Curriculum
of
Bachelor of Science(B.S.)with Honours inNutrition and Food Science

Institute of Nutrition and Food Science
University of Dhaka

Session: 2020-21 and onwards

Curriculum for Bachelor of Science (B.S.) with Honours in Nutrition and Food Science
University of Dhaka
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The Institute of Nutrition and Food Science (INFS), University of Dhaka, is a pioneering organization of research and teaching in the field of Nutrition and Food Science in Bangladesh. It was established in 1969 as a follow up of the 1962-64 National Nutrition Survey. INFS is devoted to the study of nutritional issues of the country to inform policies targeting the food and nutrition security of the Bangladeshi population. As part of capacity building and strengthening, INFS offers undergraduate (B.S. (Honors) program) and graduate (M.S. M.Phil., and Ph.D. program) and conducts specialized training for professionals. The INFS has a group of highly qualified and experienced faculty members. The primary focus of academics and research are: (i) Nutritional Biochemistry, (ii) Clinical Nutrition and Diet Therapy, (iii) Community and Public Health Nutrition, and (iv) Food Science and Technology (including Food Microbiology). Major research areas are food analysis, analysis of food toxins, the role of functional food in health and diseases, nutrition survey and surveillance, livelihood and food security, food, and nutrition policy, food hygiene and safety, and the role of diet in the disease process. Over the years, INFS has conducted several national surveys (1975-76, 1981-82, 1995-96, 2001-2003 and 2011-2012), and managed, updated, and published Food Composition Tables (FCTs) and Database for Bangladesh. The Institute has a rich seminar library with an extensive collection of reference books and journals. It possesses several research laboratories with modern equipment, facilities, and service systems. The faculty and the researchers of this Institute have been regularly publishing their research findings in high impact national and international journals. The Institute has already earned a place as a center of excellence in the field of Nutrition and Food Science research in Bangladesh. The Institute has a strong collaboration with various national and international research organizations.

Title of the Program: Bachelor of Science (B.S.) with Honours in Nutrition and Food Science

Duration of the Program: Four years

Level: Undergraduate

Medium of Instruction: English

Eligibility for Admission:
Students are admitted to the B.S. (Honors)Degree program as per the existing Ordinance and regulations of the University of Dhaka and the rules of the Faculty of Biological Sciences and INFS, University of Dhaka. The Institute may re-fix the minimum requirement for admission to the program from time to time with approval from the authority.

Courses and Credit Distribution:
Each 3-credit course will carry 75 marks (45 hours), and each 2-credit course will carry 50 marks (30 hours). Each student must take a total of 128 credit courses. The layout of the B.S. (Hons) in Nutrition and Food Science program is given below:

Year-wise credits distribution

Year	Theory	Practical	Viva	Total Credits
First	19	5	2	26
Second	22	4	2	28
Third	24	10	2	36
Fourth	26	10	2	38
Total	**91**	**29**	**8**	**128**

Course Lay-out and Credit Hours

FIRST YEAR			
	Course Number	**Name of Course**	**Credits**
Theory:	**NFS-101**	Introduction to Nutrition and Food Science	**2**
	NFS-102	Organic Chemistry	**3**
	NFS-103	Inorganic and Physical Chemistry	**3**
	NFS-104	Micro Economics	**2**
	NFS-105	Social Nutrition	**2**
	NFS-106	Microbiology	**3**
	NFS-107	Human Anatomy	**2**
	NFS-108	Foundation Course in English	**2**
Sub-total			**19**
	NFS-111	Chemistry-Practical	**3**
	NFS-112	Food Microbiology-Practical	**2**
	NFS-121	Viva Voce	**2**
Total			**26**

SECOND YEAR			
	Course Number	**Name of Course**	**Credits**
Theory:	**NFS-201**	Biochemistry I: Macronutrients	**3**
	NFS-202	Biochemistry II: Micronutrients	**3**
	NFS-203	Human Physiology	**3**
	NFS-204	Nutrition in the Life Cycle	**3**
	NFS-205	Food Chemistry	**2**
	NFS-206	Food Microbiology	**2**
	NFS-207	Food Security and Food System	**2**
	NFS-208	Macro Economics	**2**
	NFS-209	Laboratory Methods and Analytical Techniques	**2**
Sub-total			**22**
	NFS-211	Biochemistry-Practical	**2**
	NFS-212	Food Chemistry-Practical	**2**
	NFS-221	Viva Voce	**2**
Total			**28**

THE THIRD YEAR			
	Course Number	**Name of Course**	**Credits**
Theory:	**NFS-301**	Biochemistry III: Metabolism	**3**
	NFS-302	Introduction to Molecular Biology and Biotechnology	**2**
	NFS-303	Food Science	**3**
	NFS-304	Clinical Nutrition	**2**
	NFS-305	Assessment of Nutritional Status	**3**
	NFS-306	Applied Nutrition and Dietetics	**2**
	NFS-307	Nutrition Planning	**3**
	NFS-308	Nutrition Education and Counseling	**3**
	NFS-309	Biostatistics	**3**
Sub-total			**24**
	NFS-311	Nutritional Biochemistry-Practical	**2**
	NFS-312	Clinical Nutrition and Dietetics-Practical	**2**
	NFS-313	Biostatistics-Practical	**2**
	NFS-314	Food Science and Technology-Practical	**2**
	NFS-315	Internship-Food Industry	**2**
	NFS-321	Viva Voce	**2**
Total			**36**

FOURTH YEAR			
	Course Number	**Name of Course**	**Credits**
Theory:	**NFS-401**	Epidemiology	3
	NFS-402	Food Technology	3
	NFS-403	Food Microbiology and Food Safety	3
	NFS-404	Nutritional Biochemistry	3
	NFS-405	Public Health Nutrition	2
	NFS-406	Nutrition in Emergencies	2
	NFS-407	Medical Nutrition Therapy	3
	NFS-408	Data Management and Analysis	2
	NFS-409	Development Nutrition	3
	NFS-410	Research Methods	2
Sub-total			**26**
	NFS-411	Diet Preparation-Practical	2
	NFS-412	Clinical Nutrition and Physiology-Practical	2
	NFS-413	Field Assignment	2
	NFS-414	Research Project	2
	NFS-415	Internship-Hospitals/NGOs	2
	NFS-421	Viva Voce	2
Total			**38**

Grand Total for B.S. (Honors) Program: 128 Credits

DETAIL CURRICULUM AND SYLLABUS FOR FIRST YEAR B.S. (HONORS)

	Course Number	Name of Course	Credits
Theory:	**NFS-101**	Introduction to Nutrition and Food Science	**2**
	NFS-102	Organic Chemistry	**3**
	NFS-103	Inorganic and Physical Chemistry	**3**
	NFS-104	Microeconomics	**2**
	NFS-105	Social Nutrition	**2**
	NFS-106	Microbiology	**3**
	NFS-107	Human Anatomy	**2**
	NFS-108	Foundation Course in English	**2**
Sub-total			**19**
	NFS-111	Chemistry-Practical	**3**
	NFS-112	Food Microbiology-Practical	**2**
	NFS-121	Viva Voce	**2**
Total			**26**

Course No. NFS-101 Introduction to Nutrition and Food Science 2 Credits

Course Overview:
This course providesan overview of what nutrition and food science comprise. It coversa brief history of nutrition, the cell and its components, the role of nutrition throughout the life cycle, classification of nutrients and their function, nutrient deficiencies, the nutritive value of food, food groups, and forms of malnutrition. The scope and career prospects in nutrition and food science will also be discussed**.**

Learning Outcomes:
Upon completion of the course, students will be able to

- Describe the discovery of different food component and nutrients
- Describe classifications and functions of tissue, homeostasis, nutrient, and cell
- Explain the stages of the life cycle and the significance of nutrition in each stage
- Write the chemical structure of each nutrient, describe the physiological function, clinical sign-symptom of deficiency diseases
- Describe components of energy expenditure and food energy flow through the body for the maintenance of energy balance

Content:
1. History of Nutrition
2. Cell and tissues. Body fluid and its compartments, homeostasis. Nutrients and cell. The cell and its components: cell as the basic living unit, prokaryotes and eukaryotes, structure and function of sub cellular organelles, chemical components of cell.
3. Concept of life and living process, the identifying characteristics of a living matter.
4. Concepts of Food- Nutrition and Nutrients. Essential and non-essential nutrients, Macronutrients-carbohydrate, fat and protein; and micronutrients-vitamins and minerals, their chemical structures, basic physiological functions, name of deficiency diseases. Body requirement and RDA. Dietary intake standards.
5. Nutrition, health, and disease. Life cycle.
6. Role of diets in the treatment of diseases.
7. Nutritional status. Role of nutrition in human development. Forms and types of malnutrition. Pattern of malnutrition in developed and developing countries. Major nutritional problems in Bangladesh.

8. Aspects of food science. Concepts of foods. Food Sources. Classification of foods. Nutritive values of common foodstuffs. Functions of foods. Loss of nutrients in different conditions.
9. Definition, components, and development of food science; activities and scopes of food science, content of foods and their significance

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%) and a final exam (60%).

References:

1. Leininger Principles of Biochemistry 4th edition
2. Wardlaw's perspectives in nutrition, 8th edition
3. Principles of Nutritional Assessment - R. Gibson, 2nd edition
4. Food Science – N. N. Potter
5. Human Nutrition in the Developing World-Latham MC
6. Bangladesh Demographic Health Survey Report

Course No. NFS-102 Organic Chemistry 3 Credits

Course Overview:
This course providesessential knowledge of organic chemistryto help students better understanding nutrition and food science.In this course, students will be taught hydrocarbons, alcohols, amines, aldehyde and ketone, carboxylic acid, phenol, etc.

Learning Outcomes:
Upon completion of the course, students will be able to
- Draw and explain the structure and bonding of biologically importantfunctional groups
- Explain the physiochemical properties of biomolecules relevant to food
- Explain the chemical reactivity mechanisms, kinetics, and equilibriums of naturallyoccurring organic reactions relevant to the food
- Describe common natural chemical reactions of biomolecules relevant to the food

Content:
1. Aliphatic hydrocarbons: Occurrence, structure, nomenclature, preparation, physical and chemical properties of saturated and unsaturated aliphatic hydrocarbons.
2. Aromatic hydrocarbons: Structure of benzene, source of aromatic hydrocarbons, industrially important aromatic compounds, nomenclature of benzene derivatives, electrophilic aromatic substitution.
3. Alcohols, ethers, epoxides, and diols: Occurrence, structure, nomenclature, preparation, physical and chemical properties and uses.
4. Dienes and Polyenes: Structure and properties of 1, 3-butadiene, addition reaction, polymerization, Diels-Alder reaction.
5. Aldehydes and ketones: Nomenclature, synthesis, nucleophilic addition reaction, oxidation-reduction of carbonyl compounds, haloform reactions, enolisation, halocarbonyl compounds, aldol-

condensation, benzoin condensation.

6. Carboxylic acid and their derivatives: Nomenclature, preparation, classification, properties and reactions, decarboxylation reactions, dicarboxylic acids, esters.
7. Nitro-compounds and amines: Occurrence, nomenclature, preparation, classification, properties, reactions, uses, diazotisation and diazonium compounds.
8. Phenols: Occurrence, nomenclature, preparation, properties and reactions, polyhydric phenols.
9. Heterocyclic compounds (Pyrroles, purines and pyrimidines): Preparation, structure and properties.
10. General idea of organic compounds of sulfur and phosphorus.

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in course examination (35%) and a final exam (60%).

References:

1. Principles of Organic Chemistry--J.English& H.G. Cassidy
2. Organic Chemistry. vol I & II- I.L. Finar.
3. Test book of Organic Chemistry- R.T. Marrison& R.N. Boyd
4. Organic Chemistry- H.Hart&R.D.Schuetz
5. Advanced Organic Chemistry- B.S. Bahl& A. Bahl

Course No. NFS-103Inorganic and Physical Chemistry 3 Credits

Course Overview:
This course is designed to introduce students to concepts, terminology, and principles of inorganic and physical chemistry to help students for a better understanding of nutrition and food science. It includes several topics such asacid, bases and buffers, typesand properties of a solution, chemical equilibrium, chemical kinetics, oxidation and reduction, atomic structure and atomic orbitals, and chemical thermodynamics.

Learning Outcomes:
Upon completion of the course, students will be able to

- Define acid-base and describe theories of acid-base.
- Outlinethe nature and properties of a solution
- Explain chemical equilibrium and chemical kinetics
- Demonstrate knowledge of the oxidation and reduction, atomic structure and atomic orbitals, and chemical thermodynamics.

Content:

1. Acid, bases and buffers, Bronsted-Lowry concept, Lewis concept, strength of acids, p^H of solutions, Henderson-Hasselbalch equation, acid base indicator, acid-base titration's, choice of a suitable indicator, Ostwald's theory of acid base indicators, salt hydrolysis, buffer solution and buffer capacity. Buffer equations, buffer capacity, buffer in biologic systems, buffered isotonic solutions, methods of adjusting tonicity and pH.
2. Types and properties of solution, units of concentration, ideal and real solution, Henry's law, distribution of solids between two immiscible liquids, distribution law, partition coefficient, solvent extraction.Colligative properties, osmosis, osmotic behavior in living cell, ionization of electrolytes, degree of ionization, strong and weak electrolytes.
3. Chemical Equilibrium. Nature of chemical equilibrium, law of mass action, equilibrium constant, relationship between Δ G and Keq, effect of temperature and pressure. Equilibrium reaction involving protons, coupling of reactions. Applications in living systems
4. Chemical kinetics: Definition, reaction rate, rate laws, zero-, first- and second-order reactions, molecularity of a reaction, pseudo-first order reaction, half-life, determination of order and rate constant, effect of temperature on reaction rates. Theories of reaction rates – the collision theory, the activated complex theory. Catalysis - definition, types, characteristics of catalysts, activation energy and catalysis.
5. Oxidation and Reduction: Classical, valence state, electro-negativity, charge and electronic concept, oxidation state and oxidation number, oxidation reduction reactions, equivalent weights of oxidizing and reducing agents
6. Atomic structure and atomic orbital. Chemical Bonds: Electronic concepts of chemical bonds, ionic bond, co-ordination bond, covalent bond, hybrid orbitals, polarity of bonds, electro-negativity, dipole moment, potential curve, weak bonds, hydrogen bond and hydrophobic interactions, bond energies. Isotope (biomedical implications)
7. Chemical thermodynamics: Introduction, the first law of thermodynamics, work, energy and heat, work of expansion, internal energy, determination of internal energy, heat change at constant volume and constant pressure, thermodynamic reversibility, work of isothermal reversible expansion of gases, the maximum work under the isothermal expansion of a gas, heat capacities, difference between molar heats, Adiabatic processes, Joule- Thomson experiment. Thermochemistry and thermochemical law: Second law of thermodynamics, Carnot's cycle and efficiency of a perfect engine, the concept of entropy and entropy changes for an ideal gas expansion, entropy changes of materials under various conditions, free energy and work functions, Gibbs Helmholtz equation, Third law of thermodynamics. Free energy changes under equilibrium, the Clausius-Claperon equation.

Learning and Teaching method:

Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:

Regular attendance (graded), in course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in course examination (35%) and a final exam (60%).

References:

1. Introduction to Modern Inorganic Chemistry- S.Z. Haider
2. Modern Inorganic Chemistry- R.D. Madan
3. Physical Chemistry with application to Biological systems- R. Chang
4. Elements of Physical Chemistry- S. Glasstone& D. Lewis
5. Test book of Organic Chemistry- R.T. Morrison & R.N. Boyd.

6. Principles of Physical Chemistry- M.M. Huque, 1974
7. Principles of Physical Chemistry- M.M.Huque& M. Ali Nawab
8. Test book of Physical Chemistry- S. Glasstone
9. Principles of Physical Chemistry- S.H. Maron&C.F.Prutton
10. Principles of Physical Chemistry - Hamill, Williams, Mackay
11. Elementary Physical Chemistry - S.R. Palit
12. Essentials of Physical Chemistry - B.S. Bahl, G.D. Tuli&ArunBahl

Course No. NFS-104 Micro Economics 2 Credits

Course Overview:
The microeconomicscourse covers basic economic topics, the nature and functions of markets, and the role of government in market regulation. This course begins with an introduction to supply and demand and the basic forces that determine equilibrium in a market economy. This course will cover focus on the concepts of supply and demand, equilibrium in a market economy, consumer behavior and consumer decisions, production, and market structures on firms' behavior.

Learning Outcomes:
Upon completion of the course, students will be able to

- Use supply and demand diagrams to analyze the impact of overall changes in supply and demand on price and quantity.
- Solve a consumer's utility maximization problem mathematically and graphically; analyze the impact of changes in price and income on a consumer's decision via shifting income and substitution effects.
- Understand the consumer's labor supply decision.
- Solve a firm's cost minimization problem mathematically and graphically.
- Analyze the behavior of firms in a perfectly competitive market in the short-run and in the long-run.

Content:
1. Introduction to Economics: scope and principles of economics, basic economic concepts (scarcity, opportunity cost, and marginal analysis), basic economic models (production possibility frontier and circular flow model)
2. Functioning of Markets: markets and competition, market forces of supply and demand; elasticity of supply, elasticity of demand, applications of supply, demand, and elasticity; supply, demand, and government policies (taxes) to control prices.
3. Markets and Welfare: consumers, producers, and efficiency of markets (consumer surplus, producer surplus, and market efficiency); costs of taxation (deadweight loss of taxation, determinants of deadweight loss, and deadweight loss and tax revenue with varying taxes); international trade (determinants of trade and arguments for restricting trade)
4. The Economics of the Public Sector: externalities (externalities and market inefficiency, private solutions to externalities, and public policies toward externalities); public goods and common resources; and taxes (efficiency, equity and their trade-off)
5. Firms' Behavior and Organization of Industry: costs of production, firms in competitive markets, monopoly, oligopoly, and monopolistic competition.
6. Resource Markets (Economics of Labor, Land, and Capital): demand and supply for labor; equilibrium in labor market; equilibrium in markets for land and capital; and linkages among factors of production.
7. Consumer Behavior (Theory of Consumer Choice): budget constraint (what consumers can afford; preferences (what consumers want); and optimization (what consumers choose).

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%), and a final exam (60%).

References:

1. Mankiw, N. Gregory, Principles of Economics – Sixth Edition Thomson South-Western, 2012
2. Microeconomics-Pearson Series in Economics 9th Editionby Robert Pindyck, Daniel Rubinfeld

Course No. NFS-105 Social Nutrition 2 Credits

Course Overview:
The course will providea basic knowledge of sociology and anthropology to help understand the social and cultural aspects of food. It states the link between social science and nutritional science.

Learning Outcomes:
Upon completion of the course, students will be able to
- Understand the basic concepts of sociology
- Demonstrate knowledge of the importance of studying sociology and anthropology in nutrition
- Recognize different food habits and practices among different culture and society
- Understand social inequalities within the society
- Describe some of the research methods used in sociology and anthropology that have importance in nutrition research

Content:
1. Definition, nature, and importance of the study of sociology and anthropology.
2. Research methods in sociology and anthropology
3. Some basic concepts of sociology and anthropology: (a) Society (b) Community (c) Association (d) institution (e) Groups: primary and secondary groups, minority groups, ethnocentrism (f) Customs (g) Folkways and mores (h) Culture: material and non-material culture, Ogburn's theory of cultural lag (i) Socialization: Theory of Mead, Durkheim and Freud on socialization (j) Social control: agencies of social control (k) Primitive economy: Hunting, fishing, food gathering, horticulture, pastoralism and agriculture (l) Religion.
4. Geography and social life.
5. Social organization: (a) Kinship (b) Marriage (c) Family
6. Social inequality by sex, age, rank, class, caste, race.
7. Basic demographic process: (a) fertility (b) mortality (c) migration
8. Food habits and foodways: changing food habits, symbolism and prestige foods, festivals and feasts, food faddism, intra-family food distribution, culture, food, and nutrition in increasingly culturally diverse societies.
9. The social construction of eating disorders; sociological analysis of the stigmatization of obesity
10. Research approaches in nutritional anthropology

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical

demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%), and a final exam (60%).

References:

1. Foundations of Modern Sociology- M. Spencer
2. Sociology - S. Koenig
3. Social and Cultural Anthropology. A Very Short Introduction. Oxford by Monaghan, John and Peter Just
4. An Introduction to Anthropology - R. L. Beals and H. Hoijer
5. Nutritional Anthropology- F.E. Johnston
6. Nutritional Anthropology: Biocultural Perspectives on Food and Nutrition Edited by Darna L. Dufour, Alan H. Goodman, et al.
7. A Sociology of Food and Nutrition: The Social Appetite (3rd Edition) by John Germov, and Lauren Williams
8. New Perspectives in Cultural Anthropology - R.M.Keesing& F.M. Keesing
9. Principles of Sociology - F. R. Khan
10. Food, Man and Society - D. Dressler

Course No. NFS-106 Microbiology 3 Credits

Course Overview:
The course discusses the theory and techniques ofmicrobiological media preparation,methods of bacterial inoculation, the growth curve of bacteria, and the identification of these bacteria by cultural, morphological, biochemical, and serological tests. Further, this course teaches control of microbial growth and short-term and long-term preservation of microbial cultures.

Learning Outcomes:
Upon completion of the course, students will be able to
- Classify microorganisms depending on their nutrient requirement and culture media
- Describe the technique of isolation of organisms from a mixed culture by streak plate, pour plate, and spread plate technique
- Explainthe cultural characteristics of microorganisms like shape, size, elevation,etc. of a bacterial colony
- Apply direct and indirect counting methods of bacteria
- Learn the precaution and principles of asepticand sterilization techniques in the microbiology laboratory

Content:

1. Background on microbiology (the history of microbiology, basic methods, and background on microbial qualitative and quantitative assessment, and characteristics of microbiological cells).
2. Metabolism and culture methodologies (various types of microbiological culture media, their preparation, dilution, and dispensation).
3. Isolation of microorganisms (pure culture from various sources by streak, pour and surface plating techniques).
4. Aseptic techniques in microbiology - various techniques of sterilization of biological and non-biological materials.
5. Identification of microbial cells through culture, microscopy, biochemical assay, serological characterization, and by commercially available kits.
6. Enumeration of microbial growth through direct and indirect methods (count methods and calculations).
7. Growth and death of bacteria (bacterial population curves, exponential and synchronous growth curves).
8. Anaerobic and microaerophilic techniques in microbiology.
9. Scope of microbiology: inhuman welfare, agriculture, industry, health, and sanitation; environment and pollution control.
10. Control of microbial growth: principles of microbial control; the rate of microbial death; the action of microbial control agents; condition influencing microbial control; physical and chemical methods of control.
11. Short time and long-time preservation of microbial cultures; culture collection and its management
12. Classification and characterization of various nutritional and physiological groups of microorganisms

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in course examination (35%) and a final exam (60%).

References:

1. Microbiology - M.J. Pelczar, E.C.S. Chan and N.R. Krieg
2. Microbiology: An Evolving Science (4th edition) John W. Foster and Joan L. Slonczewski
3. Microbiology - an introduction, (6thedn.) - G.J. Tortora, B.R. Funke and C.L. Case.
4. Biology of Microorganisms - T. Saunders and T. Lyles.
5. Biology of Microorganisms (7thedn.) - T.D. Brock, M.T. Madigan, F.M. Martinko and J. Parker.
6. Modern Food Microbiology – James M. Jay
7. Food Microbiology – MR. Adams & M.O. Moss
8. Food Hygiene and Sanitation- S. Roday
9. Food Microbiology: An Introduction (4th edition) Thomas J. Motville, Karl R. Matthews, Kalmia E. Kniel

Course No. NFS – 107 **Human Anatomy** **2 Credits**

Course Overview:
This course provides knowledge of basic human anatomies such as cell, tissues, and its function. It will also cover the anatomy of different biological systems, namely the digestive system, reproductive system, cardiovascular system, kidney, and central nervous system.

Learning Outcomes:
Upon completion of the course, students will be able to

- Demonstrate the understanding of the classification and function of cell and tissues
- Draw and describe the digestive system of the human body
- Illustratethe reproductive and cardiovascular system of the human body
- Draw and explain the renal and central nervous system

Content:
1. Cell and tissues – classifications and functions.
2. Alimentary system – Oral cavity and its contents (lips, vestibule, gums, oral cavity proper, teeth, palate, tongue, and its taste buds). Salivary glands. Stomach- it is location, shape, size, parts, cellular structure. Small intestine - its different parts and cells. Large intestine – its different parts and cells. Liver and gall bladder - structure and cell biology of liver. Pancreas – structure and cell biology.
3. Reproductive system – Male and female reproductive organs.
4. Cardiovascular system – Heart and its chamber, anatomy of circulatory system.
5. Kidney and it's structure.
6. Central nervous system–Brain– size, shape, structure, different parts (cerebrum, cerebellum, pons, medulla oblongata). Hypothalamus. Spinal cord. Special senses – skin, eye (structure).

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%) and a final exam (60%).

References:
1. Cunningham's Manual of Practical Anatomy. Ed. G.J. Romans,(Vol. I,II,III)
2. B.D. Chaurasia: Human Anatomy. Regional and Applied (Vol. I,II,III).

Course No. NFS-108 Foundation Course in English 2 Credits

Course Overview:
This is a foundation course in English for the freshmen of this Institute. The purpose of this course is to help students develop their reading, writing, speaking, and listening skills in English to help them to succeed in the institutional courses as well as in their careers in the future.

Learning Outcomes:
Upon completion of the course, students will be able to

- Know basic grammar items; practice different strategies for deciphering requisite information after reading a text; develop their knowledge about the different types of pre-writing, while writing and post writing strategies.

- Enhance their knowledge about writing an effective topic sentence and thesis statement; develop their understanding of 5 types of paragraph writing and three types of essay writing.
- Specializein pre-listening, while-listening, and post-listening strategies for effective listening to college lectures, news clips, give short oral presentations and participate in classdiscussions.

Content:

1. **Grammar:** Tense, articles, prepositions, subject-verb agreement, noun-pronoun agreement, modal auxiliary verbs, clauses, conditionals, transformations of sentences, narration, voice, sentence variation, suffix, and prefixes
2. **Writing skills**:
   Paragraph writing: a) paragraph development by Listing; b) paragraph development by examples; c) paragraph development by comparison; d) paragraph development by contrast; e) paragraph development by cause and effect
   Writing Informal and formal Letters: informal letter, cover letter, CV (British and American Style)
   Composition: compare and contrast, argumentative composition, cause and effect essay
   Summary Writing
3. **Listening skills**: Strategies of effective listening, note taking, predicting, content, listening for key words, listening for gist, detecting signpost, listening for details, inference
4. **Reading skills**: Annotation, skimming, scanning, predicting, inference, analysis, interpretation,
5. **Oral skill:** Brainstorming, discussing and reporting, role playing, debate, impromptu presentation, report presentation on field visit (National Museum, Public library, Liberation War museum, Lalbag Fort), interviewing a native American on Skype (Life in the Silicon Valley), extempore speech interview, brochure presentation, group poster presentation on Animal Farm by George Orwell

Learning and Teaching method:

The course will be taught through a combination of lectures, group discussions, individual/grouppresentations in class, simulation of real-life situations, written Assignment, communicating with native, English Speakers(via Skype)

Assessment:

Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%) and a final exam (60%).

References:

1. New Headway
2. Animal Farm, George Orwell
3. Writing skill Handbook, Bazermann Weiner
4. From Paragraph to Essay, Maurice Imphoof
5. Writing Skill, John Langan.
6. Writing Skill, John Longman
7. A Practical English Grammar, Thomson Martinet

Course No. NFS-111 **Chemistry-Practical** **3 Credits**

Course Overview:
This practical course enables learners to know basic laboratory techniques used in nutrition and food science. This course begins with basic lab safety techniques along with the estimation and determination of various chemical parameters in food and other biological samples.

Learning Outcomes:
Upon completion of the course, students will be able to

- Demonstrate knowledge of the basic tools of laboratory analysis
- Prepare different types of solutions
- Estimate various parameters of food and biological samples
- Demonstrate different chemical process after experiments

Content:

1. Lab safety training
2. Basic tools of laboratory analysis
3. Laboratory data handling
4. Preparation of standard solutions
5. Standardization of HCI
6. Estimation of acetic acid content of vinegar
7. Estimation of calcium by the permanganate method
8. Estimation of iron content of Mohr's salt by the dichromate method
9. Estimation of iodine content of salt
10. Estimation of ascorbic acid by titrimetric method
11. Determination of saponification number of fat or oil
12. Determination of iodine number of fat or oil
13. Determination of lactose content of milk
14. Preparation of buffer and determination of pKa of acetic acid
15. Color tests for biomolecules.
16. Demonstration of the process of osmosis

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance and laboratory work (graded), in-course assessment (graded), and final examination (graded). A student's grade will be calculated based on a combination of in-course assessment (40%) and a final examination (60%).

References:
Vogel's Quantitative Chemical Analysis by J. Mendham, R.C. Denney, J. D. Barnes, M.J.K. Thomas

Course No. NFS - 112 Food Microbiology-Practical 2 Credits

Course Overview:
The food microbiology practical course will allow students to use tools used in the microbiological lab such as microscope, autoclave, incubator, cultural plates, etc. It will also enable students to learn about

the practical knowledge of different properties of bacterial culture, properties of enzymes, isolation, and identification of foodborne pathogens.

Learning Outcomes:
Upon completion of the course, students will be able to

- Handle and know the use of a microscope
- Prepare different type of media for bacterial culture
- Apply techniques to isolate, identify, and characterize bacteria
- Perform bacteriological examination of food products
- Determine different properties of the enzyme

Content:

1. Handling and use of bright field microscope.
2. Staining techniques: techniques: simple staining, negative staining, and gram staining etc.
3. Preparation of bacterial culture media of various types.
4. Enumeration of viable organisms in from food samples sample of food, water, and beverages by plate count method and turbidimetric method.
5. Techniques for isolation and creation of pure cultures from food, water, and beverages.
6. MPN technique for counting coliform in water.
7. Identification of bacteria by Cultural, Morphological, and Biochemical tests.
8. Production of microbial (fungal) extracellular enzyme, and determination of enzyme activity (amylase),
9. Determination of enzyme kinetic properties of an enzyme.
10. Determination of activators and inhibitors of enzyme.
11. Bacteriological examination of milk and milk products, RTE foods.

Learning and Teaching method:
Theory classes using all available visual aids, e.g., Blackboard, whiteboard, PowerPoint, and practical demonstrations in laboratory

Assessment:
Regular attendance and laboratory work (graded), in-course assessment (graded), and final examination (graded). A student's grade will be calculated based on a combination of in-course assessment (40%) and a final exam (60%).

References:

1. Raton, B. 2016 Food microbiology: in human health and disease. Taylor & Francis, 2016. Osman,E. 2016 Food microbiology: principles into practice: John Wiley & Sons, Inc. Persing, D. H., 2016. Molecular microbiology: diagnostic principles and practice: ASM Press, Brown, T. A., 2015. Gene cloning and DNA analysis: an introduction: Wiley Blackwell.
2. Bibek, R., 2014 Fundamental food microbiology Boca Raton: CRC Press, Taylor & Francis Group,
3. Montville T.J. Matthews K.R, & Kalmia E. Kniel. 2012, Food microbiology: an introduction. Washington, DC: ASM Press.
4. Adams, M. R., 2008. Food microbiology Cambridge: Royal Society of Chemistry.
   Jay, J.M., Loessner, M.J., Golden, D.A., 2005, Modern Food Microbiology, Aspen Publishers, , 7th Edition

Course No. NFS- 121 Viva Voce 2 Credits

The oral examination assesses the student's aptitude and learning from theory and practical courses.

Assessment: Total Marks – 50

DETAIL CURRICULUM AND SYLLABUS FOR SECOND YEAR B.S. (HONORS)

	Course Number	Name of Course	Credits
Theory:	**NFS-201**	Biochemistry I: Macronutrients	**3**
	NFS-202	Biochemistry II: Micronutrients	**3**
	NFS-203	Human Physiology	**3**
	NFS-204	Nutrition in the Life Cycle	**3**
	NFS-205	Food Chemistry	**2**
	NFS-206	Food Microbiology	**2**
	NFS-207	Food Security and Food System	**2**
	NFS-208	Macro Economics	**2**
	NFS-209	Laboratory Methods and Analytical Techniques	**2**
Sub-total			**22**
	NFS-211	Biochemistry-Practical	**2**
	NFS-212	Food Chemistry-Practical	**2**
	NFS-221	Viva Voce	**2**
Total			**28**

Course No. NFS - 201 Biochemistry-I: Macronutrients 3 Credits

Course Overview:
This course introduces the properties of carbohydrates, proteins, lipids, cholesterol, DNA, RNA, glycoproteins, and glycolipids and their importance in biological systems. Under this course,the definition, nomenclature, and other properties of the enzyme will be discussed.

Learning Outcomes:
Upon completion of the course, students will be able to

- Demonstrate knowledge of the definition, nomenclature, properties of carbohydrate and their derivatives
- Explain the structural classification and function of lipids
- Describethe amino acid structure and their biological functions, the structure of DNA and RNA and physicochemical properties ofnucleoside and nucleotides
- Understand the properties of enzyme and enzyme kinetics

Content:

1. Carbohydrates: Definition, nomenclature, classification, optical properties, ring structure of common monosaccharides, mutarotation of glucose, chemical properties of sugars, derivatives of monosaccharides-sugar acids and aminosugars. Structure and biological importance of common disaccharides-maltose, lactose, sucrose; and polysaccharides-starch, glycogen, cellulose.
2. Lipids: Definition, nomenclature, structure,classification and functions of different classes of lipids, reaction of fats, fatty acids and sterols. Essential fatty acids.
3. Amino acids and peptides: structural features, classification, physical and chemical properties of amino acids and peptides. Essential aminoacids. Proteins: classification based on shape and biological functions. Structure: Primary, Secondary, Tertiary and Quaternary structures of protein.
4. Nucleosides and nucleotides: Occurrence, structure, physicochemical properties. Polynucleotides: Occurrence, structures of DNA and RNA.
5. Enzymes: Definition, nomenclature and classification, co-enzymes and co-factors, Effect of substrate, temperature and p^H on enzyme-activity. Michaelis-Menten Equation for enzyme kinetics. Enzyme inhibitions-competitive, uncompetitive and non-competitive inhibition.

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%), and a final exam (60%).

References:

1. Harper's Biochemistry – R.K. Murray, D.K. Granner, V.W. Rodwell
2. Biochemistry- A. L. Lehniger
3. Principles of Biochemistry – A.L. Lehninger,
4. Text Book of Biochemistry- E.S. West, W.R. Tood, H.S.Mason, J.T.V. Bruggen.
5. Harper's Review of Biochemistry- D.W. Martin, P.A. Mayes, V.W. Rodwell, D.K. Garnner
6. Biochemistry – L.Stryer

Course No. NFS - 202 Biochemistry-II: Micronutrients 3 Credits

Course Overview:
This course coversthe metabolism of vitamins and minerals in human, including digestion, absorption, and transport. Further, this course discusses biochemical aspectsof deficiency diseases of vitamins and minerals, and their assessment in human being. Topics provide an in-depth view of definition, biochemical functions, deficiency disease, and toxicity of specific vitamins and minerals.

Learning Outcomes:
Upon completion of the course, students will be able to
- Gain an in-depth understanding of micronutrient metabolism
- Understand the digestion, absorption, and transport of each micronutrient, as well as the interplay between micronutrients.
- Identify both deficiency and toxicity symptoms of each micronutrient and determine how these may occur
- Demonstrate knowledge of the RDA of vitamins and minerals among the different age group

Content:
1. Vitamins: definition classification and occurrence.
2. Chemistry, and absorption of vitamins.
3. Biochemical function of vitamins including roles as coenzymes (where known).
4. Minerals: Chemistry, classification, and occurrence.
5. Absorption and excretion of minerals; role of fiber in these processes.
6. Biochemical role of minerals and trace elements including roles as cofactors (where known).
7. Biochemical aspects of deficiency diseases; RDA of vitamin and minerals

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class

participation (5%), in-course examination (35%), and a final exam (60%).

References:

1. Advanced Textbook on Food and Nutrition, vol. 1, M. Swaminathan, 1993.
2. Human Nutrition and Dietetics- J.S. Garrow and W.P.T. James.
3. The vitamins - Gerald F. Combs, Jr.
4. Minerals in animal and human nutrition - L.R. McDowell
5. Present knowledge in nutrition- M.L. Brown, Myrtle, L. Brown Editor.
6. Handbook of vitamins – Lawrence J. Machin.
7. Lippincott Illustrated Reviews: Biochemistry

Course No. NFS – 203 Human Physiology 3 Credits

Course Overview:

This course covers most of the physiological aspects of different systems in the human body, including the alimentary, respiratory, circulatory, renal, endocrine, reproductive, nervous, and immune systems. It will provide a basic understanding of the organization of the human body and how the systems work in the human body.

Learning Outcomes:

Upon completion of the course, students will be able to

- Demonstrate knowledge of human physiological systems and their functions
- Describe the alimentary and respiratory system
- Explain human circulatory and renal system and their functions
- Gain knowledge on human endocrine, reproductive and nervous system
- Explain the role of the immune system

Content:

1. Alimentary system –Digestion and absorption of nutrients (carbohydrate, fat, protein, vitamins and minerals) Liver and it's function.
2. Respiratory system – respiratory apparatus, gaseous transport in the blood and body fluid.
3. Circulatory system – Blood, it's composition, function, clotting mechanism. Blood circulation. Blood cells and their function. Normal blood pressure and it's regulation.
4. Renal system – Nephron. Urine formation, concentration and acidification. Composition of urine. Acid-base balance.
5. Endocrine system – Hormone and it's mechanism of action. Pancreatic hormones—insulin chemistry, synthesis, secretion, maintenance of blood sugar level. Thyroid hormones--chemistry, synthesis and metabolic functions, para-thyroid, pituitary, and adrenal hormones.
6. Reproductive system – Spermatogenesis and it's hormonal control, semen and it's composition. Female sex hormones, ovarian cycle, ovulation, menstrual cycle. Pregnancy – fertilization and implantation of embryo. Placenta and it's function. Hormonal control of pregnancy. Lactation—physiology of lactation
7. Nervous system--Functions of different parts of nervous system
8. Immune system – Immunity and it's types, immune cells and antibodies, hypersensitivity reactions. Immunoglobulins, Antigens, The complement system: Techniques in antigen-antibody interactions

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%), and a final exam (60%).

References:

1. Textbook of MedicalPhysiology: Guyton and Hall.
2. Human Physiology: C.C. Chatterjee, Vol. I & II.
3. Review of Medical Physiology: W.E. Ganong.
4. Elementary Immunology- Brian Burke

Course No. NFS-204 Nutrition in the Life Cycle 3 Credits
Course Overview:
This course introduces the role of nutrition throughout the entire life span. Each lifecycle is discussed with an understanding of the physiological changes and their implications for nutritional factors.

Learning Outcomes:
Upon completion of the course, students will be able to
- Describe how nutrition affects growth and development and the physiological basis of nutritional requirements throughout the life span
- Identify major nutritional facts at each stage of the human lifecycle
- Describe appropriate nutrition guidance for individuals throughout the lifecycle
- Explain current issues in life span nutrition
- Demonstrate an analysis of a nutrition-related problem, identify solutions, and suggest a counseling strategy

Content:
1. Preconception nutrition: Nutrition and fertility; nutrition during the preconception period; recommended dietary intake (RDI)for preconceptional nutritional status; nutrition care process related to the preconception period
2. Nutrition during pregnancy: Status of pregnancy outcome (IMR, LBW), physiology of pregnancy, embryonic and fetal growth development; pregnancy weight gain; energy and nutrient needs during pregnancy; factors affecting dietary intake during pregnancy; healthful diets for pregnancy; food safety during pregnancy; assessment of nutritional status during pregnancy. Maternal protein-energy malnutrition, micro-nutrient malnutrition and its effect on infant growth, development, and health. Problems of fetal malnutrition and low birth weight (LBW): determinants and challenges of low birth weight; long-term consequences of low birth weight for child and adult health and disease.
3. Nutrition during lactation: Lactation physiology, human milk composition, benefits of breastfeeding, breast milk supply and demand; breastfeeding process, maternal diet; breastfeeding promotion programs
4. Nutrition during infancy (Birth to 12 months): Infant development; Child growth and development (motor, social, visual, auditory, language and cognitive); Energy and nutrient needs; physical growth assessment; feeding young children; principles of multi-mixes and appropriate weaning diets; optimal complementary feeding and supplementary feeding; development of infant feeding skills; common nutritional problems and concerns

5. Formula feeding: Infant formulas; overview of their development, composition, and utilization. Feeding the prematurely born and low birth weight infant; role of "breast milk enhancers"
6. Nutrition for toddlers and preschool-aged children: Physiological and cognitive development; energy and nutrient needs; common nutritional problems; prevention of nutrition-related disorders; dietary and physical activity recommendations; nutrition programs for toddler and preschool children; nutrition-related conditions and interventions
7. Child and preadolescent nutrition: physiologic and cognitive development; energy and nutrient needs; dietary and physical activity recommendations; eating and feeding problems in children with special health care needs
8. Adolescent nutrition: Physical and psychosocial development; dietary requirements, intake, and adequacy among adolescents; nutrition education and counseling; overweight and obesity; dieting, disordered eating, and eating disorders.
9. Adult Nutrition: Energy, nutrients, and physical activity recommendations; Dietary guidelines; Nutrition related risk factors; Nutritional supplementation
10. Nutrition in older adults: Theories of aging; physiological changes; Nutritional risk factors; Dietary, nutrient and physical activity recommendations for older adults
11. Cultural or other factors affecting the nutrition of women and children. Malpractices about/ deviations in breast-feeding in Bangladesh, alternative practices of breast-feeding in Bangladesh, causes and gaps in knowledge, attitudes, communications and practices in professionals, Maternal and child nutrition program and policies in Bangladesh.

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%), and a final exam (60%).

References:

1. Nutrition Through the Life Cycle- Brown, Judith E
2. Krause's Food and Nutrition Therapy-L. Kathleen Mahan & Sylvia Escott-Stump
3. Protein Energy Malnutrition – J.C.Waterlow

Course No. NFS - 205 Food Chemistry 2 Credits

Course Overview:
This course introduces the structure and characteristics of water, fats, carbohydrates, proteins, natural pigments and artificial colorants, flavor compounds, additives, and vitamins in foods.This courseenables students to discuss the structure and properties of various food constituents. Further, this course teaches analysis methods that are used to test the purity of food,

Learning Outcomes:
Upon completion of the course, students will be able to
- Demonstrate knowledge of physical and chemical characteristics of water, carbohydrate, protein, and fat present in food
- Describe the structure and chemical composition of meat, milk, cereals, and vegetables
- Explain the analysis method for testing purity in milk and other produce

Content:

1. Water: structure, liquid water and ice, free and bound water, physical and chemical properties of water in the food industry, effect on storage life, water activity, water activity as an indicator, phase transitions of food containing water, WLF equation.
2. Properties of sugars, dextrin, starches, celluloses, hemicelluloses,pectins and gums; pectins and gels, gums and mucilages; gum arabic, seaweed polysaccharides, agar, carageenan, locust bean.
3. Physical and chemical properties of proteins, native and de-naturation of proteins.
4. Occurrences and composition of fats and other oils in foods, edible fats and oils, fatty acids; physical and chemical properties of fats and oils.
5. Meat:Structure, postmortem changes, color changes and tenderness.
6. Milk: Composition of milk, analysis and purity.
7. Cereals and legumes: Structure of grains, composition, properties, constituents of legumes and properties.
8. Vegetables and fruits: Composition, Structure and texture, pigments (carotenoids, chlorophylls, flavonoids, anthocyanins, tannins and other phenolic substances.
9. Food additives and their classifications

Learning and Teaching method:

Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:

Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%) and a final exam (60%).

References:

1. Food Chemistry - L.H. Meyer
2. Food Biochemistry- Charles Alias
3. Fennema's Food Chemistry-Srinivasan Damodaran & Kirk L.
4. Food Chemistry- H.-D. Belitz, W. Grosch, P. Schieberle
5. Food the Chemistry of its Components-Coultate, T.P.
6. Food Science - N.N. Potter

Course No. NFS-206 Food Microbiology 2 Credits

Course Overview:

This course provides an overview of the biology and ecology of microorganisms (fungi, bacteria), which are responsible for spoilage of fresh as well as stored food and food products. This course also emphasizes food waste treatment, purification of water, single-cell protein, prevention and controlof microorganisms, and a microbial assay of vitamins and minerals.

Learning Outcomes:

Upon completion of the course, students will be able to

- Demonstrate knowledge about the different sources of contamination, and various types of spoilage of food and food products
- Explain food waste treatment and water purification
- Demonstrate the knowledge of control and prevention of microbial contamination and spoilage of foods

- Apply the knowledge of food microbes in food preservation and food processing

Content:

1. Effect of environment on bacterial growth (effect of temperature, moisture, $p^{H,}$ oxidation-reduction potential, radiation, pressure, sonic vibration, etc.)
2. Study of yeast and fungus related to spoilage of foods.
3. Microbial contamination and spoilage of different types of foods: Plant products (fruits and vegetables; cereals; and sugars); and Animal products (meat, fish, poultry, milk etc.).
4. Microbial contamination and spoilage of fast foods, cooked foods and their ingredients.
5. Microbiology of milk and milk products (yogurt, cheese, butter,etc.)
6. Food waste treatment and disposal
7. Bacteriology and purification of water supply.
8. Microorganism as foods: single cell protein, yeast and lactic acid bacteria.
9. Control and prevention of microbial contamination and spoilage of foods
10. Microbiological assay of vitamins and minerals.

Learning and Teaching method:

Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:

Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%), and a final exam (60%).

References:

1. Food Microbiology- C.Frazier and D.C. Westhoff
2. Food Poisoning and Food Hygiene- B.C.Hobbes and R.J.Gilbert
3. Microbiology- P.L. Carpenter
4. Modern Food Microbiology – James M. Jay
5. Food Microbiology – M.R. Adams & M.O. Moss
6. Food Hygiene and Sanitation- S. Roday

Course No. NFS-207 Food Security and Food System 2 Credits

Course Overview:

This course explains the issue of food security and explores some of the different ways described both in research and in practice. Through this course, one can understand the concepts of nutrition, food security, food policy issues that are important to apply appropriate analytical tools to assess, analyze and interpret the food security situations and predicting future risks.

Learning Outcomes:

Upon completion of the course, students will be able to

- Demonstrate in-depth knowledge of food security, current food security status (Global, regional and national scenario), related concepts and theories
- Understand the factors related to food security (Social, ecological, political, economic, institutional, etc.) and how these factors affect food security
- Critically evaluate the frameworks and methods for analyzing food security with the pros and cons of those methods

- Develop, synthesize, and present a Food and Nutrition Security Portfolio for a specific region/country of the world with suggestions about framework, entities involved, performance evaluation, and potential outcomes scenarios

Content:

1. Food security and related concepts: Concept of food security, dimensions, types (duration and severity), Food security, hunger and malnutrition and relationship among these three concepts
2. Food security assessment methods (Addressing different FS dimensions): Food Balance Sheet (FBS); Weighted (Estimated) Food Records; 24 Hour Recall; Food Consumption Score (FCS); Coping Strategies Index (CSI); Reduced CSI (rCSI); HH Food Insecurity Access Scale (HHFIAS); Food Insecurity Experience Scale (FIES); Anthropometry and other methods.
3. Theories related to food insecurity and its implications: Malthusianism, Neo-Malthusianism/Environmental Determinism (Population Bomb, Limits to growth, Planetary Boundaries, etc.); Entitlement theory; Food Regime Theory; Food sovereignty vision for food security; New Variant Famine (NVF) Hypothesis; Relevant case studies.
4. Climate Change, natural hazards, and disasters: Climate change and Food Security; Direct and Indirect Impact on food security.
5. Agricultural biodiversity and food security: Agrobiodiversity and its role in food security (global and regional); Current status of biodiversity; the impacts/risks to food security; Characteristics of a healthy agroecosystem; Agrobiodiversity Index; Mainstreaming biodiversity for sustainable agriculture and food security; Challenges for future food security.
6. Pests and diseases: Plant pests and threats to food security; Food security pests and pathogens: History, status, and trends; Plant diseases and crop losses; Pesticides use and consequences; Efficient pest control; Relevant case studies.
7. Migration and food security: Different forms and trends of migration; Forced and voluntary migration; International migration; Rural-urban migration.
8. Globalization and food security: Globalization; globalisation of agri-food; The food chain; Global grain trade; Production and processing (manufacturing of food); Changes in dietary pattern (dietary convergence and adaptation); Globalisation and nutrition transition.
9. Policy issues in food security: Policy and food policy; Key policies related to food security: agricultural price, macroeconomic and public investment; Global trade/market liberalisation policies; Food subsidy policy.
10. Food systems analysis: Concept of system and food system; The Sustainable Livelihood Framework; The Food and Nutrition Security Framework; The Panarchy Framework; Food System Frameworks: Food Supply Chain, Socio-Ecological Systems (SES) framework; Food system vulnerability analysis; Application of these frameworks.

Learning and Teaching method:

Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:

Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%), and a final exam (60%).

References:

1. Food balance sheets: A handbook: 2001
2. Global food insecurity experience scale: FAO
3. Guidelines for measuring household and individual dietary diversity: FAO
4. Global Food Security Reports

5. Starvation and exchange entitlements: a general approach and its application to the great Bengal famine by Amartya Sen: 1977
6. An Essay on the Principle of Population by Thomas Malthus: 1978
7. Agriculture and the state system: the rise and fall of national agricultures, 1870 to the present by Friedmann and McMichael, 1989
8. A food regime analysis of the 'world food crisis' by McMichael, 2009
9. Environmental Hazards: assessing risk and reducing disaster: Routledge, 6th edition by Smith: 2013
10. The impact of disasters on agriculture and food security: FAO: 2015
11. Globalization of food systems in developing countries: impacts on food security and nutrition. Rome: Food & Agriculture Organization of the United Nations: FAO: 2004
12. The Globalization of Food. Oxford, UK: by Inglis, D. &Gimlin, D: 2009

Course No. NFS - 208 Macro Economics 2 Credits

Course Overview:
The course introduces basic models of macroeconomics and principles and provides an overview of macroeconomic issues: the determination of output, employment, unemployment, interest rates, and inflation. It explains and predicts food consumption and production choices, market interactions, and government interventions in the food system.Monetary and fiscal policies are also discussed.

Learning Outcomes:
Upon completion of the course, students will be able to

- Explain the basic concept of macroeconomics
- Explain the production and trade in agriculture and food markets.
- Describe macroeconomic relationships, fluctuations and trends in incomes, employment, economic growth, and development.
- Describe the role of income, wealth in macroeconomics.
- Explain consumption and investment in nutrition and health. as influenced by changes in markets and policies.

Content:
1. Key concepts of Macroeconomics: Macroeconomic Goals and objectives; Scope and Importance of Macroeconomics; macroeconomic policies, Economics of Nutrition, Macroeconomic Aspects of Nutrition Policy, Macroeconomic Variables, Aggregate Demand and supply.
2. Measurement of National Income: Gross Domestic Product (GDP), Goods flow and earnings flow,Details of national accounts, Nominal and Real GDP, Other Measures of National Income.
3. Measurement of Cost of Living: Consumer price index and it's calculation, producer price index, GDP deflator, comparison and interpretations of the measures of cost of living.
4. Unemployment: Definition and measurement of unemployment, types of unemployment, natural rate of unemployment, theory of efficient wages, effect of unemployment on consumption and nutrition.
5. Saving, Investment, and the financial system: Types and functions of financial institutions, saving and investment, coordination of saving and investment by financial system, government policies affecting saving, investment and the interest rate.
6. Consumption and Investment: The Consumption function- The Savings function- The Marginal Propensity to consume- The Marginal Propensity to saving- Common theories of Consumption: Absolute, Relative, Life Cycle and Permanent, Income theories of consumption and their implications; Determinants of Consumption- Determinants of Investment.
7. The Theory of aggregate demand: Business cycle theories- Behind AS and AD curves- The downward sloping aggregate demand curves- Determinants of AD and AS curves, influence of

monetary and fiscal policies on aggregate demand

8. The Multiplier Model output determinants: Consumption and Investment approach- Savings and Investment approach- The Adjustment mechanism and the multiplier process- The role of fiscal policy in the multiplier Model.
9. Money and Inflation: Monetary system, Value of money and price movements; quantity theory of money and its various formulations; demand for money. Inflation; measures of inflation, classification of inflation according to the causes: demand-push and cost-push inflation, inflationary and deflationary gap; control of inflation; trade-off between inflation and unemployment,

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%), and a final exam (60%).

References:

1. Gregory Mankiw – Macroeconomics
2. Olivier Blanchard and David Johnson - Macroeconomics
3. E. Shapiro. Macro-Economic Analysis.
4. G. Ackley. Macro-Economic Theory.
5. R. Dornbusch and S. Fischer. Macro Economics,
6. F.S. Brooman - Macro Economics

Course No. NFS-209 Laboratory Methods and Analytical Techniques 2 Credits

Course Overview:
This course covers chemical, biochemical, immunological, and molecular techniques used in research as applied in nutrition and food science. The emphasis will be on different chromatographic techniques, and spectrophotometry.

Learning Outcomes:
Upon completion of the course, students will be able to

- Demonstrate knowledge of the principle and methods of UV-Vis, IR, NMR and Mass spectroscopes
- Describes the principle and methods of UV-Vis, IR, NMR and Mass spectroscopes
- Analysis of UV-Vis, IR, NMR, and Mass spectroscopic data
- Explain the basis of the four chromatographic principles.
- Describe the principle and procedure for analysis of minerals by absorption spectroscopy, and gas chromatography
- Discuss the application of Radio Assays and Radioisotopes, Immunochromatographic techniques, Electrophoresis techniques, and DNA-Based techniquesto nutrition and food science research

Content:

1. Introduction to instrumental analysis; Basic characteristics of measuring devices; Sensitivity, Selectivity, Accuracy
2. Ultraviolet and visible spectroscopy: Principle, Beer-Lambert's law and determination of concentration, instrumentation, electronic transition, transition probability, selection rules,

chromophore, auxochrome, absorption & intensity shift, absorption bands, solvent effects, application in food analysis.

3. Infra-red spectroscopy: Principle, molecular vibration and their types, hook's law, fundamental vibration, number of fundamental vibrations, characteristics IR absorption of different function groups, instrumentation, finger pointing regions and its importance, application in food analysis.
4. NMR spectroscopy: 1H-NMR spectroscopy: Principle, relaxation process, instrumentation, chemical shift, spin-spin coupling, different spin systems, coupling constants, spin-spin decoupling, long range coupling; 13C NMR: Theory and structure; application in food analysis.
5. Mass spectroscopy: Principle, instrumentation, origin of mass spectrum, determination of molecular weight, ionization technique, recognition of molecular ion and isotopic peaks, fragmentation process, high-resolution MS, application in food analysis.
6. Chromatography: Basic principle, chromatogram, retention volume, capacity factor, selectivity and resolution.
7. Modes of separation: adsorption, partition, ion-exchange and size-exclusion chromatography.
8. Stationary versus mobile phase, planar chromatography: paper and thin layer chromatography (theory, technique and detection); liquid-solid and liquid-liquid chromatography, application in food analysis.
9. HPLC: Introduction, theory and principle, instrumentation, characteristics of stationary and mobile phases, reversed and normal phase HPLC, detector and application in food analysis.
10. Atomic absorption spectroscopy: principle, instrumentation, procedure for determination of mineral concentration of sample (e.g., standard addition methods), application in food analysis.
11. Gas chromatography:Principle, instrumentation, procedure for analysis of different types of samples by GC, application in food analysis.
12. Description, working principle and application of Microscope, Centrifuge, Calorimeter, Flame Photometer, Fluoro-photometer; Radio Assays and radioisotopes, Immunochromatographic techniques, Electrophoresis techniques, and DNA-Based Techniques.

Learning and Teaching method:

Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:

Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%) and a final exam (60%).

References:

1. Instrumental Methods of Analysis - Willard et. al.
2. Instrumental methods of chemical Analysis - E. Hill
3. Laboratory Techniques in chemistry & Biochemistry - Diamond &Derman.
4. Chemistry Experiments for Instrumental Methods.
5. Chromatography today - C. F. Poole and S. K. Poole.
6. Instrumental Methods in Food Analysis- J.R.J. Paré, J.M.R. Bélanger., volume 18, Elsevier
7. S. Suzanne Nielsen (Editor) (2017). Food Analysis, 5th ed., Publisher: Springer Nature, Gewerbestrasse 11, 6330 Cham, Switzerland.
8. Monika Waksmundzka-Hajnos, Joseph Sherma. High Performance Liquid Chromatography in Phytochemical Analyssi, Publisher: CRC press, Tylor and Francis Group, 6000 Broken Sound Parkway NW, Suite 300.

9. Tibor Cserhati, Esther Forgacs (1999). Chromatograph in Food Science and Technology, Publisher: Technomic Publishing Company, Inc. 851 New Holland Avenue, Box 3535, Lancaster, Pennsylvania 17604 USA.

Course No. NFS-211 Biochemistry-Practical 2 Credits

Course Overview:
This course consists of theoretical classes along with practical experiments in the laboratory. It provideslearners knowledge on qualitative and quantitative analysis of biological constituents in blood and food samples and their estimation using standard methods.

Learning Outcomes:
The student will obtain hands-on training in amino acid separation techniques and gain expertise in the determination of various biological components.

Content:
1. Use of spectrophotometer for biochemical analysis.
2. Estimation of glucose content.
3. Determination of blood glucose
4. Determination of creatinine content
5. Determination of urea/uric acid content in serum.
6. Extraction and estimation of liver glycogen
7. Amino acid separation by paper chromatography

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical experiments.

Assessment:
Regular attendance and laboratory work (graded), in-course assessment (graded), and final examination (graded). A student's grade will be calculated based on a combination of in-course assessment (40%) and a final exam (60%).

Course No. NFS-212 Food Chemistry-Practical 2 Credits

Course Overview:
This course consists of theoretical classes along with practical experiments in the laboratory. It provides learners with knowledge of qualitative and quantitative analysis of food components and their estimation using standard methods.

Learning Outcomes:
Upon completion of the course, students will be able to analyze water, proteins, carbohydrates and fats of foods and gain expertise in the laboratory techniques of HPLC.

Content:
1. (a) General methods and procedures used in food analysis. - Proximate Analysis: Estimation of moisture and water activity, Ash, Crude fat, Crude protein, different carbohydrates, Crude fiber, total dietary fiber in cereals grain, pulses, vegetables, milk and milk products, candies, etc.
   (b) Estimations of nitrogen-free extract and minerals.
   (c) Physiochemical methods used in food analysis like colorimetry, chromatography, ion-exchange separation, and filtrations

(d) Texture analysis, different method of sensory analysis
2. Analysis of chemical parameters such as acid value, peroxide value, free fatty acidin fats and oils
3. Examination of physical parameters such as melting point, color, refractive index, density in fats and oils
4. Analysis of water-soluble vitamins in foods by HPLC
5. Extraction and quantification of fruit flavonoids by HPLC
6. Separation of food additives.

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical experiments.

Assessment:
Regular attendance and laboratory work (graded), in-course assessment (graded), and final examination (graded). A student's grade will be calculated based on a combination of in-course assessment (40%) and a final exam (60%).

References:

1. Food Analysis Laboratory Manual—S. Suzanne Nielsen (Third Edition)
2. Semih Otles (Editor) (2005). Methods of Analysis of Food Components and Additives, Publisher: CRC Press, Tylor and Francis Group, 600 Broken Sound Parkway NW, Suite 300.
3. Monika Waksmundzka-Hajnos, Joseph Sherma. High-Performance Liquid Chromatography in Phytochemical Analysis, Publisher: CRC Press, Tylor and Francis Group, 6000 Broken Sound Parkway NW, Suite 300.
4. Rui M.S. Cruz, Igor Khmelinskil, Margarida C. Vieira. Methods in Food Analysis, Publisher: CRC press, Tylor and Francis Group, 6000 Broken Sound Parkway NW, Suite 300.
5. Handbook of food Analytical Chemistry (Water, Proteins, Enzymes, Lipids, and Carbohydrates). Published by John Wiley & Sons, Inc., Hoboken, New Jersey. Published simultaneously in Canada

Course No. NFS- 221 Viva Voce 2 Credits

The oral examination assesses the student's aptitude and learning from theory and practicalcourses.

Assessment: Total Marks – 50

DETAIL CURRICULUM AND SYLLABUS FOR THIRD YEAR B.S. (HONORS)

	Course Number	Name of Course	Credits
Theory:	**NFS-301**	Biochemistry III: Metabolism	**3**
	NFS-302	Introduction to Molecular Biology and Biotechnology	**2**
	NFS-303	Food Science	**3**
	NFS-304	Clinical Nutrition	**2**
	NFS-305	Assessment of Nutritional Status	**3**
	NFS-306	Applied Nutrition and Dietetics	**2**
	NFS-307	Nutrition Planning	**3**
	NFS-308	Nutrition Education and Counseling	**3**
	NFS-309	Biostatistics	**3**
Sub-total			**24**
	NFS-311	Nutritional Biochemistry-Practical	**2**
	NFS-312	Clinical Nutrition and Dietetics-Practical	**2**
	NFS-313	Biostatistics-Practical	**2**
	NFS-314	Food Science and Technology-Practical	**2**
	NFS-315	Internship-Food Industry	**2**
	NFS-321	Viva Voce	**2**
Total			**36**

Course No. NFS - 301 Biochemistry III: Metabolism 3 Credits

Course Overview:
This course introduces the concept of anabolism and catabolism of carbohydrate, protein, and fat; the role of high energy compounds in the cell. Knowledge related to the regulation of various pathways will be discussed under this course. The importance of lipids as storage molecules and the structural components of biomembranes will be ascertained. The role of high energy compounds, the TCA cycle, hormonal regulation, electron transport chain, synthesis of ATP under aerobic and anaerobic conditions will be covered.

Learning Outcomes:
Upon completion of this course, the students will be able to

- Demonstrate knowledge of the metabolism of carbohydrate, protein, and fat in cell
- Understand the role of high energy compounds in cells
- Integrate understanding and knowledge of the metabolism of carbohydrate, protein, and fat in the human

Content:
1. Bioenergetics**:** High energy containing compounds and its storage form.
2. Energy metabolism: Definition, principles of estimation, components of energy requirements, basal metabolic rate (BMR), factors affecting MBR and overall energy requirements, energy cost of activities, energy cost of digestion and absorption, energy cost of growth.
3. Biological oxidation: The respiratory chain and oxidative phosphorylation
4. Metabolism of Carbohydrate: Glycolysis, TCA cycle, alternative pathways of carbohydrate degradation – pentose phosphate pathway, glucose to glucuronic acid, and ascorbic acid. Glycogen metabolism- glycogenolysis, glycogenesis, control of glycogen metabolism.

5. Biosynthesis of carbohydrate: gluconeogenesis and its regulation, biosynthesis of Di, oligo and polysaccharides, glycoprotein, sugar interconversion, nucleotide sugars formation.
6. Metabolism of lipids: Plasma lipids and lipoproteins-its metabolism; Metabolism of adipose tissue, brown adipose tissue and its role in thermogenesis. Beta oxidation and oxidation of fatty acids. Fatty acid synthesis. Ketone Body formation and utilization, regulation of fatty acid metabolism, storage as triglyceride. Metabolism of cholesterol and triglyceride.
7. Metabolism of proteins—Protein turnover, amino acid pool, Nitrogen balance. Amino acid metabolism, NH_2 removal—Transamination, deamination, ammonia formation, Urea cycle, ammonia intoxication. Decarboxylation and synthesis of a single carbon unit. Amino acid biosynthesis. Glucogenic and ketogenic amino acids.
8. Metabolic hormones: General characteristics and role in metabolic processes.

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in course examination (35%) and a final exam (60%).

References:

1. Harper's Biochemistry- R.K. Murray, D.K. Granner, V.W. Rodwell.
2. Clinical Biochemistry-Rana Sinhe and Chatterjee
3. Biochemistry- A.L. Lehninger
4. Principles of Biochemistry - A.L.Lehninger
5. Text Book of Biochemistry – E.S. West, W.R. Todd, H.S.Mason, J.T.V.Brruggen
6. Harper's Review of Biochemistry – D.W. Martin.P.A.Mayes, V.W.Rodwell. D.K. Granner
7. Biochemistry - L. Stryer

Course No. NFS - 302 Introduction to Molecular Biology and Biotechnology 2 Credits

Course Overview:
This course provides knowledge related to the discovery of DNA as genetic material, DNA replication, transcription, DNA repair, and translation. Basic understanding of recombinant DNA technology, DNA manipulation in prokaryotes and eukaryotes, engineering of DNA molecules using restriction and modification enzymes will be discussed.

Learning Outcomes:
Upon completion of this course, the students will be able to
- Understand the structure, organization, and replication of DNA and RNA
- Demonstrate knowledge of protein synthesis, mutation, and all its consequences
- Understand the use of recombinant DNA and PCR technology and their application
- Know sequence alignment, analysis and database searching
- Understand chromosome and gene disorder

Content:
1. Nucleosides and nucleotides: Occurrence, structure, physicochemical properties. Polynucleotides: Occurrence, structures of DNA and RNA.

2. DNA organization, Replication and Repair of DNA: Semi-conservative replication; experiments of Meselson and Stahl; DNA polymerases.
3. RNA transcription, processing, and post-transcriptional modification
4. Protein synthesis and genetic code and codon; mutation and its consequences.
5. Recombinant DNA technology and its biomedical application. Gene cloning, Plasmid and phage vectors, restriction endonuclease enzymes, restriction maps, gene library and their properties, recombinant selection and screening.
6. Polymerase Chain Reaction (PCR) technology: PCR methodology and various applications of PCR technology.
7. Database searching, sequence alignment, and basic sequence analysis
8. Chromosome and gene disorders

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%) and a final exam (60%).

References:

1. An Introduction to Molecular Biotechnology: Fundamentals, Methods and Applications--Michael Wink
2. Harper's Biochemistry- R.K. Murray, D.K. Granner, V.W. Rodwell

Course No. NFS - 303 Food Science 3 Credits

Course Overview:
This course coversknowledge of food-processing and preservation methods and the choice of a techniqueconcerning food types. It overviews various conventional thermal and non-thermal food processing and preservation methods available to maximize the nutritive value of foods with safety, quality, and shelf life.

Learning Outcomes:
Upon completion of this course, the students will be able to

- Outline the constituents of food, their significance, and how deteriorative factors affect foods.
- Demonstrate knowledge of thermal preservation in the form of heat and cold preservation
- Analyze the process of processing, spoilage, and storage of seafood
- Cite the sources and processing of edible fats and oils
- Explain the processing of meat, milk and cereal products

Content:

1. Constituents of foods and significance
2. Deteriorative factors of foods and their control
3. Heat preservation and processing. Method of heat preservations and treatment. Canning methods.
4. Cold preservation and processing: Principle and methods of refrigerated storage, cold storage, and freezing
5. Dehydration and concentration: Principles and methods
6. Milk and Milk products, milk processing and preservation
7. Meat and poultry: Grading, inspection and aging pigments and color changes; curing, smoking, sausages, frank-fourter and freezing, egg composition, quality, storage and freezing
8. Sea-foods: Processing, preservation and spoilage.
9. Fats and Oils: Production and processing methods, fats and oils products (butter, hydrogenated products, margarine, shortening and frying oils, mayonnaise production and salad dressing) ;and quality control of fats and oils.
10. Cereals and products: Milling of wheat, rice and corn; principles of baking and major baking ingredients, functions of ingredients.
11. Vegetables and fruits: General properties. Harvesting and post-harvest.
12. Juices and Beverages: Manufacture and ingredients of fruits juices and non-alcoholic, alcoholic carbonated beverages.
13. Confectionery and chocolate product: types, ingredients and principles ofmanufacture.
14. Indigenous food preservation techniques in Bangladesh and their roles in public nutrition.

Learning and Teaching method:

Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:

Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%), and a final exam (60%).

References:

1. Food Science - N.N. Potter
2. Handbook of Food Preservation by Saifur Rahman
3. A Handbook on Edible Oil and Fats - G. Mowlah
4. Principles of Food Science (vol. l & 2) G. Borgstron

Course No. NFS - 304 **Clinical Nutrition** **2** Credit**s**

Course Overview:

This course introduces studentstoclinical nutrition. It coversthe definition, etiology, classification, and management of different nutritional disorders such as protein-energy malnutrition, micronutrient deficiency disorders,and eating disorders. It also includesmalnutrition, infections, and management processes of severe malnutrition. Nutritional problems will be discussed consideringthe perspective of developing and developed countries.

Learning Outcomes:

Upon completion of this course, the students will be able to

- State the risk factors and diagnostic criteria for common nutritional disorders
- Outline the goals of nutrition management in a range of clinical conditions
- Understand the pathophysiology and diagnose different nutritional disorders

- Integrate knowledge biochemistry and physiology with clinical nutrition
- Comprehend and describe the steps of the management of severe malnutrition

Content:
Definition, etiology, classification, and management of nutritional disorders:
1. Protein-energy malnutrition
2. Vitamin A deficiency disorders
3. Iodine deficiency disorder
4. Nutritional Anaemia
5. Diarrhoeal diseases
6. Vitamin B-complex deficiencies
7. Vitamin D deficiencies
8. Other deficiencies – vitamin C & D, zinc, copper, selenium, calcium
9. Management of Severe Malnutrition
10. Obesity – cause, types, complications, and management
11. Malnutrition and Infection
12. Eating disorder (Anorexia nervosa, Bullaemia) Eating disorder (Anorexia nervosa, Bulimia): Common Characteristics, Diagnosis, health complications, nutrition therapy

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%) and a final exam (60%).

References:

1. Human Nutrition & Dietetics - Garrow
2. Human Nutrition in the developing world - M.C. Latham
3. Community Nutritional Assessment - Jelliffe&Jelliffe.
4. Textbook of Preventive and Social Medicine - K. Park
5. Human Nutrition & Dietetics - Davidson & Passmore
6. Modern Nutrition – Shills

Course No. NFS - 305 Assessment of Nutritional Status 3 Credits

Course Overview:
This course provides a comprehensive introduction to the methods and approaches for conducting nutrition assessment of individuals and populations throughout the lifecycle.

Learning Outcomes:
Upon completion of this course, the students will be able to
- Demonstrateknowledge of standard methods of nutritional assessment, using dietary, biochemical, and anthropometric approaches
- Analyze the nutritional content of the diets of individuals and groups using up to date computer software and internationally standardized food composition data
- Conduct laboratory assessments of nutritional status and interpret the results
- Conduct measurements of body size and composition in children and adults and interpret data

- Describe and evaluate each method individually with respect to the clinical and researchsettings.

Content:

1. Introduction to nutritional assessment: Nutrition assessment systems; nutrition assessment methods; nutrition assessment indices and indicators
2. Anthropometric methods of Nutritional Status: Procedure, reference limits/cut-off points and public health significance of the following indices- length, weight, height, head circumference, body mass index, mid-arm circumference (1-5 years), skin-fold thickness; weight-for-age, height-for-age and weight-for-height; waist circumference; overall advantages and disadvantages of anthropometric methods.
3. Analyzing Anthropometric Data: analysis of height, weight and others. Calculation of indicators: Z scores and percentage of reference median values, percentile; presentation of results. Use of BMI as an index of nutritional status of adults: definition and meaning of BMI, classification and interpretation of BMI.
4. Biochemical Assessment of Nutritional Status: Procedure for determination of concentration of common nutrients (serum protein, e.g., albumin level; iron, folate, iodine, vit. B12, vit. A), their cut-off values and significances; procedure for the determination of blood lipids and sugar, their cut-off values and significance to determine chronic diseases; overall advantages and disadvantages of biochemical methods.
5. Clinical Assessment of Nutritional Status: Signs and symptoms used to determine the deficiency of particular nutrients, advantages, and disadvantages of clinical methods. Signs of protein-energy malnutrition (PEM), signs of micronutrient deficiencies
6. Dietary Intake: Dietary intake assessment methods: Quantitative, Qualitative: Quantitative Dietary Surveys - Inventory method, diary method, recall method, weighing method, duplicate sample method, food balance sheet; Qualitative Dietary Surveys - Dietary history of habitual intake pattern, food frequencies; limitations of different survey methods, translating dietary intakes into nutrients, use of food composition tables and their limitations, evaluation of the adequacy of dietary intakes; measurement errors in dietary assessment
7. Socio-economic and ecological assessment: Social determinants of health
8. Nutritional assessment of hospital patients: screening using a single index; multiparameter screening
9. Designing a nutritional status assessment survey program. Nutritional survey and surveillance: Purpose, meaning, and type; population, sampling; Sampling methods, sample size. Initial assessment, indicators of nutritional status, data Sources, institutional arrangements for data collection, data processing/analysis.

Learning and Teaching method:

Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:

Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%), and a final exam (60%).

References:

1. Principles of Nutritional Assessment - R. Gibson
2. Nutritional Assessment-Robert D Lee
3. Methodology of Nutritional Surveillance - Report of a Joint FAO/ UNICEF/ WHO/ Expert committee
4. Community Nutrition Assessment - Jelliffe&Jelliffe
5. Dietary Assessment, a resource guide to method selection and application in low resource settings-FAO, Rome (2018)

Course No. NFS - 306 Applied Nutrition and Dietetics 2 Credits

Course Overview:
The course covers basic knowledge of dietary requirements and therapeutic nutrition. It will focus on meal planning and menu planning. It enables one to acquire knowledge of some diseases that are caused by dietary abnormalities. It helps to gain skills in dietary modification, management among athletes and patients in the treatment of each disease state.

Learning Outcomes:
Upon completion of this course, the students will be able to

- Demonstrate knowledge of nutrient requirements, and recommended dietary allowance, and dietary guidelines
- Understand nutrient requirements throughout the lifecycle
- Calculate the energy and protein requirements of the individuals
- Plan menu and diet chart for diverse groups
- Demonstrate an understanding of the different clinical conditions and their dietary management.
- Demonstrate knowledge of sports nutrition and caring practices

Content:
1. Nature and scopes of applied nutrition and dietetics; the role of nutrition therapy in health care
2. Concept of requirements; recommended dietary allowances; Dietary guidelines
3. Protein and energy requirements of different age groups; energy intake and expenditure, gender variation in the intake, adaptation theory protein-energy interactions; linear growth retardation-causes and mechanism, chronic energy deficiency (CED) and its consequences.
4. Care and Nutrition: Caring Practices: Definitions, concepts, and importance of caring practices; Situation of caring practices in Bangladesh; Caring practices of different population groups and physiological outcomes; Constraints to caring practices; Measures to improve caring practices
5. Balance diet for different age groups.
6. Menu planning. Diet preparation for subjects of different age groups.
7. Diet for pregnancy and lactation.
8. Importance of breastfeeding, weaning food, supplementary food.
9. Principle, classification, purpose of diet therapy and importance.
10. Diet and diseases in Childhood: Nutrition therapy of malabsorption. Celiac disease, pneumonia, Rheumatic fever, Dysentery, Constipation, Cystic Fibrosis, galactosemia, PKU, and Congenital heart disease.
11. Gout and allergy
12. Sports nutrition: Nutritional requirements of exercise; weight management; diet before, during, and after training; Ergogenic aids

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%) and a final exam (60%).

References:

1. Krauses's Food and Nutrition Therapy-L. Kathleen Mahan & Sylvia Escott-Stump
2. Mannual of Nutrition and Diet Therapy - N.J.Gills& M.V. Bosscher
3. Principles of Nutritional Assessment-Rosalind S. Gibson
4. Clinical Dietetics & Nutrition - F.P. Antia&P.Abraham
5. Human Energy Requirements-FAO/WHO/UNU
6. Nutrition & Physical Fitness - Bogert, Briggs &Callowey
7. Food and Nutrition - M. Swaminathan
8. Food for Fitness-Anita Bean
9. Chronic Energy Deficiency: Consequences and Related Issues- Beat Schurch& Nevin S. Scrimshaw
10. Causes and Mechanisms of Linear Growth Retardation-John C. Waterlow& Beat Schurch
11. Care and Nutrition: Concepts and Measurement- Patrice L. Engle, Purnima Menon, Lawrence Haddad

Course No. NFS - 307 Nutrition Planning 3 Credits

Course Overview:
This course covers various methods or approaches to combat malnutrition. This applied course teaches nutrition planning in two stages: first, it highlights the theory and tools required for nutrition planning, and then it discusses the application of the theory and concepts in planning and designing nutrition interventions. The goal of this course is to enable a student to write a nutrition program having public health importance.

Learning Outcomes:
Upon completion of this course, the students will be able to
- Demonstrate understanding of the basic concept of planning, process of planning, and best suitable planning model
- Demonstrate knowledge of nutrition-specific and nutrition-sensitive interventions.
- Critically evaluate various nutrition interventions
- Design and write a nutrition intervention project

Content:
1. Planning: Concepts of planning; Planning in mixed developing economies; Rationale for planning in developing economies. Basic planning models: Aggregate growth model, Input-output Model,
2. Economics of nutritional interventions: the costs of undernutrition; the costs of interventions to reduce undernutrition; concept of cost-benefit analyses, cost-effectiveness analysis, and sensitivity analysis; cost-effectiveness and benefit-cost of interventions to reduce undernutrition
3. Planning Process: Characteristics of the planning process; Limitations of planning models;Need for nutrition planning; Short term and long-term objectives; Strategies of nutrition planning; Sequences

of nutrition planning; Sectoral/Multisectoral approach to nutrition planning

4. Needs Assessment: Basic principles of needs assessment, methods of obtaining data about the target population, issues in data collection. Data sources: Food balance sheet approach; Consumer expenditure/household expenditure survey; Food consumption survey; Demographic health survey; Advantages and limitations of the approaches
5. Nutrition Program Planning: Steps in nutrition program planning, Logic model, SMART Objectives, Monitoring and evaluation; SWOT Analysis
6. Growth monitoring; Interpretation of monitoring data; Advantages and limitations of growth monitoring.
7. Supplementary Feeding: Concepts; Advantages, disadvantages, costs and benefits of feeding programs; Nutritional impact of feeding programs; Measures to improve the nutritional impact of feeding programs
8. Maternal and child nutrition intervention: Framework for actions to achieve optimum fetal and child nutrition and development, nutrition-specific and nutrition-sensitive interventions and programmes, Burden of nutritional conditions; Cost of scaling up proven interventions; interventions and delivery strategies and platforms; Social, behavioral change communication (SBCC) strategy for improving nutrition
9. Approaches to combat malnutrition: Supplementation, Food fortification, Food-based approaches: Concepts, Potentials, advantages, costs, Government, and private sector involvement.Micronutrients and health development- Micronutrient malnutrition (Hidden hunger), health and social effects of micronutrient deficiencies.
10. Health determinants, measurements and trends: the determinants of health; key health indicators; measuring the burden of disease; Risk factors of health; Health system: Functions of the health system; Primary health care; the roles of the public, private and NGO sector; Key health sector issues; Universal health coverage; Water, sanitation and Hygiene (WASH) intervention
11. Designing an intervention on a selected nutritional issue.

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%) and a final exam (60%).

References:

1. Economic Development in the Third World - Michael P. Todaro
2. Community Nutrition in Action, An Entrepreneurial Approach-Marie A. Boyle
3. Global Health 101-Richard Skolnik
4. Economic Analysis of Agricultural Projects - J. Price Gittinger
5. Nutrition and Health in a Developing World by Saskia de Pee, Douglas Taren, Martin W. Bloem, Third Edition
6. Repositioning nutrition as central to development: A strategy for large scale action-by Shekar, M., Heaver, R. and Lee, Y.K., 2006. World Bank Publications.
7. Improving nutrition through multisectoral approaches- Alderman et al., 2013 (No. 75102, pp. 1-178). The World Bank.

Course No. NFS - 308 Nutrition Education and Counselling 3 Credits

Course Overview:
This course introduces students to the theories and skills necessary to design and implement nutrition education programs. It discusses how nutrition education influences dietary changes across a diverse group of people. Further, itcovers nutrition counseling theory and techniques,and its application acrossthe life span.

Learning Outcomes:
Upon completion of this course, the students will be able to

- Define the role of nutrition education in influencing healthy dietary behaviors
- Understand the role of intra-and interpersonal processes in food choice and dietary behaviors
- Understand behavior/action focused approaches to nutrition education
- Describe a conceptual model for theory-based nutrition education
- Understand and describe behavior theories and how they can be applied in nutrition education programs to enhance behavior change
- Describe the implications for nutrition education strategies to facilitate behavior change
- Apply a six-step procedure for designing theory-based behavior focused nutrition education
- Demonstrate an understanding of counseling theory and technique

Content:

1. Nutrition education - Concepts and importance; Challenges of educating people about healthy eating; Scope of nutrition education; The roles and context of nutrition education
2. Determinants of Food Choices and Diet-related behavior-Biological and Personal issues; Social and environmental/economic issues
3. Nutrition Education: focus on behaviors, actions, and practices. Determinants of action and behavior; Influences of the behavior; Theory and intervention framework to guide the intervention; Dosage and duration
4. Increasing awareness and enhancing motivation: Translating theory into educational strategies-Health Belief model; Precaution Adoption Process Model; Theory of Planned Behavior; Social Cognitive Theory; Self-efficacy Theory; Stages of Change
5. Designing theory-based nutrition education: Identifying health issues and the intended audience; Identifying the behaviors and the practices that contribute to the health issues; Identifying the behavior and the action goal to be the focus of the program; Stepwise procedure
6. Effective communication: Learning styles, develop supporting visuals, using written materials, Social marketing, Use of technology
    a. Nutritional awareness building; Messages in Nutrition education; Audio and visual aids in nutrition education; Communication strategies in nutrition education.
    b. Dissemination of nutrition knowledge through group discussions; Importance of practical demonstrations and role-plays in nutrition education; Preparation and demonstration of nutrition education materials.
    c. Field-testing of nutrition education materials; Group exercise on the preparation of nutrition education materials
    d. Development of nutrition education schedule and curriculum; Pre - and post nutritional knowledge evaluation- importance, formulation, and scoring systems.
    e. Working with a diverse population:children, diverse cultural groups, low-literacy audience
7. Strategies to improve environmental and policy to support action or behavior: Organizational level; Community level; Policy and system changes activities
8. Counseling theory and technique: Communication; Interviewing; Counseling theories; initiating and maintaining dietary changes; Person center counseling, counseling for behavior modification, counseling through the lifespan
9. Case assignments on various aspects of nutrition education. Designing nutrition education intervention on the selected nutritional issue.

Learning and Teaching method:

Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:

Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%) and a final exam (60%).

References:

1. Nutrition Education, Linking Research, Theory, and practice-Isobel R. Contento
2. Nutrition education and Counselling skills-Betsy B. Holli, & Judith A. Beto
3. Nutritional Assessment-Robert D Lee

4. Community Participation in Nutrition Education - A Training Manual, UNESCO.
5. Visual Aids in Nutrition Education - Alan C Holmes, FAO, 1968.
6. Community Nutrition - Md. Aminul Haque Bhuyan and NayeemaJafar.

Course No. NFS – 309 Biostatistics 3 Credits

Course Overview:
This course offers the student a good understanding of the theory and application of biostatistical methods used in nutrition and food science. It develops the capacity to deal with mathematical data. It covers probability distribution, hypothesis testing, descriptive statistics and inferential statistics, correlation, regression, and one-way ANOVA. It also includes concepts of power, sample size, and effect size regarding research.

Learning Outcomes:
Upon completion of this course, the students will be able to

- Demonstrate understanding of probability distribution, descriptive and inferential statistics
- Choose correct statistical tests for research questions
- Calculate the sample size of a study
- Interpret and present the findings of a study

Content:

1. Definition, scope of statistics and biostatistics, uses and importance of statistics and biostatistics, limitations of using statistics and biostatistics, population, sample, parameter, statistic, estimator and estimate
2. Data presentation-meaning of data, level of measurement, variable (discrete and continuous); summarizing and presenting data; Tabular, graphical, and diagrammatic representation of data
3. Descriptive Statistics**:** Measures of central tendency-Arithmetic mean, geometric mean, harmonic mean, median and mode. Measures of dispersion: - Range, mean deviation, variance coefficient of variation, standard deviation. Moments, skewness and kurtosis.
4. Probability distribution: - The normal, binomial and poison distribution, derivation, means and variances. Point estimation - The Mean & its Standard Error; The Central Limit Theorem; Confidence Intervals-The Mean of a sample, Binomial proportions
5. Hypothesis testing- General concepts,the basic idea of significance text- Simple significance tests based on the normal distribution, comparison with a known standard, comparison of means of two large samples.
6. The use of 't' tests for small samples, importance of small sample comparison of sample means with a standard, comparison of means of two small sample (unknown variances-assumed equal, not assumed equal) confidence limits. One-sample t-test, Paired & unpaired t-tests, Nonparametric analogs
7. Contingency Tables- Comparing binomial proportions, X^2-tests of goodness of fit and homogeneity introduction to general idea, testing the fit of a whole frequency distribution to data, tests of homogeneity, variance ratio test.
8. Correlation coefficients- Properties of ρ, Pearson's correlation coefficient, Spearman's ρ (rho), Kendall's τ (tau), Type of Correlation- Bivariate Correlations, Partial Correlations, Distances
9. Introduction to Linear Regression-Purposes and assumption for using linear regression model, Least Squares Method, R^2 - Variance explained
10. Analysis of variance: One-way ANOVA
11. Power, sample size, and effect size; Practical vs. statistical significance.

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical

demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%), and a final exam (60%).

References:

1. Basic Statistics-M A Jalil &RezinaFerdous
2. Fundamentals of Biostatistics- Rosner, B.
3. Biostatistics - W.W.Daniel
4. Methods in Biostatistics - B.K.Mahajan
5. Methods of statistics - M.G.Mostafa

Course No. NFS - 311 Nutritional Biochemistry-Practical 2 Credits

Course Overview:
This course consists of theoretical classes along with practical experiments in the laboratory. It enriches learners by obtaining knowledge on chromatography, separation, and determination of molecules in biological samples.

Learning Outcomes:
Upon completion of this course, the students will be able to

- Demonstrate knowledge of the use ofHPLC, GLC, and Atomic Absorption Spectrophotometer for nutrient analysis
- Determine serum protein,serum albumin, and serum lipid profile,
- Use of thin-layer chromatography (TLC) for nutrient separation Calculate nutritive values of foods
- Use real-time PCR in a biological context

Content:
1. Use of HPLC, GLC, and Atomic Absorption Spectrophotometer for nutrient analysis (demonstration).
2. Determination of serum protein concentration.
3. Determination of serum albumin concentration.
4. Determination of serum lipid profile.
5. Determination of carotene content by column chromatography.
6. Animal experimentation - care of animal and preparation of diet
7. Use of thin-layer chromatography (TLC) for nutrient separation.
8. Separation of amino acid by TLC.
9. Introduction to real-time PCR in a biological context

Learning and Teaching method:
Theory classes using all available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides and practical experiments in the laboratory

Assessment:
Regular attendance and laboratory work (graded), in-course assessment (graded), and final examination (graded). A student's grade will be calculated based on a combination of in-course assessment (40%) and a final exam (60%).

References:
Food Analysis Laboratory Manual—S. Suzanne Nielsen

Course No. NFS- 312 Clinical Nutrition and Dietetics - Practical 2 Credits
Course Overview:
This course coverstheoretical classes along with practical experimentsin the laboratory. It includes practical demonstration and diagnosis of PEM, Vitamin deficiency disorders, and NCDs patients.It also covers eye estimation of food weight and different cooking effect on food.

Learning Outcomes:
Upon completion of this course, the students will be able to

- Obtain hands-on training in clinical nutrition in class and through hospital visits
- Describe and report sign and symptoms of nutritional disorders
- Demonstrate eye estimation of food weight
- Calculate nutritive values of foods
- Prepare food exchange list

Content:
A. Clinical Nutrition

1. Weighing and measuring children
2. Calculation of SD scores
3. Demonstration signs of PEM and vitamin deficiencies
4. Demonstration signs of anemia
5. Demonstration signs of IDD
6. Hospital visit (Children, Diabetic, Cardiovascular, icddr,b)
7. Slide detection

B. **Dietetics: Food Groups and Exchange List**

1. Practical demonstration of different food groups (cost-wise)
2. Eye estimation of food weight and match by weighing in the balance
3. Calculation of nutritive values of foods
4. Effect of cooking on food weight and nutrient loss
5. Preparation of exchange list, conversion factor,etc.

Learning and Teaching method:
Theory classes using all available visual aids,e.g., Blackboard, whiteboard, PowerPoint slides,and practical experiments and demonstrations in laboratory

Assessment:
Regular attendance and laboratory work (graded), in-course assessment (graded), and final examination (graded). A student's grade will be calculated based on a combination of in-course assessment (40%) and a final exam (60%).

Course No. NFS - 313 Food Science and Technology - Practical 2 Credits

Course Overview:
This course consists of theoretical classes along with practical experiments in the laboratory. It provideslearners with knowledge ofthe qualitative properties of food. It will help learners to gain an understandingof food industry visits.

Learning Outcomes:
Upon completion of this course, the students will be able to

- Obtain hands-on training on the preparation and processing of food,
- Perform sensory assessment of food
- Prepare technical notes of newly developed food products.
- Gain experience through industrial visits

Content:

1. Carbohydrate crystallization, Gelling of foods,Dough formation, Food emulsion
2. Formulations and preparations of weaning food, pickles, jam and jelly.
3. Canning, and sausage preparation.
4. Fermentation of milk and other foods.
5. Sensory assessment of food quality
6. Preparation of technical and non-technical notes of a food product
7. Analysis of mineral content of foods by atomic absorption spectrophotometer (AAS) and traditional methods.
8. Analysis of fat-soluble vitamins in foods by HPLC
9. Analysis of fatty acids by GC
10. Determination of molecular mass by mass spectrometry
11. Visits to food industries

Learning and Teaching method:
Theory classes using available visual aids,e.g., Blackboard, whiteboard, PowerPoint slides and practical experiments in the laboratory

Assessment:
Regular attendance and laboratory work (graded), in-course assessment (graded), and final examination (graded). A student's grade will be calculated based on a combination of in-course assessment (40%) and a final exam (60%).

References:
Food Analysis Laboratory Manual—S. Suzanne Nielsen

Course No. NFS- 314 Biostatistics -Practical 2 Credits

Course Overview:
The course is composed of practical classes, including assignments. The course teaches students how to calculate parameters and statistics and how to apply statistical tests.

Learning Outcomes:
Upon completion of this course, the students will be able to

- Calculate simple parameters and statistic

- Demonstrate knowledge of hypothesis testing
- Interpret and present data from statistical tests

Content:

1. Introduction
2. Means and variances: Basic calculation
3. Estimation: Standard errors and confidence limit.
4. Sample significance test
5. The use of 't' tests
6. X^2- tests of goodness-of-fit and homogeneity
7. Calculation of correlation coefficient, significance tests for correlation coefficients
8. Calculation of regression coefficient, standard errors & significant test
9. Simple experimental design and analysis of variance (ANOVA)

Learning and Teaching method:

Theory classes using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practicalassignments.

Assessment:

Regular attendance and laboratory work (graded), in-course assessment (graded), and final examination (graded). A student's grade will be calculated based on a combination of in-course assessment (40%) and a final exam (60%).

References:

1. Basic Statistics-M A Jalil &RezinaFerdous
2. Fundamentals of Biostatistics- Rosner, B.

Course No. NFS- 315 Internship-Food Industry 2 Credits

Students will complete a 2-4 week of internship in a food manufacturing company.

Assessment:

Total Marks – 50: The supervisor will give feedback, and the intern will do a self-evaluation.The course teacherand the examination committee will finally evaluate the internship.

Course No. NFS- 321 VivaVoce 2 Credits

The oral examination assesses the student's aptitude and learning from theory and practical courses.

Assessment: Total Marks – 50

DETAIL CURRICULUM AND SYLLABUS FOR FOURTH YEAR B.S. (HONORS)

	Course Number	Name of Course	Credits
Theory:	**NFS-401**	Epidemiology	3
	NFS-402	Food Technology	3
	NFS-403	Food Microbiology and Food Safety	3
	NFS-404	Nutritional Biochemistry	3
	NFS-405	Public Health Nutrition	2
	NFS-406	Nutrition in Emergencies	2
	NFS-407	Medical Nutrition Therapy	3
	NFS-408	Data Management and Analysis	2
	NFS-409	Development Nutrition	3
	NFS-410	Research Methods	2
Sub-total			**26**
	NFS-411	Diet Preparation-Practical	2
	NFS-412	Physiology-Practical	2
	NFS-413	Field Assignment	2
	NFS-414	Research Project	2
	NFS-415	Internship-Hospitals/NGOs	2
	NFS-421	Viva Voce	2
Total			**38**

Course No. NFS- 401 Epidemiology 3 Credits

Course Overview:
This course introduces descriptive and analytic methods in epidemiology and their application to research and practice in public health and nutrition.

Learning Outcomes:
Upon completion of this course, the students will be able to

- Explain epidemiologic terminology
- Calculate and interpret crude, specific, and adjusted rates and measures of excess risk
- Understand important epidemiologic concepts including measures of association, bias, and causal reasoning
- Read published studies to recognize study designs and evaluate the potential for selection, information, and analytic bias, confounding and interaction
- Evaluate the relevance of findings in the medical literature to both public health nutrition and clinical practice.

Content:

1. Introduction: Definition of Epidemiology, Health & disease, Levels of prevention, application of prevention and natural history, the scope of epidemiology
2. Descriptive epidemiology: Persons, Place and Time; Age, Sex, Ethnic group and color, Social class, Occupation, Marital Status, Other family variables; Scope of epidemiology
3. Sources of Data on community Health: The Census, Vital Statistics, Morbidity data, Linked health record.
4. Measures of Morbidity and Mortality: Need of rates, Incidence and prevalence rates, Crude rates, specific rates, adjusted rates. Major sources of errors in the measurement of the disease. Adjustment of rates, need for adjusting rates, direct adjustment of rates, indirect adjustment of rates. Selected Indices of Community Health: Cause-specific indices Infant and Neonatal mortality, Fetal and

Prenatal mortality, Maternal Mortality, Life expectancy, Measurement of disability, other health-related information.

5. Epidemiologic Aspects of Infectious Disease: Host-parasite relations, Mechanism of transmission of infections, Type of epidemics (Common source *vs.* propagated); Aspects of person to person spread of disease, Investigation of an epidemic, Concept underlying control of infectious diseases, Current status of infectious diseases problem in Bangladesh
6. Epidemiologic Methods: Types of epidemiological studies-Observational studies, Experimental studies
   Ecological, Cross-sectional, cohort, case-control and Experimental studies (Single-blind, double-blind RCT), mixed designs; Design issues in epidemiological research
7. Bias, confounding, validity, and effect modification. Evaluating the role of confounders
8. Basic risk measurements: Relative risk, Attributable Risk and Odds ratio, Interpretation of measures of association
9. Association and Causation: Concept of causality and steps in the establishment of a causal relationship, Criteria for judging whether an association is causal
10. Evaluation of screening programs: Definition of screening, Criteria for Evaluation of screening tests-reproducibility and validity, sensitivity, specificity, predictive value. Principles underlying screening programs, Overview of current screening practices.
11. Nutritional epidemiology: Epidemiologic approaches to diet and disease, Correlation studies, Special exposure groups, Migrant studies, and secular trends. Multivariate relationship between diet and disease.

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%) and a final exam (60%).

References:

1. Basic Epidemiology (WHO, 1993) - R. Bealehole, R. Bonita, T. Kjellsterm.
2. Epidemiology-Leon Gordis
3. Nutritional Epidemiology -W. Willet.
4. Epidemiology beyond the basics- MoysesSzklo and F. Javier Nieto
5. Epidemiology in Medicine - C. H. Hennekens& J.E. Buring.
6. Clinical Epidemiology & Biostatistics - R.G. Knapp.

Course No. NFS - 402 Food Technology 3 Credits

Course Overview:
This course covers several aspects of food science, including preparation, processing, and distribution of food, and also various methods of preservation, storage, and new product development.This course will prepare students for success in the food industry by understanding the principles and applications of different technologies.

Learning Outcomes:
Upon completion of this course, the students will be able to

- Know about the preparation, processing, and distribution of food
- Define the meaning of unit operation in food processing technologies
- Understand the range of processing technologies typically applied by the food industry such as dairy, fish, spice technology, etc.
- Show knowledge of typical processing equipment associated with the studied unit operations

Content:

1. **Food irradiation and microwave heating:** effect of radiation on foods; dose determining factors; safety and wholesomeness of irradiated foods; properties of microwaves; application of microwave in food processing.
2. **Nutritional aspects of food processing:** browning reactions; food recipe and retention factors.
3. **Food packaging:**Basic principles of food packaging; requirements and functions of containers
4. **Unit operations in food industries:** unit operation approach, principles and names of common unit operation
5. **Baking and Confectionery Technology:** Wheat Flour Milling: The milling process; products and by-products of flour milling industry. Tests for baking quality of wheat flour. Yeast-Leavened Products: Flour quality for bread making; Bread making: Standard formulation of bread, Manufacturing process of bread and associated machineries; Defects in breads and their prevention. Pasta and Noodles: Flour for pasta and noodles; Production processes and associated equipment's. Breakfast cereals: Classification and manufacturing process. Confectionery Products: Types of confectionery products & manufacturing processes.
6. **Beverages Technology:** Introduction to soft drinks, Beverages and fermented products and their classification. Methods of preparation, processing, preservation, handling and storage of soft drinks and fermented products. Ingredients and manufacture of non-carbonated and carbonated soft drinks– sugar, flavorings, color, acids, water, carbon-di-oxide. Fruits and vegetable juices, pulps, squash, cordials, nectars, purees, sauces etc.Food fermentations: Introduction, definitions, additional benefits from fermentation, types of microbial changes in food; controlling fermentations in various foods
7. **Dairy Technology:** Milk composition, physical, chemical, and nutritional proportion of milk. Sources of contamination of milk and their control. Fresh and sour cream and related products, processing of butter, ice cream, cheese condensed milk and yoghourt.
8. **Fish Processing:** Introduction to fish processing. Postmortem changes in fish. Low-temperature preservation of fish and quality control. Fish curing: drying, dehydration, salting and smoking methods and quality aspect. Fish canning and quality of canned products. Modern approaches to fish processing, including vacuum packaging, irradiation in packaging etc. Packaging – function, selection, regulation etc. Planning and design of cold storage and fish processing plant.
9. **Spices Technology:** Classification of spices; chemical composition and flavoring components of spices; Manufacture of essential oils and oleoresins; Processing, preservation, quality control, packaging and storage of various spices and their products.
10. **Extruded Food:** Classification of extruder, Extruder design, Factors affecting extrusion performance, Merits and demerits of extrusion technology, and use of extruded food.

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%) and a final exam (60%).

References:

1. Food processing and Preservation –Saifur Rahman
2. Food Science - N.N. Potter
3. The Technology of Food Preservation - N .W. Desrosier
4. Food Science and Technology - M. Pyke.
5. Food Processing and Preservation by G. Subbalakshmi and Shobha A. Udipi.
6. The Science of Bakery Products by W. P. Edwards
7. Food Science by Norman H. Potter and Joshep H. Hotchkiss.
8. Handbook of Food, Beverage, and Fermentation Technology by Y. H. Hui.
9. Principles of Fermentation Technology by Peter F. Stanbury and Allan Whitaker
10. Outlines of Dairy Technology by Sukumer Dey
11. Developing technologies in food science: status, applications and challenges- Meghwal, M. and Goyal M
12. Handbook of food science, technology and processing. Elkins, L. and Labonte, G.
13. Thermal technologies in food processing- Richardson, P

Course No. NFS-403 Food Microbiology and Food Safety 3 Credits

Course Overview:
This course covers the concept of foodborne illness,personal hygiene, food hygiene, and food safety and the role of hygiene in the food industry and the development and maintenance of appropriate documented hygiene standards and practices in commercial premises.

Learning Outcomes:
Upon completion of this course, students should be able to:

- Explain bacterial infection and intoxication, mycotoxin, chemical poisoning, parasites, and rickettsia
- Understand every aspect of the personal hygiene of the food handler.
- Describe different types of cleaning compounds and processes and sanitizers usually used in the food industry.
- Explain the rationale for good manufacturing practices in the food industry
- Assess the basic components food safety & quality systems and how these are applied in commercial practice
- Develop an appreciation of how food safety & quality systems are constructed and maintained, and the interrelationships between the components of Food safety systems.
- Document and operate a HACCP system

Content:

1. Food borne illness:
   a. Diseases due to bacterial toxication and infection (clostridium botulinum. C. Perfingens, S. aureus, V. parahaemolyticus, E. coli, B. cereous, Salmonella and Shigella);
   b. Diseases due to non-bacterial sources (mycotoxin, viruses, rickettsia and parasites) and Diseases due to poisoneous plant, animals, chemicals, additives etc.
2. Update on etiological agents in food borne disease; trends in food borne illness
3. Maintenance of food hygiene and sanitation in the manufacture, processing and service of food (cleaning and sanitazation)
   Personal hygiene of the food handlers and production of safe food with special reference to the contamination of pathogenic microorganisms
4. Food Safety Management Systems (FSMS): Concept, elements and challenges of FSMS; Food hazards- biological, chemical and physical hazards; Food and personal hygiene; Hygienic design in food premises and food equipment; Food safety standards; Ethics in food safety management.
   History of food safety regulation internationally and in Bangladesh; the role of food regulation in the protection of the food buyer and seller; Official Controls in Bangladesh, their organization and operation nationally; Food Safety Authority
5. Food Safety Regulations and Enforcement: National legislation and enforcing agency; Safety of domestic, import and export foods; Roles of national, regional and international organizations/agencies; National and International policies on Food Safety and Quality; Global food safety initiatives (GFSI). Introduction to international food regulation- the WTO and the Codex Alimentarius.
   Codes of practice guidelines and standards applicable in Bangladesh; Control of food additives; labelling legislation; Nutrition & Health Claims legislation; Food Supplements Legislation.
6. Preventive Management of Food Production: Primary production – natural and GM crops, Good Agricultural Practice (GAP), Sanitary and Phytosanitary (SPS); Secondary production- Good Hygiene Practice (GHP), Good Manufacturing Practice (GMP), HACCP plan, Code of practice, Standard operating procedures, ISO 22000 and other guidelines for food safety and quality. Good Agricultural Practices (GAP) & Good Handling Practices (GHP); Principles of good manufacturing practices (GMP); Hazard analysis and critical control point (HACCP)
7. Microbiological Food Safety Analysis and Surveillance Systems: Food safety laboratory supports; Food safety analysis- safety assessment, management, and communication; Investigation of microbiological foodborne disease outbreaks and surveillance systems; Management of food safety incidence and emergency.
8. Development of Food Safety System: Prevention of microbiological food-borne Illness; Food risk management in retailing; Food safety management systems for food business operators; Survey on microbiological and chemical status of foods; Recent trends in food safety management systems
9. Food Safety Inspection: Traditional inspection systems; Categorization of risk foods; Risk-based food safety inspection systems; Food labeling and claims; Food safety alert; Traceability system; Assessment of food safety management systems

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%) and a final exam (60%).

References:

1. Principles of Food Sanitation - N.G. Marriot
2. Food Poisoning and Food Hygiene- B.C. Hobbes and R.J.Gilbert
3. Food Microbiology - W.C. Frazier and D.C. Westhoff.
4. Modern Food Microbiology – James M. Jay
5. Food Microbiology – M.R. Adams & M.O. Moss
6. Food Hygiene and Sanitation- S. Roday
7. FSAI, (Latest Revision) Guidance Note 10 Traceability and Product Recall Sprenger, R. A. 2015, Hygiene for Management, Highfield.Co.UK
8. ISO, 2008; Quality Management Systems Standard 9001, International Standards Organization.
9. Springer R., 2008, Hygiene for Management, Highfield
10. Engel D., MacDonald D., Nash C., Hackett M., 2007, Managing Food Safety, Chadwick House Group Ltd.; 2nd Revised edition
11. The Microbiological Safety and Quality of Foods (vol 1) – BM Lund, TC Baird-Parker and GW Gould; Aspen Publications
12. Advances in Microbial Food Safety (vol 1 & 2) – J Sofos, Woodhead Publishing
13. Food Safety and Protection – VR Rai and JA Bai; CRC Press
14. Food Safety Management Programs: Applications, best practices and compliances – D Newslow; CRC Press
15. Food Safety Management- Y Mutarjemi and H Lelieveld; Elsevier
16. Principles of Food Sanitation, Safety and Hygiene – B Malicse, Technology Business
17. Food Safety Risk management– FAO of the UN, Food Safety & Quality Series No. 4. 2017
18. ISO 22000: 2018 Food Safety Management System – International Organization for Standardization

Course No. NFS - 404 Nutritional Biochemistry 3 Credits

Course Overview:
Nutritional Biochemistry is the study of nutrients and their metabolic functions. This course covers biomolecules and metabolic pathways that are essential for the human body, with a focus on macronutrient metabolism.

Learning Outcomes:
Upon completion of this course, students will be able to
- Describe the role of carbohydrate, protein, and fat in human nutrition
- Know the source, classification, and role of fiber in human nutrition
- Understand protein quality assessment methods
- Describe protein biosynthesis, genetic code, and gene expression regulation

Content:

1. Role of carbohydrate in nutrition. Its function, requirements, food sources, deficiency problems. Importance as the main source of energy. Role of carbohydrate in health and nutrition of special groups: sports nutrition, weight management, pregnant. Current development in carbohydrate research-fructose and chronic diseases
2. Fiber: Definitions of dietary fiber and functional Fiber; sources, Chemistry and characteristics of dietary and functional Fibers- selected properties and physiological and metabolic effects of fiber, classification, recommended fiber intakes, Roles of fiber in disease prevention and management—cardiovascular disease, Diabetes Mellitus, obesity and weight control, gastrointestinal Disorders
3. Protein quality-methods of determination, advantages, and disadvantages of the methods. Protein requirements, function, food sources, deficiency problems. Amino acid supplementation and complement of each other's deficiencies. Essential amino acids. Limiting amino acids. Amino acid toxicity. New protein sources use to solve deficiency problems.
4. Sources of fats and oils. Requirements as a source of energy. Advantages and disadvantages of saturated and unsaturated fatty acids, essential fatty acids. Importance of dietary fat on serum lipids and lipoproteins.
5. Lipoprotein metabolism: Exogenous pathway, endogenous pathway, reverse cholesterol transport pathway, DRIs for lipids; Role of w-3 and w-6 fatty acids in health and nutrition; Current research in lipids—Omega-3fatty acids and cancer, dietary fat and weight management, fish consumption, fish oil, Omega-3 fatty acids, and cardiovascular disease, nut consumption and type 2 diabetes.
6. Protein biosynthesis and the genetic code, Recombinant DNA, and in vitro expression. Regulation of gene expression.

Learning and Teaching method:

Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:

Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%) and a final exam (60%).

References:

1. Advanced Nutrition and Human Metabolism (7th edition) by Sareen S. Gropper, Jack L. Smith and Timothy P. Carr
2. Present Knowledge in Nutrition (11th edition) – edited by Bernadette Marriott, Diane F. Birt, Virginia Stalling, and Allison Yates
3. Modern Nutrition in Health and Disease – M.E. Shils, T.A. Olson, M. Shike.
4. Harper's Review of Biochemistry – D.W. Martin, P.A. Mayes, V.W. Ridwekk, D.K. Granner.
5. Principles of Biochemistry- A.L. Lehninger
6. Biochemistry – L. Stryer
7. National Biochemistry – T. Brody
8. Human Nutrition and Dietetics – J. S. Garrow& W.P.T. James
9. Advanced Textbook on Nutrition – vol 1 & II, M. Swaminathan

Course No. NFS - 405 Public Health Nutrition 2 Credits

Course Overview:
This course covers the concepts, principles, functions, and competencies required by public health nutrition professionals. This course includes the assessment of dietary habits, and physical activity as well as issues of public health concern such as IYCFpractices, obesity, vitamin D, and bone health.

Learning Outcomes:
Upon completion of this course, students will be able to

- Demonstrate knowledge of concepts, principles, functions, and competencies required for public health nutrition
- Conduct capacity analysis, problem analysis, and stakeholder analysis
- Demonstrate knowledge of dietary and physical activity assessments methods
- Demonstrate the understanding of public health nutrition issues with approaches for designing and implementing public health nutrition interventions.
- Critically appraise public health/community nutrition strategies, policies, and interventions
- Complete a written project on a chosen relevant topic of public health nutrition concern

Content:

1. Introduction to Public Health Nutrition (PHN): History, definitions of public health and nutrition; Core functions and essential public health services; principles of public health nutrition; The core functions of the PHN workforce; Competencies for PHN practice; Professionalism and PHN practice; The PHN practice cycle; A bi-cyclic framework for public health;
2. Assessment of dietary habits, dietary reference values; Assessment of nutritional status in public health nutrition settings
3. Assessment of physical activity. Global changes in diet and physical activity
4. Community Engagement Analysis; Problem analysis; Stakeholder analysis and engagement; Determinant analysis; Capacity analysis; Risk assessment and strategy prioritization; Managing implementation; Evaluation
5. Logic modeling: logic model, Types of logic model, Logic model elements, Logic modeling in PHN practice, Developing a logic model
6. Infant and young children feeding practices: Importance of IYCF, Nutritional needs, and IYCF recommendations; Current patterns of IYCF; Strategies and lessons learned in Bangladesh
7. Obesity: Determinants of obesity, current solutions strategies, an ecologic perspective on challenges and solutions, recommendations for policy research and practice
8. Vitamin D and Bone Health: Dietary recommendations, assessment of vitamin D status, osteoporosis, and public health.
9. Geographical Information System (GIS) and Public Health: Definition, function and application of GIS, Spatial data and databases, Mapping health and nutrition information, analyzing spatial clustering of health events, analyzing access to health services, applying GIS to nutrition surveys.
10. Designing and writing a public health nutrition intervention with the following sections: Content-Intervention summary statement; Community analysis, problem analysis, stakeholder analysis, determinant analysis, mandates for action, Existing capacity for action; project partners and governance; Goals and objectives; Intervention research; Strategy matrix; Evaluation plan; Activity planning; Budget; Risk management, Communication management(valorization); References.

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%) and a final exam (60%).

References:

1. Public Health Nutrition, 2nd Edition- Edited by Judith L. Buttriss, Ailsa A. Welch, John M. Kearney, Susan A. Lanham
2. Practical Public Health Nutrition. John Wiley & Sons.Hughes, R.
3. Public Health Nutrition, Principles and Practices in Community and Global health-Natalie Stein
4. Global Health 101-Richard Skolnik
5. GIS and Public Health, 2nd Edition by Ellen K. Cromley, Sara L. McLafferty

Course No. NFS - 406 Nutrition in Emergencies 2 Credits

Course Overview:
The course introduces students to nutrition responses in an emergency and provides an understanding of the causes and nutritional outcomes of humanitarian crises and complex emergencies (malnutrition, morbidity, and mortality). Further, the course reviews international response strategies, nutrition programs, and relevant policies. The course provides the opportunity for active class participation drawing upon the actual work experience of the students and applying a range of up-to-date case-study materials based on current humanitarian crises.

Learning Outcomes:
Upon completion of this course, students will be able to
- Demonstrate knowledge of nutrition responses during an emergency and its different implication
- Demonstrate an understanding of disaster management
- Demonstrate knowledge of food assistance, macro, and micronutrient needs, IYCF and livelihood issues during emergency
- Demonstrate an understanding of monitoring and evaluation ofnutritional emergencies.

Content:
1. Definition of nutritional emergency; Its causes and implications
2. Disaster situation in Bangladesh; Historical perspectives
3. Models of early warning; Role of nutritional, health and socio-economic data on early warning; Framework for disaster relief- needs assessment and targeting intervention design
4. Disaster management in Bangladesh: concept and practice
5. Food Assistance:Emergency food aid; mechanisms, modalities, and planning rations; Management and practice of the different types of emergency feeding programs (general food distribution, mass feeding, therapeutic feeding, and special foods during an emergency, vulnerable group feeding).

6. Importance of nutritional relief. Field level difficulties- camp administration, transportation, food storage, etc.
7. Addressing macro - and micronutrient deficiencies in an emergency; direct nutrition interventions (DNIs) in Emergency; Assessment and surveillance of nutritional status in an emergency; SMART survey in Emergency; SENS survey
8. Conceptual timeline of nutrition in an emergency (pre- and post-crisis); Decision tree tool for Nutrition scale-up and response to emergencies; Stakeholder mapping exercise in emergency
9. Infant & Young child feeding in Emergencies;Water, Sanitation and Hygiene in Emergencies;Gender in nutrition and emergency; Community Management of Acute Malnutrition (CMAM) in emergency
10. Agriculture, food security, livelihoods, cash in an emergency
11. Monitoring and evaluation of nutritional emergencies; Nutrition Cluster Approach and Humanitarian Coordination; Responsibilities and Mandate of UN bodies and different GOs and NGOs in an emergency, especially on food relief

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%), and a final exam (60%).

References:

1. The Management of Nutritional Emergencies in Large Populations - Goyet&.Geijer
2. Disaster in Bangladesh - L. Chen
3. The Management of Nutrition in Major Emergencies-WHO, Geneva, 2000.
4. SMART Survey Methodology. https://smartmethodology.org/

Course No. NFS - 407 Medical Nutrition Therapy 3 Credits

Course Overview:
This course preparesstudents for future dietetic professionals. This course covers the pathophysiology of selected disease states and their associated medical problems. The course focuses explicitly on the medical nutrition needs of patients in the treatment of each disease state.

Learning Outcomes:
Upon completion of this course, the students will be able to

- Use the nutrition care process to make decisions, to identify nutrition-related problems and determine and evaluate nutrition interventions, including medical nutrition therapy, disease prevention, and health promotion
- Know medical nutrition therapy for various disease states including critical care patients
- Demonstrate how to locate, interpret, evaluate, and use professional literature to make ethical, evidence-based practice decisions
- Demonstrate competent and professional oral and written communication and documentation

Content:
1. The principle, classification, purpose of diet therapy and importance
2. Dietitian - Classification, involvement in different places. Role of the Dietitian in the Health Care System

3. The Nutrition Care Process: Steps of NCP—Nutrition assessment, nutrition diagnosis, nutrition intervention, nutrition monitoring, and evaluation
1. Documentation of the nutrition care process
2. Enteral and Parenteral Nutrition Support: Indication, access, equipment, nutritional substrates, monitoring, and evaluation; Estimating requirements in disease states; Malnutrition universal screening tool (MUST); Pre- and post-operative condition diet
3. Protein Energy Malnutrition (PEM):Marasmus: definition, causes, nutritional, biochemical (Creatinine height index), clinical and dietary assessment; Cachexia; MNT for Marasmus
   Kwashiorkor: definition; causes; nutritional, biochemical (nitrogen balance studies), clinical and dietary assessment; MNT for Kwashiorkor
4. Weight management: Nutrition therapy for overweight, obesity, and underweight.
5. Diabetes: Definition and types/categories; Signs, symptoms, & characteristics; Goals for DM management; Risk and causative factors, Diagnosis, Complications, Management of T2 Diabetes
6. Nutrition Therapy for Hypertension: DASH diet; Steps in behavior counseling (5As)
7. Peptic Ulcer Disease: Definition, epidemiology, etiology, clinical manifestation and diagnosis, MNT for peptic ulcer disease
8. Diet for an inborn error of metabolism.

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%) and a final exam (60%).

References:

1. Nutrition Therapy and Pathophysiology-Marcia Nelms, Kathryn P. Sucher & Karen lacey
2. Lutz's Nutrition and Diet Therapy-Nancy Litch
3. Krauses's Food and Nutrition Therapy-L. Kathleen Mahan & Sylvia Escott-Stump
4. The essential Pocket Guide for Clinical Nutrition-Mary Width & Tonia Reinhard
5. Manual of Nutrition and Diet Therapy - N.J.Gills& M.V. Bosscher
6. Clinical Dietetics & Nutrition - F.P. Antia&P.Abraham
7. Nutrition & Physical Fitness - Bogert, Briggs &Callowey
8. Food and Nutrition - M. Swaminathan
9. Applied Nutrition - R. Rajalakshmi

Course No. NFS- 408 Data Management and Analysis 2 Credits

Course Overview:
This course covers basic knowledge of data processing, statistical computing, database construction, error detection and correction, creation of composite variables, descriptive statistics, univariate analyses, regression analysis of continuous, binary, and categorical outcomes, ANOVA.This course also teaches the use of nutritional software and analysisof nutritional data.

Learning Outcomes:
Upon completion of this course, the students will be able to
- Process and prepare socioeconomic, anthropometric, and dietary data for analysis
- Conduct necessary statistical analysis (descriptive and inferential statistics) based on the research question

- Interpret and present findings for scientific communications

Content:
1. Introduction to nutritional software and applications
2. Overview of Statistical Package for Social Science (SPSS): Graphical user interface, types of files, basic command syntax
3. Enter and edit data, import and export data, Merge Files, variable and value labels, Data Cleaning
4. Data management: Data transformation—Recoding variables, Computing Variables, Count values within cases, Ranking. Data manipulation—Selecting cases, Splitting files, Weight cases, Aggregate
5. Data analysis: Choosing the Correct Test; Exploratory Analysis, Descriptive Statistics; Hypothesis testing—Independent sample t-test, paired t-test, one-sample *t*-test, Chi-squared test, Simple linear regression, ANOVA; Type 1 and 2 error, level of significance, power of test
6. Graphical representation of data (Excel)
7. Anthropometric and Socio-economic data handling
8. Dietary data analysis: Dietary data collection; entering dietary data, Estimation of nutrient intake from food (using syntax)
9. Practical nutritional data analysis using SPSS, Anthro, AnthroPlus, ENA for SMART, and other related software packages

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%), and a final exam (60%).

References:

1. Medical statistics: A guide to data analysis and critical appraisal. Peat, J. and Barton, B.
2. WHO Anthro & AnthroPlus Manual
3. An interactive 24-hour recall for assessing the adequacy of iron and zinc intakes in developing countries. Gibson, R.S. and Ferguson, E.L., 2008. Washington, DC: IFPRI and CIAT.
4. Analysis in Nutrition Research-Edited by George Pounis
5. Biostatistics: A guide to design, Analysis, and Discovery—Forthofer, R. N., Lee, E. S., & Hernandez, M. (2006).
6. Fundamentally of Biostatistics—B. Rosner.
7. Medical Statistics—Kirkwood and Strne

Course No. NFS - 409 Development Nutrition 3 Credits

Course Overview:
This course links nutrition with economic growth and development and covers different issues such as poverty, population, urbanization, food, and nutrition policymaking in Bangladesh. Further, this course addresses recent topics such as SDGs, gender, nutrition transition, nutrition,and climate change.

Learning Outcomes:
Upon completion of this course, the students will be able to
- Demonstrate knowledge of different economic growth and development models
- Understand concepts and measurements related to poverty, population, and urbanization

- Evaluate food and nutrition policymaking in Bangladesh and elsewhere
- Know about SDG goals and its relationship with nutrition
- Critically discuss issues such as nutrition transition, nutrition and climate change, and nutrition governance

Content:

1. Concept of development: Meaning of economic development; Economic development and economic growth; measurements; Noneconomic factors.
2. Models of growth and development: Harrod Domar model, Rostow stages of growth model, Lewis two sector model, International dependence, and Free-market model; characteristics and limitations
3. Poverty: Define poverty. Briefly describe the poverty situation and trend in Bangladesh; Absolute versus relative poverty measurement, Measurement of poverty; indicator advantages and disadvantages; Measuring inequality (Gini coefficient); Composite indicators such as the Human Development Index; Poverty reduction strategies in Bangladesh
4. Population: Concepts and measurements of population growth; Theory of demographic transition; Malthusian theory of population trap; Microeconomic theory of fertility; Population problem in Bangladesh; Nutrition and population growth; Measures for population control
5. Urbanization: Concepts and measurements of urbanization; Urbanization in Bangladesh; Causes of urban migration; Urban nutrition problems and their characteristics; Measures for addressing urban nutrition.Urbanization and urban food security; Links between food security and migration; agricultural labor mobility; Food (in)security for refugees; Migration, conflict and food insecurity; Relevant case studies.
6. Food and nutrition policy: The process of policymaking; the legislative and regulatory process; the political process; Food and nutrition policy in Bangladesh, Components of food and nutrition policies,

   Agricultural policies and programs affecting nutrition; Concept of green revolution; Effects of green revolution on production and consumption of food and nutrition.Impact assessment of food policy; Relevant case studies.
7. Climate change and nutrition: Climate variability and climate change; Levels and time scales of climate variation and change; Climate change and Food Security; Direct and Indirect impact on food security; Conceptual framework; Natural hazards/disasters and its impact on food security; Global distribution of risks for agricultural production systems; Vulnerability and resilience in terms of food security; Climate Smart Agriculture; Conservation Agriculture; Relevant case studies.
8. Gender issues in nutrition: Gender inequality in nutrition,gender-sensitive programming for nutrition
9. Nutrition transitions:Stages of the nutrition transition;critical dimensions of nutrition transition, program and policy issues in modifying the adverse dynamics of nutrition transition,Indices to measure effectiveness of nutrition transition and capacity building.

10. Nutrition governance in Bangladesh; Sustainable development goals (SDGs), key challenges in evaluating nutrition-sensitive programs.

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%), and a final exam (60%).

References:

1. Economic Development in the Third World - M. P. Todaro
2. Handbook on poverty and inequality—J. Haughton, J., and Khandker, S.R., 2009. World Bank Publications.
3. Nutrition andHealth in aDeveloping World bySaskia de Pee, Douglas Taren, Martin W. Bloem
4. Nutritional Health Strategies for Disease Prevention by Norman J. Temple, Ted Wilson, David R. Jacobs, Jr. Leading Issues in Economic Development - G. M. Meier
5. Public Health Nutrition, Principles and Practices in Community and Global Health-Natalie Stein
6. Growth and Development - A. P. Thirlwall
7. Economic Development - G. M. Meier and R. E. Baldwin

Course No. NFS-410 Research Methodology 2 Credits

Course Overview:
This basic course introduces the fundamentals of research, ethical principles and challenges, and the elements of the research process, research methods within the quantitative domain. Further, this course covers topics such as survey research, research proposal, and report writing.

Learning Outcomes:
Upon completion of this course, students should be able to:
- Formulate research questions and apply literature search skills
- Know the scientific principles, methods, and analytical/ technical skills to investigate a research question, and interpret the results of a study
- Understand survey research methodology
- Construct a research proposal and conduct it accordingly
- Write a scientific report for professional communication.

Content:
1. Research, the purpose of research, types of research
2. Ethical research; Regulatory protections of human subjects in research
3. Research process, problem formulation; Formulating research objectives, hypothesis, and research questions; Definitions, operationalization, and indicators
4. Review of the literature
5. Research methods: Descriptive studies, Analytic studies. Pre-Experimental designs (One-shot case study, One group pretest-posttest, static group comparison); Experimental designs (Pretest, Posttest, Control group design, Posttest-only Control group design, Solomon Four-Group design); and Quasi-

Experimental designs (Non-equivalent control group design, Separate Sample Pre-test, Posttest design, Time series design)
6. Sampling methods and sample size
7. Data collection and design of the questionnaire
8. Surveys: Definition, objective, limitations, survey steps
9. Construction of a research proposal: Background, rationale, research question, objectives, methods, data analysis plan, management of research project, consent forms
10. Report writing: Abstract/summary, introduction, methodology, results/findings, discussion, conclusion and recommendations, references

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations where possible.

Assessment:
Regular attendance (graded), in-course assessment (graded), quiz (non-graded), assignment (non-graded), and final examination (graded). A student's grade will be calculated based on a combination of class participation (5%), in-course examination (35%), and a final exam (60%).

References:

1. Introduction Research and Medical Literature—J. Glenn Forister& J. Dennis Blessing
2. Research Methodology-M.A. Salam Akanda
3. Analysis in Nutrition Research-Edited by George Pounis
4. Research Methodology and Applied Statistics – Jaime B. Valera
5. Health Research Methodology: A Guide for training in research method. WHO
6. Survey Research Methodology – Floyd J. Fowler,Jr.

Course No. NFS - 411 Diet Preparation-Practical 2 Credits

Course Overview:
This practical course coverscalculation, menu planning, and prescription of diet charts for different age groups and various disease states. It prepares students for future dietitians.

Learning Outcomes:
Upon completion of this course, the students will be able to
- Calculate ideal body weight, energy and protein requirements
- Prepare menu plans for different age groups, for the family of different sizes and people with varying states of disease.
- Provide a diet prescription and counseling.

Content:

1. Different methods of calculation for diet preparation and menu planning
2. Diet preparation for different age groups by calculation
3. Diet preparation for the family of different sizes.
4. Diet preparation for the different physiological conditions-- obesity, underweight, diabetes, cardiovascular diseases, liver disease, kidney diseases.
5. Individual energy intake and expenditure by calculation
6. Diet Prescription

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPoint slides, and practical demonstrations and laboratory works where applicable

Assessment:
Regular attendance and laboratory work (graded), in-course assessment (graded), and final examination (graded). A student's grade will be calculated based on a combination of in-course assessment (40%) and a final exam (60%).

References:

1. Medical Nutrition Therapy: A case Study Approach-Marcia Nahikian Nelms & Sara long Roth
2. Advances in Diet Therapy-Practical manual-V. Vimla
3. Nutrition in major metabolic Diseases-C. Gopalan & Kamala Krishnaswamy
4. Manual of Nutrition and Diet Therapy - N.J.Gills& M.V. Bosscher
5. Applied Nutrition - R. Rajalakshmi

Course No. NFS-412 Clinical Nutrition and Physiology-Practical2 Credits

Course Overview:
This course includes practical experiments in the clinical nutrition and physiology laboratory.

Learning Outcomes:
Upon completion of this course, the students will be able to

- Collect and separate blood
- Estimate hemoglobin and ESR
- Record blood pressure and interpret
- Identify metabolic syndrome, and determine ALT and AST, serum bilirubin, total count of WBC, differential count of WBC
- Perform routine microscopic examination of stool and urine

Content:
1. Collection and separation of blood and estimation of hemoglobin
2. Estimation of ESR
3. Recording of blood pressure and its interpretation
4. Identification of metabolic syndrome (blood sugar, HbA1c, lipid profile, BUN, creatinine, total protein A/G ratio)

5. Determination of AST and ALT
6. Estimation of serum bilirubin and its interpretation
7. Determination of total count of WBC, differential count of WBC
8. Routine microscopic examination of stool and urine

Learning and Teaching method:
Formal lectures using available visual aids,e.g. Blackboard, whiteboard, PowerPoint slides, and practical demonstrations and laboratory works where applicable

Assessment:
Regular attendance and laboratory work (graded), in-course assessment (graded), and final examination (graded). A student's grade will be calculated based on a combination of in-course assessment (40%) and a final examination (60%).

References:
1. Practical Medical Biochemistry-Chawla
2. Practical Physiology- Professor Md. Ruhul Amin
3. Practical Physiology-Dr. Selim Reza

Course No. NFS – 413 Field Assignment Practical 2 Credits

Course Overview:
The students will go to the field to collect data through questionnaires. The emphasis would be given to dietary, anthropometric, and socioeconomic data collection. Before going to the field, students will develop the questionnaire. This course provides practical experience in field-level data collection. On completion of the field assignment, students will prepare written reports based on their study findings. The students will present the field assignment report in the final examination.

Learning Outcomes:
Upon completion of this course, the students will be able to
- Plan, conduct, analyze, and report on field investigations into the dietary, anthropometric, and socio-economic aspect of nutrition
- Record, collate, analyze, interpret, and report nutrition-related data using appropriate statistical methods
- Analyze, synthesize, and summarize information critically

Content:
1. Dietary Assignment
2. Anthropometric Assignment
3. Socio-Economic Assignment

Learning and Teaching method:
Formal lectures using available visual aids, e.g., Blackboard, whiteboard, PowerPointslides, and practical data collection in the field

Assessment:
Marks – 50: 40% Continuous Assessment; 60% Final Examination; Written field assignment report (40%), and final presentation (60%).The course teacher and the examination committee will evaluate the field assignment report and presentation.

Course No. NFS – 414 Research Project 2

Credits

Course Overview:
Students will complete a group research project on a selected nutrition/food science issue. The Institute will provide facilities to the students for the project works. The students may also avail the opportunity to work in other reputed research laboratories or organizations for carrying out part of their works. Upon completion of the research project, students prepare written reports based on their research findings. The respective project supervisor reviews them, and the project report is presented in a final examination.

Learning Outcomes:
Upon completion of this course, the students will be able to

- Plan, conduct, analyze, and report on investigations into an aspect of nutrition in the laboratory and / or in the field in a responsible, safe, and ethical manner
- Record, collate, analyze, interpret, and report nutrition-related data using appropriate statistical methods
- Analyze, synthesize, and summarize information critically, including published research or reports

Learning and Teaching method:
Group research work under a supervisor

Assessment:
Total Marks – 50: Written research report (40%), and final presentation (60%).The course teacher and the examination committee will evaluate the research report and presentation.

Course No. NFS – 415 Internship-Hospitals/NGOs 2 Credits

Students will complete one to three months of internship at Hospitals/Government organizations (GOs)/ Non - Government Organizations (NGOs)/ International Non - Government organizations (INGOs) either in dietetics or in the public health nutrition arena.

Assessment:
Total Marks – 50: The supervisor will give feedback, and the intern will do a self-evaluation.The course teacherand the examination committee will finally evaluate the internship.

Course No. NFS- 421 VivaVoce 2 Credits

The oral examination assesses the student's aptitude and potential to perform as an independent nutritionist/food scientist professional.

Assessment: Total Marks – 50