2. Explore the pharmacological & therapeutic role of macro-minerals.
Content Outline	**Macro-minerals** ● Calcium and Phosphorus ● Magnesium ● Sodium, Potassium, Chloride
Module 4	1
Learning Outcomes	After learning the module, learners will be able to 1. Acknowledge the metabolism of micro-minerals 2. Explore the pharmacological & therapeutic role of micro-minerals
Content Outline	**Microminerals** ● Iron ● Copper ● Manganese ● Iodine ● Fluoride ● Zinc ● Selenium ● Cobalt ● Chromium ● Molybdenum
Assignments/Activities towards Comprehensive Continuous Evaluation (CCE): - Demonstrate the role of each micronutrient for human health and relate its deficiency with its physical representation. - Summarise the effect of supplementation of vitamins and minerals in non-communicable disease.	

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- Journal of Nutrition
- American Journal of Clinical Nutrition
- British Journal of Nutrition
- European Journal of Clinical Nutrition
- International Journal of Vitamin and Nutrition Research
- International Journal of Food Science and Nutrition
- Nutrition Research
- Annual Nutrition Metabolism

2.3 Major Core

Semester II		
214313	**Food Safety and Quality Control (Pr.)**	4
Course Objectives	This course enables students to: 1. Learn the basic principles of food safety in industrial food production. 2. Understand the importance and methods of quality control in food production unit. 3.Comprehend the principles and techniques used in product analysis.	
Course Outcomes	After going through the course, learners will be able to	
	1. Recognize the importance of quality assurance in food industry.	
	2. Execute various tests and assess quality, using standards for quality assessment and food safety.	
	3. Conduct various tests used to detect food adulterants	
Module 1		0.5
Learning Outcomes	After learning the module, learners will be able to	
	1. Conduct quality assurance programmes	
Content Outline	**Introduction to quality assurance and food safety. Current concepts of quality control.** **Quality Assurance Programme:** Quality plan, documentation of records, product standards, product and purchase specifications, process control and HACCP, hygiene and housekeeping, corrective action, quality and programme and total quality process.	
Module 2		1
Learning Outcomes	After learning the module, learners will be able to	
	1. Evaluate Product analysis	
	2. Assess purity & quality of food additives & contaminants.	
Content Outline	**Product Evaluation**: - Sampling for product evaluation and line control. - Statistical quality and process control - Specifications and food standards. International, National – Mandatory, Voluntary. - Sample preparation - Reporting results and reliability of analysis. **Assessment of purity and quality using appropriate standard tests and Detection / Estimation of Food Additives and Contaminants- qualitative and quantitative methods for**: - Water including mineral water. - Cereals and cereal products	

	- Pulses and legumes - Flesh foods
Module 3	1.5
Learning Outcomes	After learning the module, learners will be able to 1. Evaluate Product analysis 2. Assess purity & quality of food additives & contaminants.
Content Outline	- Milk and milk products - Ice creams and sherbets - Confectionery - Fats and oils including butter, ghee, and hydrogenated fat - Fried snacks and high fat foods
Module 4	1
Learning Outcomes	After learning the module, learners will be able to 1. Evaluate Product analysis 2. Assess purity & quality of food additives & contaminants.
Content Outline	- Spices and condiments and salt, pickles, sauces, and chutneys. - Tea and coffee - Canned, dehydrated, frozen and bottled fruit/vegetable products - Specific food ingredients such as glycerine, vinegar - Fruit juices, concentrates and beverages.
Assignments/Activities towards Comprehensive Continuous Evaluation (CCE): - Demonstrate the working principle of Quality control employed by indicated food production companies/ units. - Prepare a report on possible adulterations in each category of food products.	

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- Askar, A. and Treptow, H. (1993): Quality Assurance in Tropical Fruit Processing, Springer-Verlag, Berlin.
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2.4 Major Core

Semester II		
214324	**Food Product Development, Modifications & Sensory Evaluation (Practical)**	2
Course Objective	This course enables students to: 1. Learn the basic principles of food product development. 2. Understand the application of varied techniques for sensory analysis. 3.Comprehend the current trends of food sale in the market	
Course Outcomes	After going through the course, learners will be able to	
	Acknowledge the concepts about sensory evaluation of food, also analyse and interpret the data.	
	Implement different sensory methods for evaluating variety of foods	
Module 1		1
Learning Outcomes	After learning the module, learners will be able to	
	1. Establish sensory panels	
	2. Organise an experiment for sensory evaluation	
Content Outline	**A. Introduction to sensory analysis and uses of sensory tests.** General testing conditions. **B. Establishing sensory panels:** a. Selecting and recruiting panelists, orienting, screening for trained panels, training panelists, monitoring performance. b. **Recognition tests** for 4 basic tastes, odour, and aroma. c. Tests with other senses. d. Threshold tests. **C. Analytical tests**: (i) Difference, (ii) Ranking, (iii) Descriptive, (iv) Scoring and (v) Rating **D. Planning an Experiment for Sensory Evaluation:** (i) Designing the questionnaire and score card, (ii) Identifying descriptors (iii) Designing Sensory Testing Facilities: Permanent and Temporary **E. Conducting the Test:** a. Preparing samples - Presenting samples - Using reference samples - Reducing panel response error b. Consumer oriented tests - Product oriented tests c. Shelf-life studies d. Product matching - Product mapping e. Taint Investigation and Prevention	

	F. Collecting and analysing sensory data, statistical analysis, interpretations. Report Writing	
Module 2		0.5
Learning Outcomes	After learning the module, learners will be able to	
	1. Define & classify food products.	
	2. Conduct market & consumer survey to identify new food products.	
Content Outline	**A New Food Products** a. Definition, Classification b. Characterization Factors shaping new product development- Social concerns, health concerns impact of technology and market place influence. **B. Market Survey, Consumer survey to identify new products in terms of** - Line Extension - Repositioning Existing Products - New form/Reformulation - New packaging of existing products - Innovative products - Creative Products. **C. Tapping traditional foods and unconventional sources of foods.** a. Minimizing post-harvest losses. b. Identification of concept & product for development c. Market research for the concept and selected product	
Module 3		0.5
Learning Outcomes	After learning the module, learners will be able to	
	1. Develop new food product.	
	2. Standardize new food product.	
Content Outline	Identification of product, selection of one product and its standardization	
Assignments/Activities towards Comprehensive Continuous Evaluation (CCE): - Conduct food product surveys in whole sale and retail markets. - Conduct sensory evaluation for food product available in the market and their healthier, home-made alternatives.		

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Journals:

- International Journal of Food Science and Technology
- Food Technology
- Journal of Food Technology
- Trends in Food Science and Technology
- Critical Reviews in Food Science and Nutrition

2.5 Major Elective

Semester II		
224313	**Functional Foods, Biodynamic principles, Nutraceuticals (Th.)**	4
Course Objective	This course enables students to: 1. Learn the basic principles and regulations in relation to the functional food. 2. Understand the application of functional food in various disease conditions. 3.Comprehend the current trends of research in the field of nutraceuticals.	
Course Outcomes	After going through the course, learners will be able to	
	Define & classify functional foods & nutraceuticals	
	Apply the usage of functional foods & nutraceuticals	
Module 1		1
Learning Outcomes	After learning the module, learners will be able to	

	Define probiotics, prebiotics & synbiotics
Content Outline	**Introduction:** Definition, history, classification – Type of classification (Probiotics, prebiotics and synbiotics; Nutrient vs. Non-nutrient; according to target organ; according to source or origin). Metabolism of xenobiotics (review) **Probiotics** a. Taxonomy and important features of probiotic micro-organisms. b. Health effects of probiotics including mechanism of action. c. Probiotics in various foods: fermented milk products, non-milk products etc. d. Quality Assurance of probiotics and safety. **Prebiotics** Unit 1. Definition, chemistry, sources, metabolism and bioavailability, effect of processing, physiological effects, effects on human health and potential applications in risk reduction of diseases, perspective for food applications for the following: ● Non-digestible carbohydrates/oligosaccharides: ● Dietary fibre ● Resistant starch ● Gums
Module 2	2
Learning Outcomes	After learning the module, learners will be able to
	1. Analyse the potential health benefits of functional foods
Content Outline	**Potential health benefits of the following biodynamic principles:** Definition, chemistry, sources, metabolism and bioavailability, effect of processing, physiological effects, effects on human health and potential applications in risk reduction of diseases, perspective for food applications for: ● Polyphenols: Flavonoids, catechins, isoflavones, tannins Curcumin, Resveratrol ● Phytoestrogens/ Isoflavones ● Phytosterols ● Glucosinolates ● Pigments: Lycopene, Carotenoids ● Organo sulphur compounds ● Other components – Phytates, Protease inhibitors, saponins, Amylase inhibitors, haemagglutinins
Module 3	1
Learning Outcomes	After learning the module, learners will be able to
	2. Identify the non-nutrient effects of specific nutrients
Content Outline	**Non- nutrient effect of specific nutrients:** Proteins, Peptides, and nucleotides, Conjugated linoleic acid and non-fatty acids, Vitamins and Minerals. **Active biodynamic principles in spices, condiments and other plant materials and their evidence-based effects**
Assignments/Activities towards Comprehensive Continuous Evaluation (CCE): - Conduct literature search and summarise the current trend in the usage of functional foods for therapeutic purposes. - List the functional foods available in the market.	

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2.6 Major Elective

Semester II		
244341	**INTERNSHIP** On The Job Training (0+4)	**4**
	Internship is to help the student explore world outside classroom. A student can do internship in any government, non-government or corporate organization which is engaged in food science related activities and /or research activities. She may work with Organization/programme/agency/institution involved in food related work.	
Course Objectives:	Internship will enable the students to: 1. Apply knowledge gained during the programme to work situations. 2. Comprehend the current trends in the market Gain hands-on experience of working in the field through an organizational interface and become job ready.	
Course Outcomes:	At the end of Internship, the student will be able to: ● Comprehend modalities of professional practice by being at work space. ● Recognize concepts of a professional work environment and become part of one. ● Conduct one in line with deliverable outcomes for given organization. ● Apply their theoretical learnings into practical work environment. ● Able to reflect her work and learnings and be able to articulate them at the end of the OJT- on the job training. Apply skills gained in the classroom in work life spaces.	
Duration	One month or 240 hours	
Sectors	Students are required to work in Research & Development Laboratory/Food Analysis Laboratory/ Nutrition Research areas.	
Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):		

The report of the internship along with the supervisor's evaluation will have to be submitted to the Head of the Department within fifteen days of completion of internship before or after the theory examination depending upon the local conditions. She is required to maintain diary and present her work in viva voce held at the end of the internship. She will be assessed by the internship agency supervisor as well as Department/College mentor for the work done by her.

End of Semester II

Semester III

Course Syllabus

3.1 Major (Core)

Course Title **Subject Code**	**Research and Statistical Application** **314411**
Course Credits	**4**
Course Outcomes	After going through the course, learners will be able to
	1. Identify parametric and non-parametric tests
	2. Apply statistical tests for data analysis for both large and small samples
	3. Interpret the results of statistical analysis of data
	4. Summarize data and present it using tables and graphs
Module 1 (Credit 1) - Basics of statistics, data management, and statistical tests.	
Learning Outcomes	After learning the module, learners will be able to
	1. Analyse parametric and non-parametric test
	2. Apply the statistical programs for data management
Content Outline	**Introduction to Statistics** Definition, conceptual understanding of statistical measures, popular concepts and misuse of statistics **Normal Distribution and its Properties** a. Normal distribution b. Binomial distribution c. Probability, use of normal probability tables, area under normal distribution curve d. Parametric and non-parametric tests **Data Management** Planning for data analysis – coding of responses, preparation of code book Coding of data Use of statistical programs - MS Excel – SPSS
Module 2(Credit 1) - Understanding and applying data analysis methods.	
Learning Outcomes	After learning the module, learners will be able to

	1. Describe quantitative analysis, descriptive & inferential statistics.
	2. Apply large and small sample tests and interpret the results.
Content Outline	**Data Analysis** a. Quantitative analysis, descriptive statistics, inferential statistics: Uses and limitations, Summation sign and its properties b. Proportions, percentages, ratios c. Measures of central tendency-mean, median, mode-arithmetic mean and its uses, mid – range, geometric mean, weighted mean d. Measures of dispersion /variability- range, variance, standard deviation, standard error, coefficient of variation, Kurtosis, skewness Grouped data-frequency distribution, histogram, frequency polygons, percentiles, quartiles, tertiles, ogive e. Large and Small Sample tests and interpretation -. Z-test for single proportions and difference between proportions -. Large sample test for single mean and difference between means -. Small sample tests- 't'-test, paired 't'-test, 'F' Test
Module 3(Credit 1) - Using chi-square, correlation, and experiment designs	
Learning Outcomes	After learning the module, learners will be able to
	1. Interpret chi square test, correlation & regression
	2. Distinguish between experiment designs
Content Outline	**Chi square test and its interpretation** a. General features, goodness of fit b. Independence of Attributes **Correlation and Regression and its interpretation** a. Basic concepts b Linear regression and correlation coefficient Regression and prediction c. Rank correlation, Product-moment method **Analysis of Variance and its interpretation** a. One-factor analysis of variance b. Two-factor analysis of variance

	Design of Experiments a. Completely randomized design b. Randomized block design c. Latin square design d. Factorial design
Module 4(Credit 1)- Presenting data and creating research proposals	
Learning Outcomes	After learning the module, learners will be able to
	1. Discuss the presentation of Data
	2. Prepare research proposal
Content Outline	**Presentation of Data** a. Tabulation and Organization of data- frequency distributions, cumulative frequency distribution, contingency tables b. Graphical presentation of data- histogram, frequency polygon, ogive, stem and leaf plot, box and whiskers plot, Graphs for nominal and ordinal data- pie diagram, bar graphs of different types, graphs for relation between two variables, line diagram. Use of illustrations Cautions in visual display of data **The Research Report** Basic components of a research report- prefatory material, introduction and Review of Related Literature, Methodology, Results, Discussion, Conclusion, Summary, Abstract, Bibliography and Appendices Students to design a research study on a topic- - specify type of research - sample selection - protocol/operationalization - tools - tests for statistical analysis **Preparation of a Research Proposal**

Assignments / Activities towards Comprehensive Continuous Evaluation (CCE):

- Assignment on a standard normal curve
- Assignment on calculation of descriptive statistics
- Assignment to test the hypothesis
- Assignment on sample size calculation

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3.2 Major (Core)

Course Title **Subject Code**	**Maternal & Child Nutrition** **314312**
Course Credits	**4**
Course Outcomes	After going through the course, learners will be able to
	1. Discuss the physiological changes in pregnancy and lactation
	2. Describe the growth and developmental changes from conception till adolescence.
	3. Identify the inter-relationship between nutrition and growth and development during life cycle
	4. Apply their knowledge in community and public nutrition/health programmes
Module 1(Credit 1) - Nutrition and pregnancy care.	
Learning Outcomes	After learning the module, learners will be able to
	1.Determine the physiological changes during pregnancy and discuss the stages of embryonic development
	2. Discuss the nutritional requirements during pregnancy
	3. Determine the various complications that occur during pregnancy and their management
Content Outline	**Changing concepts and controversies in Maternal and Child Nutrition** **Importance of Maternal Nutrition during Pregnancy:** Unit 1. Importance of nutrition prior to and during pregnancy Unit 2. Pre-requisites for successful outcome. Effect of undernutrition on mother-child dyad including pregnancy outcome and Maternal and Child Health – Short term and long term Unit 3. Physiology and endocrinology of pregnancy and embryonic and fetal growth and development

	Unit 4. Nutritional requirements during pregnancy Unit 5. Adolescent Pregnancy Unit 6. Pregnancy and AIDS, Pregnancy and TB Unit 7. Intra-uterine growth retardation critical windows of development and programming concepts Unit 8. Complications of pregnancy and management and importance of antenatal care Unit 9. Congenital malformations, fetal alcohol syndrome and gestational diabetes mellitus
Module 2(Credit 1) - Breastfeeding and infant nutrition	
Learning Outcomes	After learning the module, learners will be able to
	1. Describe the physiology and endocrinology of lactation
	2. Discuss the nutritional composition of breastmilk
	3. Describe key nutritional strategies for infant feeding and importance of exclusive breastfeeding
	4. Identify problems faced by lactating mothers and their management
Content Outline	**Lactation and Infant feeding** Unit 1. Development of mammary tissue and role of hormones Unit 2. Physiology and endocrinology of lactation – Synthesis of milk components, let down reflex, role of hormones, lactational amenorrhea, effect of breast feeding on maternal health Unit 3. Human milk composition and factors affecting breastfeeding and fertility, maternal nutritional status and milk composition Unit 4. Management of lactation – Prenatal breastfeeding skills Education. Rooming in, problems – sore ripples, engorged breast, inverted nipples Unit 5. Exclusive breastfeeding Baby friendly Hospitals Initiative Unit 6. Breast feeding in the age of AIDS

	Feeding of infants and children and dietary management, key issues in infant Feeding
Module 3(Credit 1) - Child growth and preterm infant care	
Learning Outcomes	After learning the module, learners will be able to
	1. Discuss nutritional management strategies adopted for preterm and LBW infants
	2. Describe the growth and development patterns in various stages of childhood
	3. Apply the knowledge of using growth charts into practise by conducting growth monitoring of infants, children and adolescents
Content Outline	**Infant physiology and the preterm and LBW infants: Implications for feeding and management** **Growth and development during infancy, childhood and adolescence** a. Normal pattern of growth and development b. Norms/standards for growth Growth monitoring and promotion, growth faltering, Failure to thrive
Module 4(Credit 1) - Malnutrition and health programs	
Learning Outcomes	After learning the module, learners will be able to
	1. Determine the intergenerational impact of maternal and child malnutrition
	2. Discuss public health policies and programmes in realm of maternal and child care in India
Content Outline	Malnutrition in mothers and children: etiology and management (in brief) Consequences of malnutrition on physical development, mental development, cognitive development. Effect of deficiencies of specific nutrients Current Nutrition and Health Status of Women and Children in India. Policies and programmes for promoting maternal and child nutrition & health. International, national and state level Concept of small family, methods of family planning, merits and demerits.

Assignments / Activities towards Comprehensive Continuous Evaluation (CCE):

- Assignment on clinical assessment of malnutrition amongst children.
- Case study of low-birth-weight babies.
- Nutritional assessment of mothers.
- Workshop on SAM and MAM children.
- Visit to ICDS Centres.

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3.3 Major (Core)

Course Title **Subject Code**	**Food Microbiology II** **314313**
Course Credits	**4 (2 Th+2 Pr)**
Course Outcomes	After going through the course, learners will be able to
	1. Discuss the hazards of food- borne disorders and identify the recent procedures adopted in various food operations to prevent them
	2. Conduct bacteriological examination of food samples
	3. Apply the concepts of food safety and microbiological testing into practice
Theory - Module 1(Credit 1) - Food-borne diseases and harmful microbes.	
Learning Outcomes	After learning the module, learners will be able to
	1. Describe the common pathogens implicated in food-borne disorders
	2. Discuss the risk factors and impact of food-borne disorders
Content Outline	**Food borne infections and diseases:** Significance to public health Food hazards and risk factors Bacterial, and viral food-borne disorders, Food-borne important animal parasites, Mycotoxins. *Bacillus, Campylobacter, Brucella, Staphylococcus, Clostridium, E.coli, Aeromonas, Vibrio cholerae, Listeria, Mycobacterium,Salmonella, Shigella*
Module 2(Credit 1) - Food safety rules and HACCP	
Learning Outcomes	After learning the module, learners will be able to
	1. Determine the legal rules and regulations concerning food safety
	2. Apply the principles of HACCP in conducting food safety analysis

Content Outline	**Quality Control/Quality Assurance** Legislation for food safety – national and international Criteria, sampling schemes, records, risk analysis QC- microbial source, code Indicators of food safety and quality: Microbiological criteria of foods and their significance The HACCP system and food safety used in controlling microbiological hazards
Practical - Module 1(Credit 1) - Testing food for bacteria	
Learning Outcomes	After learning the module, learners will be able to
	1. Conduct tests for identification of bacterial contamination of food samples
Content Outline	**Various biochemical tests used in identification of commonly found bacteria in foods:**IMVIC urease, H2S, Catalase, coagulase, gelatin and fermentation (Acid/gas) Demonstration of available rapid methods and diagnostic kits used In identification of microorganisms or their products. HACCP
Module 2 (Credit 1) - Visiting food labs and projects	
Learning Outcomes	After learning the module, learners will be able to -
	1. Summarize latest techniques in food microbiology
Content Outline	Visits (at least two) to food processing unit or any other organization dealing with advanced methods in food microbiology Project

Assignments / Activities towards Comprehensive Continuous Evaluation (CCE):

1. Discuss the latest approaches in detection of pathogens in food.
2. What is NABL accreditation in food testing laboratories
3. Discuss the importance of having a HACc-P system in a food manufacturing unit.

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Journals:

- Food Technology published by the Institute of Food Technologists, Chicago, U.S.A.
- Journal of Food Science and Technology published by Association of Food Scientists and Technologists (India) CFTRI – MYSORE.
- Journal of Food Science Published by the Institute of Food Technologists, Chicago, U.S.A.

3.4. Major (Core)

Course Title **Subject Code**	**Assessment of Nutritional Status** **314324**
Course Credits	**2**
Course Outcomes	After going through the course, learners will be able to
	1. Analyze and various methods for assessment of nutritional status, body composition analysis.
	2. Carry out and interpret the assessment of dietary/nutrient intakes
	3. Conduct assessment of physical activity and energy expenditure
Practical - Module 1(Credit 1) - Body Composition & Anthropometry	
Learning Outcomes	After learning the module, learners will be able to
	1. Evaluate the different body composition analysis techniques for nutritional assessment
	2. Apply the correct methods for anthropometric measurements
Content Outline	**Assessment of Nutritional Status** a) Reliability b) Validity c) Accuracy d) Precision **Measurement of weight and height** a) Assessment of nutritional status for adults, young and older children b) Calculation of BMI c)Interpretation Use of WHO reference standards Wasting, stunting, underweight, severe and moderate malnutrition d) Calculation of z-scores and use of software Circumference Measurements – chest, head, mid arm. Waist, hip and ratios wherever applicable to children and adults **Body Composition**

	a) Use of skinfold b) Bioelectric impedance c) Dual X-ray Absorptiometry (DEXA) d) Calculation of body fat WHO Software for Z Scores, IAP Growth charts.
Module 2(Credit 1) - Dietary Intake & Energy Expenditure	
Learning Outcomes	After learning the module, learners will be able to
	2. Determine the legal rules and regulations concerning food safety
	2. Apply the principles of HACCP in conducting food safety analysis
Content Outline	**Dietary intake assessment** a) Food frequency questionnaire b) A 24-hour diet recall and record - Weighment method **Assessment of energy expenditure** a) Indirect calorimetry - use of ergometer, treadmill, heart rate monitoring b) Recording physical activities c) Factorial estimation of energy expenditure: MET, PAL Study of food labels- calculation of DV d) Study of food labels- calculation of DV e) In vitro starch digestibility

Assignments / Activities towards Comprehensive Continuous Evaluation (CCE):

- Executing WHO Software for Z Scores.
- Plotting IAP Growth charts.
- Using BIA machine to analyze body composition of adults.
- Project on dietary assessment using dietary recall techniques.

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3.5 Major (Elective)

Course Title **Subject Code**	**Food Product Development (Practical)** **324321**
Course Credits	**4**
Course Outcomes	After going through the course, learners will be able to
	1. Apply various aspects of food product development including Food Science and Technology, Marketing and Consumer research, finance and communication
	2. Develop products which meet consumer needs, and are nutritionally and commercially viable
	3. Acquire skills in the various aspects including shelf life assessment, testing of quality parameters and acceptability, packaging and labelling of a product
Module 1(Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	1. Prepare food product and conduct its nutritional evaluation
Content Outline	**Nutritional evaluation (estimation of relevant parameters)** **Packaging and Labelling of the product - Packaging design, graphics and labeling**
Module 2(Credit 2)	
Learning Outcomes	After learning the module, learners will be able to
	1. Undertake bulk preparation of the proposed food product and conduct its shelf-life testing
Content Outline	**Bulk preparation of product** **Shelf-life testing of the product** (testing for appropriate quality parameters- chemical, microbiological and nutrient content, acceptability studies) Product integrity and conformance to standard
Module 3(Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	1. Undertake costing, marketing, advertising and sales of the developed product

Content Outline	Costing the product and determining the sales price Advertising and test marketing the product
Module 4: **Report preparation**	
Learning Outcomes	After learning the module, learners will be able to, 1. Compile and present findings of the food product development process.
Content Outline	• Structure of the research report, including methodology, results, and conclusions. • Guidelines for effective presentation and communication of findings, including visual aids.

Assignments / Activities towards Comprehensive Continuous Evaluation (CCE):

- Market survey of recent/ innovative food products.
- Assignment on packaging material.
- Test marketing, costing and sensory evaluation.
- Development of food product and quantity food production.

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Journals:

- Critical Reviews in Food Science and Nutrition
- Food Technology
- International Journal of Food Science and Technology
- Journal of Food Technology
- Trends in Food Science and Technology

3.6 Research Project

Course Title **Subject Code**	**Research Project** **354331**
Course Credits	**4**
Course Outcomes	After going through the course, learners will be able to
	1. Experience the research process and prior to undertaking primary research plan and examine existing literature.
	2. Undertake the process of reviewing existing literature, form hypothesis, and define plans for gathering data and analysing data for their research problem.
	3. Recognise process of knowledge production in their subject discipline.
Module 1(Credit 1) - Problem Formulation	
Learning Outcomes	After learning the module, learners will be able to
	1. Recognize and undertake research problem.
Content Outline	Formulation of problem
Module 2(Credit 2) - Literature Review	
Learning Outcomes	After learning the module, learners will be able to
	1. Review the existing literature
Content Outline	Review of Literature
Module 3(Credit 1) - Research Proposal Design	
Learning Outcomes	After learning the module, learners will be able to
	1. Apply critical thinking to the problem selected for research
Content Outline	Designing Research proposal
Module 4 (Credit 1) - Data Collection Planning	
Learning Outcomes	After learning the module, learners will be able to
	1. Able to design the research work and plan the execution.
Content Outline	Planning tools & techniques for data collection

Assignments / Activities towards Comprehensive Continuous Evaluation (CCE):

- Designing a research proposal.
- Presenting review of literature.
- Constructing tools and techniques for data collection.

END OF SEMESTER III

Semester IV

Syllabus Contents

4.1 Major (Core)

Course Title **Subject Code**	**Nutrigenetics And Nutrigenomics** **414311**
Course Credits	**4**
Course Outcomes	After going through the course, learners will be able to
	1. Apply Nutrigenetics through the course of life. 2. Correlate the relationship between genetics of obesity and metabolic syndrome. 3. Counsel patients based on the principles of nutrigenomics.
Module 1 (Credit 1) - Human Genetics Basics	
Learning Outcomes	After learning the module, learners will be able to
	1. Describe the basics of genetics and the normal physiology of DNA 2. Identify diseases with genetic inheritance patterns
Content Outline	**Introduction to Human Genetics** ● Definition of gene, genome, DNA, allele, chromosome. Mitosis and Meiosis. ● Mendelian Principles- Chromosome Theory of Heredity (Sutton-Boveri), Inheritance patterns, the phenomenon of Dominance, Recessive, and Codominance. ● Inheritance patterns in Humans (Sex-linked, Autosomal, Mitochondrial, Unifactorial, Multi-factorial). ● Molecular effects of genetic variation- polymorphism, genetic linkage- linkage disequilibrium, haplotype, copy number variants, and mutations. Hardy-Weinberg equilibrium. Gene nomenclature
Module 2 (Credit 1) - Nutrigenetics & Nutrigenomics Overview	
Learning Outcomes	After learning the module, learners will be able to
	1. Examine history of genetics in nutrition 2. Evaluate the relationship between nutrition, environment and genomics. 3. Recognise interactions of epigenetic changes and nutrient components.

Content Outline	**Introduction to Nutrigenetic and Nutrigenomics** ● Introduction to Epigenomics, Molecular mechanisms of Epigenomics, Epigenomics and Nutrition (Molecular bases of gene-gene and gen-environment interaction), Epigenomics and disease, ● What is Nutrigenetics and Nutrigenomics? How are they different from each other? Nutrigenomic interactions [direct and indirect method]. ● History of Nutrigenetics- Phenylketonuria, MTHFR genes, Where Nutrigenetics differences comes from- Nutritional Relativism, Nutrigenetics and the early life origins of health and diseases.
Module 3 (Credit 1) - Genetics of Metabolic Health	
Learning Outcomes	After learning the module, learners will be able to
	1. Examine relationship of genetics of obesity and metabolic health. 2. Recognise the influence of genes on response to dietary interventions.
Content Outline	**Nutrigenetics and Nutrigenomics of Metabolic Health** ● Brief Overview of lipid metabolism ● Genetic disorders of lipid metabolism ● SNPs associated with Lipid profile – ABCG8, CELSR, LDLR, ABCA1, CETP, APOA1, APOA5, GCKR gene. ● Genomics of eating behaviour and appetite regulation (HPA, serotonin) ● Genetics of body composition; from obesity to extreme leanness, Genetic implication of energy homeostasis, Genetic variation with influence on the individualized response to weight loss diet: FTO Gene as evident, Genetics variation with influence on the individualized body fat percentage: ADRB3, BDNF, FTO, MC4R, SH1B2, TMEM18. ● Nutrient-gene interaction studies, lifestyle intervention studies
Module 4 (Credit 1) - Health Coaching & Nutrigenetic Counselling	
Learning Outcomes	After learning the module, learners will be able to
	1. Gain skills in undertaking health history using varied tools. Recognise role of counselling and coaching in nutrigenetic counselling.
Content Outline	**Effective Health Coaching and Nutrigenetic Counselling** ● Conducting health history questionnaires, health goals, identifying physiological parameters that are essential for the ideal diet planning ● Purpose of Effective Counselling, explain Nutrigenetic recommendations and diet plan, Planning the grocery list.

Assignments / Activities towards Comprehensive Continuous Evaluation (CCE):

1. Review current ICMR/NIN guidelines for diet in adults
2. Report on factors affecting genetic changes and epigenetics
3. Formation of a health assessment questionnaire focusing on nutrigenetics.
4. Role play of effective nutrigenetic counselling

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4.2 Major (Core)

Course Title **Subject Code**	**Nutrition Human Microbiome & Health** **414312**
Course Credits	**4**
Course Outcomes	After going through the course, learners will be able to
	1. Illustrate the role of microbiota across the lifespan 2. Explain the application of microbiome in nutritional interventions
Module 1(Credit 1) - Importance of the Microbiome	
Learning Outcomes	After learning the module, learners will be able to
	1. Explain the importance of microbiome in health 2. Discuss the development of microbiota in the body
Content Outline	**Introduction to Human Microbiome** ● Various microbes in human body ● Importance of microbiome in human health ● Microbiota development in all organ systems (microbiota in different niches like respiratory tract, gut microbiota, vaginal and reproductive tract etc.) ● Life changing events and personal microbiota development.
Module 2 (Credit 1) - Microbiome Across the Lifespan	
Learning Outcomes	After learning the module, learners will be able to
	1. Explain the mechanism of microbiome in immunity 2. Describe the role of microbiome in longevity and ageing
Content Outline	**Human Microbiome Across the Lifespan** ● Microbiota development in all epochs of life ● Role of microbiota in aging including healthy aging and role in longevity and ageing related diseases ● Role of microbiota in infancy and childhood immunity
Module 3(Credit 1) - Microbial Therapies in Disease	
Learning Outcomes	After learning the module, learners will be able to
	1. Elucidate microbial therapies in gastrointestinal diseases
Content Outline	**Microbiota In Diet And Disease** ● Obesity ● Malabsorption syndrome ● SIBO ● GI Cancers ● IBD/IBS ● GI Surgery **Microbial therapies and diagnostics and personalized therapies**
Module 4 (Credit 1) - Microbiome in Pharmacology and Nutrition	

Learning Outcomes	After learning the module, learners will be able to
	1. Explain the application of healthy microbiome in pharmacology and nutritional therapy
Content Outline	**Applicability And Societal Impact** ● Role and applicability of microbiome in pharmacy and medical therapy ● Approaches to study the Microbiome in healthy and diseased states using data sets like metagenome transcriptome genome and other omics approaches.

Assignments / Activities towards Comprehensive Continuous Evaluation (CCE):

1. Enlist the significant microbes in heath and disease
2. Conduct a market survey of nutraceuticals containing microbes
3. Design audio visual aids to illustrate microbiome development.

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4.3Major (Core)

Course Title **Subject Code**	**Nutrition In Society (Pr.)** **414323**
Course Credits	**4**
Course Outcomes	**After going through the course, learners will be able to**
	1. Familiarize with the problems related to food and nutrition security among various communities / socio-economic groups / rural, tribal, urban slums.
	2. Enable to assess nutritional status of individuals/group.
	3. Enable to plan, implement, monitor and evaluate intervention programmes
	4. Familiarize with the various strategies / approaches used to combat malnutrition.
Module 1(Credit 1) - Food and Nutrition Security in India	
Learning Outcomes	After learning the module, learners will be able to
	1.Illustrate the impact of food and nutrition security in India
Content Outline	Food and nutrition security of different segments of the society vis- à-vis food production and consumption patterns in different states of India Epidemiologic and socio-demographic indicators – current situation
Module 2 (Credit 1) - Strategies to Combat Malnutrition	
Learning Outcomes	After learning the module, learners will be able to
	1. Discuss the strategies of supplementation in vulnerable population for malnutrition 2. Elucidate the economics for such strategies
Content Outline	**Strategies and approaches to combat malnutrition – short term and long term** *For each unit field visits should be undertaken by students. Case studies are to be done and report prepared* a. Food supplementation b. Nutrient supplementation c. Fortification and enrichment d. Food-based approaches, dietary diversification, IEC Cost Analysis: Cost benefits, cost effectiveness and cost efficiency

Module 3 (Credit 1) - Product Development for Vulnerable Groups	
Learning Outcomes	After learning the module, learners will be able to
	1. Develop food products for vulnerable groups and specific target population
Content Outline	Development and preparation of food supplements for various target groups and programmes e.g. pre-schoolers, pregnant/lactating women, mid-day meal programme, emergency situations, Nutritional rehabilitation centres.
Module 4 (Credit 1) - Evaluating Nutrition Policies and Programs	
Learning Outcomes	After learning the module, learners will be able to
	1. Identify the strengths and weakness of national and state policies and programmes for nutrition intervention
Content Outline	**Appraisal of existing programmes: Planning and implementation of an intervention programme** Situation analysis and needs identification Intervention planning and intervention Plan for monitoring and evaluation

Assignments / Activities towards Comprehensive Continuous Evaluation (CCE):

1. Visit to an NGO
2. Recipe development and demonstration for nutrition awareness through interactive aids targeting people of different age groups

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4.4.1 Major (Elective)

Course Title **Subject Code**	**Nutritional Epidemiology** **424317**
Course Credits	**4**
Course Outcomes	After going through the course, learners will be able to
	1. Examine epidemiologic methodology in relation to nutritional measures
	2. Conduct nutritional epidemiologic research
	3. Identify and interpret scientific literature about the relationship between nutrition and disease
Module 1 (Credit 1) - Principles of Epidemiological Study Design	
Learning Outcomes	After learning the module, learners will be able to
	1. Describe the principles of epidemiological study design
Content Outline	**Introduction to Epidemiology** ● Definition, nutritional epidemiology, history ● Purpose of undertaking nutritional epidemiological studies ● Components – levels of data outputs ● The epidemiology triad ● Methodological considerations in study designs in nutritional epidemiology ● Life-span developmental approach in nutritional epidemiology
Module 2 (Credit 1) - Dietary Assessment Methods	
Learning Outcomes	After learning the module, learners will be able to
	1. Describe the range of dietary assessment methods and discuss their application 2. Discuss the strengths and limitations of nutritional epidemiological methods
Content Outline	**Types of nutritional epidemiological studies** ● KAP survey ● Consumer survey ● Incidence reports ● Prevalence studies ● RCTs ● Nutrition Database **Methods of dietary assessments – key features, strengths, limitations** ● 24-hour recall ● Food Diary ● Food Frequency Questionnaires ● Weighment Method
Module 3 (Credit 1) - Interpreting Nutrition and Disease Associations	
	After learning the module, learners will be able to

Learning Outcomes	1. Interpret nutritional epidemiological research 2. Describe the associations between diet and disease
Content Outline	**Linking exposures and outcomes - Evaluation of diet/disease relationships** ● association and causation, ● role of chance, errors, bias, and confounding variables. ● adjustment for total energy, selection of co-founders, continuous versus categorical analyses **Interpretation of nutritional epidemiological findings** ● correlations, linear and logistic regressions, factor analyses, analysis of variance ● Issues in analysis and presentation of dietary data and biostatistics ● A single dietary factor and whole diet approaches in epidemiological analysis
Module 4 (Credit 1) - Applications of Nutritional Epidemiology	
Learning Outcomes	After learning the module, learners will be able to
	1. Provide examples of food policy in practice in vulnerable population groups Describe the socio-ecological influences on food choice
Content Outline	**Applications of nutritional epidemiology** ● Policy making in healthy and vulnerable populations ● Food product development ● Clinical recommendations ● Food economics and social impact of food choices, etc. **Recent advances in technological methods of nutritional epidemiology** – AI, digital dietary assessment, etc. **Key study designs and ethical considerations in NE**

Assignments / Activities towards Comprehensive Continuous Evaluation (CCE):

1. Design and conduct an end-in-sight KAP survey in a small group
2. Design a dietary assessment tool that can be used with modern technologies like AI and video conferencing

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Journals:

- Journal of Nutrition
- Nutrients
- American Journal of Clinical Nutrition
- American Journal of Epidemiology
- Public Health Nutrition
- Indian Journal of Public Health
- Frontiers in Nutrition

4.4.2 Major (Elective)

Course Title **Subject Code**	**Food Product Development for Special Population** **424314**
Course Credits	4
Course Outcomes	After going through the course, learners will be able to -
	1. Apply various aspects of food science for dietary management and product development.
	2. Develop products which meet nutritional needs of consumers.
	3. Explore theoretical concepts and apply during product development/ modification.
	4. Use different sensory methods to evaluate a variety of developed foods.
Module 1 (Credit 1) - Enhancing Food Attributes	
Learning Outcomes	After learning the module, learners will be able to -
	1. Plan specific ingredients to enhance the appearance, texture, and taste of any particular food.
Content Outline	• Use of different food ingredients for development of health foods – artificial sweeteners, modified starches, fat replacers, increasing fiber content, functional ingredients, low sodium food adjuncts, protein concentrates, whey
Module 2 (Credit 1) - Nutritional Needs in Extreme Conditions	
Learning Outcomes	After learning the module, learners will be able to -
	1. Evaluate nutritional needs based on specific conditions and develop wholesome, nutrient-dense foods.
Content Outline	• Developing foods for people under specified conditions: High altitude, Extreme temperatures (high and low), Under water (Scuba divers), Space foods (Astronauts).
Module 3 (Credit 1) - Food Development for Crisis Situations	
Learning Outcomes	After learning the module, learners will be able to -
	1. Develop wholesome and nutrient dense foods based on foods available to meet the nutrient requirements
Content Outline	• Developing foods for people under certain unforeseen situations and natural calamities: War situation (Army, Navy, Air Force), Political unrest, Drought, Famine, Floods, Earthquakes

Module 4 (Credit 1) - Alternatives for Allergies and Intolerances	
Learning Outcomes	After learning the module, learners will be able to -
	1. Develop food alternatives for people with allergies and intolerance
Content Outline	• Foods for people with allergies and intolerances: Lactose free, gluten free • Vegan foods, mock meats

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Develop innovative recipes using artificial sweetener & fat replacer
2. Develop product for any specific condition (High Altitude, extreme temperatures, space food, etc.
3. Plan a food care kit for any unforeseen situations.

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Journals:

- International Journal of Food Science and Technology.
- Food Technology
- Journal of Food Technology
- Trends in Food Science and Technology
- Critical Reviews in Food Science and Nutrition

4.5 Research Project

454331	**Dissertation**		**6**
Sr. No.	**Modules and Outcomes**	**Course Contents**	**Cr**
Course Outcomes:	At the end of this course Learners will be able to – - Demonstrate mastery of parametric and non-parametric statistical tests through application in data analysis. - Evaluate and critique quantitative analysis methods, demonstrating proficiency in interpreting large and small sample tests for inferential statistics. - Synthesize advanced statistical techniques such as chi-square tests, correlation, and regression to analyze complex datasets and draw meaningful conclusions. - Construct an argument based on their prior research proposal, integrating data analysis and presentation techniques and drawing summary and conclusion with clarity and precision.		
Following Steps to be completed during the semester:			
	Data collection / finalization/ analysis ● Gather and finalize any remaining data required for the dissertation. ● Ensure all data is complete, validated, and ready for analysis. ● Conduct final data analysis using appropriate statistical methods. ● Validate findings and ensure they align with research objectives and hypotheses.		
	Finalization of chapters of Introduction & Methodology ● Review and finalize the introduction chapter, providing a clear rationale and background for the study. ● Refine the methodology chapter, detailing the research design, sampling methods, and data collection procedures. ● Ensure all methodological aspects are well-documented and align with the research questions. ● Incorporate any feedback or suggestions to enhance the clarity and coherence of these chapters.		
	Finalization of Results and Discussion ● Analyse and interpret the final results obtained from the data analysis. ● Present findings in a clear and structured manner, using tables, graphs, and figures as needed. ● Discuss the implications of the results in relation to the research questions and existing literature. ● Address any unexpected findings or limitations and provide possible explanations.		

	Finalization of Summary and Conclusion ● Summarize the key findings of the dissertation in the summary chapter. ● Discuss the significance of the findings and their contributions to the field of study. ● Revisit the research objectives and evaluate whether they have been met. ● Craft a well-rounded conclusion that reflects on the overall research journey and its implications.	
	Approval of final draft of the dissertation and research article ● Submit the final draft of the dissertation to the academic advisor or committee for review and approval. ● Address any feedback or revisions requested by the advisor or committee to ensure the dissertation meets academic standards. ● Simultaneously, students will prepare a research article based on their dissertation findings for submission to an international journal of high repute. ● The article should be structured according to the journal's guidelines, emphasizing the novelty, significance, and implications of the research	
	Submission of dissertation and Viva voce ● Submit the approved dissertation to the academic institution by the specified deadline. ● Ensure the dissertation adheres to all formatting and documentation requirements for final submission. ● Concurrently, students will finalize the research article based on their dissertation findings for submission to the international journal. ● Prepare for the viva voce (oral defense) examination, which includes defending both the dissertation and the research article before a panel of examiners. ● Demonstrate in-depth knowledge, critical thinking, and the ability to articulate and defend research findings during the viva voce.	

Dissertation Assessment Template:

	INTERNAL ASSESSMENT **(25)**			***TOTAL Marks Obtained***
		Proposal (15)		
		Understanding of concept & Execution (10)		
	TOTAL Marks 25		**out of**	
	INTERNAL ASSESSMENT **(25)**	**(A) General**		
		Punctuality, Sincerity, Perseverance, Commitment, Attitude		
		TOTAL	**Out of 15**	
		(B) Skills		
		Use of Resources, Literature, Use of Technology, Communication, Any other		
		TOTAL	**Out of 10**	
	TOTAL Marks (by the internal supervisor) Out of 50			
			INTERNAL EXAMINER	EXTERNAL EXAMINER
	JOINT ASSESSMENT (100)	Dissertation (50)		
		Viva Voce (50)		
		TOTAL		
		TOTAL (Average of the two)		
	OVERALL TOTAL (OUT OF 150)			