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## SCHOOL OF PHARMACY AND HEALTH SCIENCES

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**COURSE** : **BCM 3130A: NUTRITIONAL BIOCHEMISTRY**  
**CREDIT** : **3.0**

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### 1.1 COURSE DESCRIPTION

This oral intensive course in nutritional biochemistry offers a comprehensive exploration of the intricate interplay between nutrition, health, and food systems. Through lively discussions and interactive presentations, students explore essential nutrients, dietary requirements, and the influence of dietary habits on overall well-being. They investigate the role of nutrition in combating degenerative diseases like obesity, coronary heart diseases, and cancer, while also assessing nutritional status through various evaluation techniques. Moreover, the course delves into public health aspects such as food safety, quality control, and the nutritional development landscape in Kenya, encompassing food policies, feed formulation, and advanced food processing methods. Through engaging activities and real-world case studies, students develop critical thinking skills and gain practical insights into the complexities of nutritional science, emerging equipped with a holistic understanding of its significance for public health and sustainable food systems. This course aligns to Sustainable Development Goal 4 (SDG 4), which seeks to ensure equitable quality education which promotes lifelong learning, SDG 8 which prepares the students for full productive employment, and SDG 10 which targets to reduce inequality and discrimination in the work environment.

**1.1.2 PREREQUISITES:** *Structure and Function of Biomolecules, Carbohydrate and Lipid Metabolism, Nitrogen Metabolism*

### 1.2 COURSE CONTENT

WEEK	CONTENT/TOPIC
Week 1	<b>1.0 FOUNDATIONS OF NUTRITIONAL BIOCHEMISTRY:</b>

## ESSENTIAL NUTRIENTS, DIETARY GUIDELINES, AND FOOD HABITS

### 1.1 Learning Outcomes

- i. Explain the importance of studying nutritional biochemistry and its impact on health.
- ii. Describe essential nutrients, their functions, and the factors affecting nutrient requirements.
- iii. Interpret Dietary Reference Intakes (DRIs) and apply them to dietary planning.
- iv. Analyze the influence of cultural, social, and economic factors on food habits and dietary patterns.
- v. Present and discuss nutritional biochemistry concepts and findings effectively in oral presentations. (Oral Intensive).

### 1.2 Content

#### 1. Introduction to Nutritional Biochemistry

- Importance of Studying Nutritional Biochemistry
- Basic Concepts and Principles in Nutritional Biochemistry
- Essential Nutrients and their Functions
- Categories of Nutrients
- Factors Affecting Nutrient Requirements

#### 2. Dietary Reference Intakes (DRIs)

- Definition and Overview of DRIs
- Estimated Average Requirement (EAR)
- Recommended Dietary Allowance (RDA)
- Adequate Intake (AI)
- Tolerable Upper Intake Level (UL)

#### 3. Food Habits

- Food Habits and Intakes
- Factors Influencing Food Choices
- Cultural, Social, and Economic Influences on Food Choices
- Trends in Food Consumption Patterns and Dietary Habits

### 1.3 Learning Activities/Opportunities

- **Lectures and Discussions:** Interactive sessions to cover theoretical aspects.
- **Group Discussions:** Collaborative discussions on the impact of various factors on food choices.
- **Case Studies:** Real-world scenarios to apply DRIs and analyze food habits.
- **Oral Presentations:** Students present on topics related to nutritional biochemistry, focusing on the importance and application of DRIs.
- **Guest Lectures:** Experts in nutrition and dietetics share insights on current trends and research.

### 1.4 Assessment/Assignments

- **Quizzes:** Regular quizzes to test understanding of essential nutrients, DRIs, and basic concepts.
- **Written Assignments:** Essays on factors affecting nutrient requirements and cultural influences on food choices.
- **Case Study Analysis:** Written reports on case studies focusing on dietary planning using DRIs.

	<ul style="list-style-type: none"> <li>• <b>Oral Presentations:</b> Students present a topic related to food habits, integrating course concepts and demonstrating effective communication skills.</li> <li>• <b>Final Exam:</b> Comprehensive assessment covering all course content.</li> </ul> <p><b>1.5 References</b></p> <ul style="list-style-type: none"> <li>i. <b>Textbooks:</b> <ul style="list-style-type: none"> <li>a. Gropper, S. S., Smith, J. L., &amp; Carr, T. P. (2021). <b>Advanced Nutrition and Human Metabolism</b> (8th ed.). Cengage Learning.</li> <li>b. Whitney, E., &amp; Rolfes, S. R. (2018). <b>Understanding Nutrition</b> (15th ed.). Cengage Learning.</li> </ul> </li> <li>ii. <b>Journal Articles:</b> <ul style="list-style-type: none"> <li>a. National Academies of Sciences, Engineering, and Medicine. (2019). <b>Dietary Reference Intakes for Sodium and Potassium.</b></li> <li>b. FAO/WHO. (2021). <b>Vitamin and Mineral Requirements in Human Nutrition.</b></li> </ul> </li> <li>iii. <b>Online Resources:</b> <ul style="list-style-type: none"> <li>a. National Institutes of Health (NIH) Office of Dietary Supplements. <a href="https://ods.od.nih.gov">ods.od.nih.gov</a></li> <li>b. World Health Organization (WHO) Nutrition. <a href="http://who.int/nutrition">who.int/nutrition</a></li> </ul> </li> </ul>
<p><b>Week 2</b></p>	<p><b>2.0 COMPREHENSIVE APPROACHES IN NUTRITIONAL ASSESSMENT AND FOOD ANALYSIS</b></p> <p><b>2.1 Learning Outcomes</b></p> <ul style="list-style-type: none"> <li>i. Identify and describe various methods of nutritional assessments, including clinical, dietary, anthropometric, and biochemical assessments.</li> <li>ii. Explain the principles and applications of physical and chemical methods used in food analysis.</li> <li>iii. Interpret and analyze food labels according to nutritional labeling regulations.</li> <li>iv. Conduct oral presentations on the analysis and interpretation of food labels, demonstrating effective communication skills in explaining nutritional information. (Oral Intensive)</li> <li>v. Apply knowledge of food analysis techniques to assess the nutrient content of different food samples.</li> </ul> <p><b>2.2 Content</b></p> <p><b>1. Methods of Nutritional Assessments</b></p> <ul style="list-style-type: none"> <li>• Clinical Examination</li> <li>• Methods for Assessing Dietary Intake: <ul style="list-style-type: none"> <li>○ Food Diaries</li> <li>○ Food Frequency Questionnaires</li> <li>○ 24-Hour Recalls</li> </ul> </li> <li>• Anthropometric Measurement</li> <li>• Biochemical Assessments</li> </ul> <p><b>2. Food Analysis</b></p> <ul style="list-style-type: none"> <li>• Theory and Application of Physical and Chemical Methods for Determining Food Constituents <ul style="list-style-type: none"> <li>○ Overview of Analytical Techniques and Their Applications in Food Analysis</li> </ul> </li> </ul>

- Stages in Food Analysis
- Methods for Determining Nutrient Content:
  - Proximate Analysis: Moisture Content, Ash Content, Crude Protein, Crude Fat, Crude Fiber, Nitrogen-Free Extract (NFE)
  - Vitamin Assays
  - Mineral Analysis

### 3. Food Labels

- Interpretation of Food Labels
- Nutritional Labelling Regulations
- Reading and Understanding Food Labels

### 2.3 Learning Activities/Opportunities

- **Lectures and Discussions:** In-depth exploration of nutritional assessment methods, food analysis techniques, and food labeling regulations.
- **Hands-on Laboratory Sessions:** Practical exercises on conducting dietary assessments, performing food analysis techniques, and interpreting food labels.
- **Group Projects:** Collaborative projects analyzing food samples and presenting findings.
- **Oral Presentations:** Students will present on selected topics, such as food label interpretation, to enhance their oral communication skills.
- **Case Studies:** Real-world scenarios involving nutritional assessments and food analysis.

### 2.4 Assessment/Assignments

- **Written Assignments:** Essays and reports on topics such as methods of nutritional assessments and food analysis techniques.
- **Lab Reports:** Detailed documentation of laboratory exercises, including the methods and results of food analysis.
- **Oral Presentations:** Students will give presentations on the interpretation of food labels, demonstrating their understanding and ability to communicate nutritional information.
- **Quizzes and Exams:** Assessing knowledge on the methods of nutritional assessments, food analysis techniques, and food labeling regulations.
- **Group Projects:** Collaborative projects with both written and oral components, evaluating the nutrient content of food samples.

### 2.5 References

- i. **Textbooks:**
  - a. Whitney, E., & Rolfes, S. R. (2021). *Understanding Nutrition* (16th ed.). Cengage Learning.
  - b. Nielsen, S. S. (2017). *Food Analysis* (5th ed.). Springer.
  - c. Mahan, L. K., Raymond, J. L., & Krause, M. V. (2020). *Krause's Food & the Nutrition Care Process* (15th ed.). Saunders.
- ii. **Journals and Articles:**
  - a. Journal of the Academy of Nutrition and Dietetics
  - b. Food Chemistry
  - c. American Journal of Clinical Nutrition
- iii. **Online Resources:**
  - a. World Health Organization (WHO) - Nutritional Assessment Guidelines

	<p>b. Food and Drug Administration (FDA) - Nutrition Labeling and Education Act.</p> <p>c. USDA National Nutrient Database.</p>
<p><b>Week 3</b></p>	<p><b>3.0 VITAMINS: FAT SOLUBLE VITAMINS</b></p> <p><b>3.1 Learning Outcomes</b></p> <ol style="list-style-type: none"> <li>i. Describe the dietary sources, recommended dietary allowances (RDAs), digestion, absorption, transport, and metabolism of fat-soluble vitamins (A, D, E, K).</li> <li>ii. Explain the biochemical mechanisms and physiological roles of fat-soluble vitamins, particularly their involvement in vision, bone health, antioxidant defense, and blood clotting.</li> <li>iii. Analyze the clinical manifestations and consequences of deficiencies and hypervitaminosis of fat-soluble vitamins.</li> <li>iv. Discuss the role of Vitamin D in calcium and phosphorus homeostasis and its implications for bone health.</li> <li>v. Develop and present an oral report on a selected topic related to fat-soluble vitamins, demonstrating proficiency in oral communication and critical analysis.</li> </ol> <p><b>3.2 Content</b></p> <p><b>Vitamin A:</b></p> <ul style="list-style-type: none"> <li>• Dietary sources; RDAs</li> <li>• Digestion, absorption, and transport</li> <li>• Mechanism of action in phototransduction</li> <li>• Deficiency and night blindness</li> <li>• Hypervitaminosis</li> </ul> <p><b>Calcitriol (Vitamin D):</b></p> <ul style="list-style-type: none"> <li>• Dietary sources; RDAs</li> <li>• Synthesis from the skin</li> <li>• Absorption and transport</li> <li>• Role in calcium and phosphorus homeostasis</li> <li>• Deficiency: Rickets and osteomalacia</li> <li>• Hypervitaminosis</li> </ul> <p><b>Vitamin E:</b></p> <ul style="list-style-type: none"> <li>• Dietary sources; RDAs</li> <li>• Metabolism</li> <li>• Antioxidant role</li> <li>• Deficiency</li> </ul> <p><b>Vitamin K:</b></p> <ul style="list-style-type: none"> <li>• Dietary sources; RDAs</li> <li>• Digestion, absorption, and transport</li> <li>• Activation of clotting factors</li> <li>• Vitamin K cycle</li> <li>• Mechanism of action in blood clotting factor activation</li> <li>• Vitamin K antagonists: Warfarin and Dicumarol</li> <li>• Mechanism of action in mitochondria</li> <li>• Deficiency</li> <li>• Hypervitaminosis</li> </ul>

### 3.3 Learning Activities/Opportunities

- **Lectures and Discussions:** Interactive lectures covering the key topics, with opportunities for student participation and Q&A sessions.
- **Case Studies:** Analysis of clinical cases involving vitamin deficiencies and hypervitaminosis to apply theoretical knowledge to real-world scenarios.
- **Group Presentations:** Students work in groups to research, prepare, and present on specific topics related to fat-soluble vitamins, enhancing their collaborative and oral communication skills.
- **Laboratory Sessions:** Practical sessions to examine the biochemical and physiological effects of fat-soluble vitamins.
- **Debates:** Structured debates on controversial topics, such as the use of vitamin supplements and the risks of hypervitaminosis, to develop critical thinking and oral argumentation skills.

### 3.4 Assessment/Assignments

- **Quizzes and Exams:** Written assessments to evaluate understanding of key concepts, mechanisms, and clinical implications.
- **Oral Presentations:** Individual or group presentations on selected topics, assessed on content, clarity, and delivery.
- **Case Study Analysis:** Written reports and discussions based on clinical case studies, focusing on diagnosis and treatment of vitamin-related conditions.
- **Participation:** Active participation in discussions, debates, and group activities, contributing to the overall learning experience.
- **Lab Reports:** Documentation and analysis of laboratory findings related to the study of fat-soluble vitamins.

### 3.5 References

- Textbooks:**
  - a. "Modern Nutrition in Health and Disease" by A. Catherine Ross, Benjamin Caballero, Robert J. Cousins, Katherine L. Tucker, Thomas R. Ziegler.
  - b. "Nutritional Biochemistry" by Tom Brody.
- Journal Articles:**
  - a. "The role of vitamin D in health and disease" by Holick MF, in the New England Journal of Medicine.
  - b. "Vitamin E in human health and disease" by Traber MG, Stevens JF, in the Journal of Lipid Research.
- Websites:**
  - a. National Institutes of Health (NIH) Office of Dietary Supplements: <https://ods.od.nih.gov/>
  - b. World Health Organization (WHO) Nutrition: <https://www.who.int/nutrition/>
- Review Papers:**
  - a. "Vitamin A and vision" by Blomhoff R, Blomhoff HK, in Physiological Reviews.
  - b. "Vitamin K metabolism and vitamin K-dependent proteins" by Shearer MJ, Newman P, in Thrombosis and Haemostasis.

<p><b>Week 4</b></p>	<p><b>4.0 VITAMINS: WATER SOLUBLE VITAMINS</b></p> <p><b>4.1 Learning Outcomes</b></p> <ol style="list-style-type: none"> <li>i. Demonstrate a comprehensive understanding of the dietary sources, RDAs, and biochemical functions of water-soluble vitamins (Vitamin C and B complex).</li> <li>ii. Explain the processes of digestion, absorption, and transport of Vitamin C and B complex vitamins in the human body.</li> <li>iii. Critically evaluate the clinical manifestations and health implications of deficiencies in water-soluble vitamins.</li> <li>iv. Effectively articulate and discuss the metabolic pathways and enzyme interactions involving water-soluble vitamins in an oral presentation.</li> <li>v. Analyze and synthesize current research on the therapeutic roles and dietary recommendations of water-soluble vitamins.</li> </ol> <p><b>4.2 Content</b></p> <p><b>Vitamins: Water Soluble Vitamins</b></p> <p><b>a. Vitamin C:</b></p> <ul style="list-style-type: none"> <li>• Dietary sources; Recommended Daily Allowances (RDAs)</li> <li>• Digestion, absorption, and transport</li> <li>• Biochemical functions: <ul style="list-style-type: none"> <li>○ Enzyme activation</li> <li>○ Reduction of iron</li> <li>○ Iron mobilization</li> <li>○ Carnitine synthesis</li> <li>○ Hydroxylation reactions</li> </ul> </li> <li>• Deficiency: Scurvy</li> </ul> <p><b>b. Vitamin B1: Thiamine</b></p> <ul style="list-style-type: none"> <li>• Dietary sources; RDAs</li> <li>• Absorption and transport</li> <li>• Biochemical functions</li> <li>• Deficiency: <ul style="list-style-type: none"> <li>○ Dry, wet, and infantile beriberi</li> <li>○ Wernicke-Korsakoff syndrome</li> </ul> </li> </ul> <p><b>c. Vitamin B2: Riboflavin</b></p> <ul style="list-style-type: none"> <li>• Dietary sources; RDAs</li> <li>• Flavoproteins and metabolism pathways</li> <li>• Deficiency: Glossitis</li> </ul> <p><b>d. Vitamin B3: Niacin</b></p> <ul style="list-style-type: none"> <li>• Dietary sources; RDAs</li> <li>• Formation of NAD<sup>+</sup>, NADH, NADP<sup>+</sup>, NADPH</li> <li>• Biochemical functions</li> <li>• Deficiency: <ul style="list-style-type: none"> <li>○ Causes</li> <li>○ Pellagra</li> </ul> </li> </ul> <p><b>e. Vitamin B5: Pantothenic Acid</b></p> <ul style="list-style-type: none"> <li>• Dietary sources; RDAs</li> </ul>

- Metabolism
- Biochemical functions: Acetyl CoA
- Deficiency: Burning foot syndrome

**f. Vitamin B6: Pyridoxine**

- Dietary sources; RDAs
- Metabolism
- Biochemical functions: PLP
- Deficiency:
  - Causes
  - Clinical manifestations: Neurological, dermatological, and hematological

**g. Vitamin B7: Biotin**

- Dietary sources; RDAs
- Forms
- Metabolism
- Biochemical functions
- Deficiency: Causes

**h. Vitamin B9: Folic Acid**

- Dietary sources; RDAs
- Absorption and metabolism
- Biochemical functions: One-carbon metabolism, methionine synthesis
- Deficiency:
  - Causes
  - Clinical manifestations: Hyperhomocysteinemia, neural tube defects, macrocytic anemia
- Therapeutic role of folic acid analogues

**i. Vitamin B12: Cobalamin**

- Dietary sources; RDAs
- Absorption
- Biochemical functions: Methylcobalamin, deoxyadenosylcobalamin
- Deficiency:
  - Causes
  - Clinical manifestations: Hyperhomocysteinemia, folate trap, megaloblastic anemia, demyelination of neurons

**4.3 Learning Activities/Opportunities**

- **Lectures and Discussions:** Interactive sessions to introduce and discuss the functions, sources, and deficiencies of water-soluble vitamins.
- **Group Presentations:** Students will prepare and deliver oral presentations on assigned topics related to the biochemical functions and clinical significance of specific vitamins.
- **Case Studies:** Analyze real-life scenarios involving vitamin deficiencies and their clinical presentations to enhance critical thinking and application skills.
- **Debates:** Engage in debates on the therapeutic roles and dietary recommendations of water-soluble vitamins to develop persuasive communication skills.
- **Research Projects:** Conduct research on current developments in vitamin studies and present findings orally to the class.



	<p><b>4.4 Assessment/Assignments</b></p> <ul style="list-style-type: none"> <li>• <b>Oral Presentations (30%):</b> Students will be assessed on their ability to present information clearly and accurately on the biochemical functions and deficiencies of assigned vitamins.</li> <li>• <b>Written Exams (30%):</b> Evaluate understanding of the digestion, absorption, transport, and biochemical roles of water-soluble vitamins through multiple-choice and short-answer questions.</li> <li>• <b>Case Study Analysis (20%):</b> Written and oral analysis of clinical cases related to vitamin deficiencies, demonstrating application of knowledge to practical scenarios.</li> <li>• <b>Research Paper (20%):</b> Students will write a research paper on a current topic related to water-soluble vitamins, followed by an oral defense of their findings.</li> </ul> <p><b>4.5 References</b></p> <ol style="list-style-type: none"> <li>i. <b>"Advanced Nutrition and Human Metabolism" by Sareen S. Gropper and Jack L. Smith</b> - This textbook provides detailed information on the biochemical functions and metabolism of vitamins.</li> <li>ii. <b>"Vitamins: Their Role in the Human Body" by Peter J. F. Butterworth and John Nicholson</b> - A comprehensive guide to understanding the roles and mechanisms of vitamins.</li> <li>iii. <b>"Modern Nutrition in Health and Disease" by A. Catharine Ross <i>et al.</i></b> - An in-depth resource covering the clinical aspects and health implications of vitamin deficiencies.</li> <li>iv. <b>"Clinical Nutrition" by Michael J. Gibney <i>et al.</i></b> - Offers insights into the practical applications and clinical case studies of vitamin deficiencies.</li> <li>v. <b>Peer-reviewed journals:</b> Students will be directed to use databases like PubMed for the latest research articles on water-soluble vitamins and their health impacts.</li> </ol>
<p><b>Week 5</b></p>	<p><b>5.0 PROTEINS &amp; AMINO ACIDS METABOLISM AS WELL AS ASSOCIATED DISORDERS</b></p> <p><b>5.1 Learning Outcomes</b></p> <ol style="list-style-type: none"> <li>i. Demonstrate an in-depth understanding of the processes involved in protein digestion and amino acid absorption.</li> <li>ii. Analyze the metabolic pathways of amino acids and identify key regulatory mechanisms.</li> <li>iii. Evaluate the mechanisms and implications of amino acid toxicity in the human body.</li> <li>iv. Discuss various disorders of amino acid metabolism and propose potential diagnostic and therapeutic approaches.</li> <li>v. Develop and deliver oral presentations on specific disorders of amino acid metabolism, demonstrating effective communication and critical thinking skills (Oral Intensive).</li> </ol> <p><b>5.2 Content</b></p> <ol style="list-style-type: none"> <li>1. <b>Digestion of Proteins</b> <ul style="list-style-type: none"> <li>○ Enzymatic breakdown of dietary proteins</li> <li>○ Role of stomach and pancreatic enzymes</li> </ul> </li> </ol>

- Protein digestion products
- 2. **Absorption of Amino Acids**
  - Transport mechanisms in the small intestine
  - Absorption efficiency and factors affecting absorption
- 3. **Overview of Amino Acid Metabolism**
  - General pathways of amino acid catabolism and anabolism
  - Role of the liver in amino acid metabolism
  - Key metabolic intermediates
- 4. **Mechanisms of Amino Acid Toxicity**
  - Causes and biochemical mechanisms of toxicity
  - Clinical manifestations and effects on organ systems
- 5. **Disorders of Amino Acid Metabolism**
  - Phenylketonuria (PKU)
  - Gout
  - Lesch-Nyhan Syndrome
  - Homocystinuria
  - Tyrosinemia
  - Hartnup Disease
  - Alkaptonuria
  - Maple Syrup Urine Disease
- 6. **Metabolic Disturbances of Proteins**
  - Protein-Energy Malnutrition: Kwashiorkor
  - Protein-Energy Malnutrition: Marasmus
  - Amyloidosis

### 5.3 Learning Activities/Opportunities

1. **Lectures and Discussions**
  - Interactive lectures on protein digestion, absorption, and metabolism.
  - Group discussions on case studies of amino acid metabolism disorders.
2. **Laboratory Sessions**
  - Practical experiments on protein digestion and amino acid absorption.
  - Simulated clinical diagnostics for metabolic disorders.
3. **Oral Presentations**
  - Students will research and present on specific disorders of amino acid metabolism, focusing on biochemical mechanisms and clinical management.
4. **Problem-Based Learning (PBL)**
  - Case-based learning activities where students solve clinical cases related to amino acid metabolism disorders.
5. **Guest Lectures**
  - Invited experts will provide insights into current research and clinical practices related to amino acid metabolism.

### 5.4 Assessment/Assignments

1. **Written Examinations**
  - Mid-term and final exams covering all course content.
2. **Laboratory Reports**

	<ul style="list-style-type: none"> <li>○ Detailed reports on lab experiments, including data analysis and interpretation.</li> </ul> <p><b>3. Oral Presentations</b></p> <ul style="list-style-type: none"> <li>○ Assessment based on clarity, depth of content, and ability to answer questions.</li> </ul> <p><b>4. Case Study Analysis</b></p> <ul style="list-style-type: none"> <li>○ Written assignments analyzing specific metabolic disorders, including proposed diagnostic and therapeutic approaches.</li> </ul> <p><b>5. Participation and Attendance</b></p> <ul style="list-style-type: none"> <li>○ Active participation in discussions, labs, and presentations.</li> </ul> <p><b>5.5 References</b></p> <ul style="list-style-type: none"> <li>i. <b>Textbooks</b> <ul style="list-style-type: none"> <li>a. Berg, J. M., Tymoczko, J. L., &amp; Stryer, L. (2015). <i>Biochemistry</i>. W.H. Freeman.</li> <li>b. Devlin, T. M. (2010). <i>Textbook of Biochemistry with Clinical Correlations</i>. Wiley.</li> </ul> </li> <li>ii. <b>Journal Articles</b> <ul style="list-style-type: none"> <li>a. Wolfe, R. R. (2006). The underappreciated role of muscle in health and disease. <i>The American Journal of Clinical Nutrition</i>, 84(3), 475-482.</li> <li>b. Rosenberg, L. E. (2002). Genetic disorders of amino acid metabolism. <i>Annual Review of Biochemistry</i>, 71, 1-25.</li> </ul> </li> <li>iii. <b>Online Resources</b> <ul style="list-style-type: none"> <li>a. National Center for Biotechnology Information (NCBI) - <a href="http://www.ncbi.nlm.nih.gov">www.ncbi.nlm.nih.gov</a></li> <li>b. MedlinePlus - <a href="http://medlineplus.gov">medlineplus.gov</a></li> </ul> </li> <li>iv. <b>Clinical Guidelines</b> <ul style="list-style-type: none"> <li>a. American College of Medical Genetics and Genomics (ACMG) practice guidelines for the treatment of metabolic disorders.</li> </ul> </li> </ul>
<b>Week 6</b>	<p><b>6.0 MINERALS AND THEIR NUTRITIVE VALUE</b></p> <p><b>6.1 Learning Outcomes</b></p> <ul style="list-style-type: none"> <li>i. Understand the dietary sources, recommended dietary allowances (RDAs), and absorption mechanisms of key trace and major minerals.</li> <li>ii. Explain the biochemical functions of iron, zinc, iodine, selenium, fluoride, chromium, manganese, calcium, phosphorous, magnesium, sodium, potassium, and chloride.</li> <li>iii. Identify the causes, clinical consequences, and diseases associated with deficiencies and toxicities of these minerals.</li> <li>iv. Develop skills to critically analyze and discuss mineral-related health issues orally.</li> <li>v. Conduct and present research on mineral metabolism and its impact on human health, demonstrating effective oral communication skills.</li> </ul> <p><b>6.2 Content</b></p> <p><b>Trace Elements (Minor Minerals)</b></p> <ul style="list-style-type: none"> <li>1. <b>Iron</b></li> </ul>

	<ul style="list-style-type: none"> <li>○ Dietary Sources and RDAs</li> <li>○ Absorption of Iron</li> <li>○ Biochemical Functions of Iron</li> <li>○ Causes of Iron Deficiency</li> <li>○ Clinical Consequences of Iron Deficiency</li> <li>○ Diseases Associated with Iron Toxicity (Overload)</li> </ul> <p>2. <b>Zinc</b></p> <ul style="list-style-type: none"> <li>○ Dietary Sources and RDAs</li> <li>○ Absorption of Zinc</li> <li>○ Biochemical Functions of Zinc</li> <li>○ Causes of Zinc Deficiency</li> <li>○ Clinical Consequences of Zinc Deficiency</li> <li>○ Diseases Associated with Zinc Toxicity (Overload)</li> </ul> <p>3. <b>Iodine</b></p> <ul style="list-style-type: none"> <li>○ Dietary Sources and RDAs</li> <li>○ Absorption of Iodine</li> <li>○ Biochemical Functions of Iodine</li> <li>○ Causes of Iodine Deficiency</li> <li>○ Clinical Consequences of Iodine Deficiency</li> <li>○ Diseases Associated with Iodine Toxicity (Overload)</li> </ul> <p>4. <b>Selenium</b></p> <ul style="list-style-type: none"> <li>○ Dietary Sources and RDAs</li> <li>○ Absorption of Selenium</li> <li>○ Biochemical Functions of Selenium</li> <li>○ Causes of Selenium Deficiency</li> <li>○ Clinical Consequences of Selenium Deficiency</li> <li>○ Diseases Associated with Selenium Toxicity (Overload)</li> </ul> <p>5. <b>Fluoride</b></p> <ul style="list-style-type: none"> <li>○ Dietary Sources and RDAs</li> <li>○ Absorption of Fluoride</li> <li>○ Biochemical Functions of Fluoride</li> <li>○ Causes of Fluoride Deficiency</li> <li>○ Clinical Consequences of Fluoride Deficiency</li> <li>○ Diseases Associated with Fluoride Toxicity (Overload)</li> </ul> <p>6. <b>Chromium</b></p> <ul style="list-style-type: none"> <li>○ Dietary Sources and RDAs</li> <li>○ Absorption of Chromium</li> <li>○ Biochemical Functions of Chromium</li> <li>○ Causes of Chromium Deficiency</li> <li>○ Clinical Consequences of Chromium Deficiency</li> <li>○ Diseases Associated with Chromium Toxicity (Overload)</li> </ul> <p>7. <b>Manganese</b></p> <ul style="list-style-type: none"> <li>○ Dietary Sources and RDAs</li> <li>○ Absorption of Manganese</li> <li>○ Biochemical Functions of Manganese</li> </ul>
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- Causes of Manganese Deficiency
- Clinical Consequences of Manganese Deficiency
- Diseases Associated with Manganese Toxicity (Overload)

**Major Minerals**

**1. Calcium**

- Dietary Sources and RDAs
- Absorption of Calcium
- Biochemical Functions of Calcium
- Causes of Calcium Deficiency
- Clinical Consequences of Calcium Deficiency
- Diseases Associated with Calcium Toxicity (Overload)

**2. Phosphorous**

- Dietary Sources and RDAs
- Absorption of Phosphorous
- Biochemical Functions of Phosphorous
- Causes of Phosphorous Deficiency
- Clinical Consequences of Phosphorous Deficiency
- Diseases Associated with Phosphorous Toxicity (Overload)

**3. Magnesium**

- Dietary Sources and RDAs
- Absorption of Magnesium
- Biochemical Functions of Magnesium
- Causes of Magnesium Deficiency
- Clinical Consequences of Magnesium Deficiency
- Diseases Associated with Magnesium Toxicity (Overload)

**4. Sodium**

- Dietary Sources and RDAs
- Absorption of Sodium
- Biochemical Functions of Sodium
- Causes of Sodium Deficiency
- Clinical Consequences of Sodium Deficiency
- Diseases Associated with Sodium Toxicity (Overload)

**5. Potassium**

- Dietary Sources and RDAs
- Absorption of Potassium
- Biochemical Functions of Potassium
- Causes of Potassium Deficiency
- Clinical Consequences of Potassium Deficiency
- Diseases Associated with Potassium Toxicity (Overload)

**6. Chloride**

- Dietary Sources and RDAs
- Absorption of Chloride
- Biochemical Functions of Chloride

	<ul style="list-style-type: none"> <li>○ Causes of Chloride Deficiency</li> <li>○ Clinical Consequences of Chloride Deficiency</li> <li>○ Diseases Associated with Chloride Toxicity (Overload)</li> </ul> <p><b>6.3 Learning Activities/Opportunities</b></p> <ul style="list-style-type: none"> <li>• <b>Lectures:</b> Comprehensive lectures on each mineral, including dietary sources, absorption, biochemical functions, deficiencies, toxicities, and related diseases.</li> <li>• <b>Group Discussions:</b> Weekly group discussions to analyze case studies on mineral deficiencies and toxicities.</li> <li>• <b>Oral Presentations:</b> Students will prepare and deliver oral presentations on assigned minerals, focusing on their importance in human health.</li> <li>• <b>Debates:</b> Structured debates on controversial topics related to mineral supplementation and public health policies.</li> <li>• <b>Laboratory Work:</b> Practical sessions to measure mineral content in various food samples and understand their bioavailability.</li> </ul> <p><b>6.4 Assessment/Assignments</b></p> <ul style="list-style-type: none"> <li>• <b>Quizzes:</b> Regular quizzes to test understanding of the dietary sources, absorption, and functions of minerals.</li> <li>• <b>Oral Presentations:</b> Students will be assessed on their oral presentations regarding a specific mineral’s health impacts.</li> <li>• <b>Research Paper:</b> A research paper on a chosen mineral-related health issue, including causes, consequences, and potential interventions.</li> <li>• <b>Participation:</b> Active participation in group discussions and debates.</li> <li>• <b>Final Exam:</b> A comprehensive exam covering all course content.</li> </ul> <p><b>6.5 References</b></p> <ol style="list-style-type: none"> <li>i. Gropper, S. S., Smith, J. L., &amp; Carr, T. P. (2017). <b>Advanced Nutrition and Human Metabolism</b>. Cengage Learning.</li> <li>ii. Ross, A. C., Caballero, B. H., Cousins, R. J., Tucker, K. L., &amp; Ziegler, T. R. (2014). <b>Modern Nutrition in Health and Disease</b>. Lippincott Williams &amp; Wilkins.</li> <li>iii. <b>National Institutes of Health (NIH) Office of Dietary Supplements</b>. (n.d.). <i>Mineral Supplements</i>. Retrieved from <a href="#">NIH ODS</a></li> <li>iv. <b>Food and Agriculture Organization (FAO)</b>. (2011). <i>Dietary Assessment: A Resource Guide to Method Selection and Application in Low Resource Settings</i>. Retrieved from <a href="#">FAO</a></li> <li>v. <b>Murray, M. T., &amp; Pizzorno, J. E.</b> (2012). <i>Textbook of Natural Medicine</i>. Elsevier Health Sciences.</li> <li>vi. <b>Institute of Medicine</b>. (2001). <i>Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride</i>. National Academies Press.</li> <li>vii. <b>World Health Organization (WHO)</b>. (2004). <i>Vitamin and Mineral Requirements in Human Nutrition</i>. Retrieved from <a href="#">WHO</a></li> </ol>
<b>Week 7</b>	<b>MID-SEMESTER EXAMINATION</b>
<b>Week 8 (A)</b>	<b>8.0 DISORDERS OF CARBOHYDRATE METABOLISM</b>

## 8.1 Learning Outcomes

- i. Understand and explain the processes of digestion and absorption of carbohydrates.
- ii. Describe the metabolic pathways of fructose and their implications for health, particularly obesity.
- iii. Discuss the sorbitol pathway and its role in the pathogenesis of Diabetes Mellitus.
- iv. Identify and explain the disorders associated with galactose and fructose metabolism, including hereditary fructose intolerance and galactosemia.
- v. Develop and deliver an oral presentation explaining the biochemical mechanisms underlying lactose intolerance, hypoglycemia, and hyperglycemia, emphasizing clarity and audience engagement.

## 8.2 Content

1. **Digestion & Absorption of Carbohydrates**
  - Overview of carbohydrate digestion
  - Enzymes involved in carbohydrate digestion
  - Absorption mechanisms in the small intestine
2. **Fructose Metabolism: Absorption, Fructolysis, Regulation, and Role in Obesity**
  - Absorption of fructose
  - Fructolysis pathway
  - Regulation of fructose metabolism
  - Role of fructose in obesity
3. **Disorders of Fructose Metabolism**
  - Hereditary fructose intolerance
  - Essential fructosuria
4. **Sorbitol Pathway and Its Role in the Pathogenesis of Diabetes Mellitus**
  - Sorbitol pathway mechanisms
  - Role in diabetes complications
5. **Galactose Metabolism**
  - Overview of galactose metabolism
  - Enzymes involved in galactose metabolism
6. **Disorders of Galactose Metabolism**
  - Classical galactosemia
  - Non-classical galactosemia
7. **Lactose Intolerance**
  - Mechanisms and symptoms
  - Diagnosis and management
8. **Hypoglycemia**
  - Causes and symptoms
  - Biochemical mechanisms
  - Treatment and prevention
9. **Hyperglycemia**
  - Causes and symptoms

- Diabetic ketoacidosis
- Management and complications

### 8.3 Learning Activities/Opportunities

- **Lectures and Discussions:** In-depth exploration of each topic, with opportunities for questions and interactive discussions.
- **Case Studies:** Analysis of real-life cases related to disorders of carbohydrate metabolism to understand clinical implications.
- **Group Work:** Collaborative projects to research and present on specific topics, encouraging peer learning and teamwork.
- **Oral Presentations:** Each student will prepare and deliver an oral presentation on a selected topic, with a focus on clarity, organization, and engagement.
- **Problem-Solving Sessions:** Practical exercises and problem sets to apply theoretical knowledge to clinical and biochemical problems.

### 8.4 Assessment/Assignments

- **Written Exams:** Assessing understanding of the biochemical pathways, mechanisms, and disorders related to carbohydrate metabolism.
- **Oral Presentation:** Each student will give an in-depth presentation on a chosen topic, demonstrating their ability to communicate complex information effectively.
- **Case Study Reports:** Written reports on analyzed case studies, discussing the biochemical basis and clinical management of various metabolic disorders.
- **Participation and Engagement:** Active participation in discussions, group work, and problem-solving sessions.

### 8.5 References

- i. **Textbooks**
  - a. "Biochemistry" by Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer.
  - b. "Harper's Illustrated Biochemistry" by Victor W. Rodwell, David Bender, Kathleen M. Botham, *et al.*
- ii. **Journals and Articles**
  - a. "Metabolism of Fructose and Related Sugars" in *Annual Review of Nutrition*.
  - b. "The Sorbitol Pathway and Diabetes Complications" in *Journal of Clinical Investigation*.
  - c. "Galactosemia: Current Insights and Future Directions" in *Journal of Inherited Metabolic Disease*.
- iii. **Online Resources**
  - a. National Center for Biotechnology Information (NCBI) [ncbi.nlm.nih.gov](http://ncbi.nlm.nih.gov)
  - b. PubMed for peer-reviewed articles on carbohydrate metabolism and related disorders.
- iv. **Clinical Guidelines**
  - a. American Diabetes Association (ADA) guidelines on the management of diabetes and its complications.



	<p>b. European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines on nutrition and metabolic disorders.</p>
<p><b>Week 8 (B)</b></p>	<p><b>8.0 DISORDERS OF LIPID METABOLISM</b></p> <p><b>8.1 Learning Outcomes</b></p> <ol style="list-style-type: none"> <li>i. <b>Understand the digestion and absorption of lipids:</b> Students will be able to explain the processes and mechanisms involved in the digestion and absorption of lipids in the human body.</li> <li>ii. <b>Describe the transport mechanisms of lipids:</b> Students will identify and describe the roles of chylomicrons, VLDL, LDL, IDL, and HDL in lipid transport.</li> <li>iii. <b>Analyze beta-oxidation of fatty acids:</b> Students will compare and contrast the beta-oxidation pathways of even and odd-chain fatty acids.</li> <li>iv. <b>Evaluate endogenous fatty acid synthesis:</b> Students will understand the biochemical pathways and regulatory mechanisms involved in the synthesis of fatty acids within the body.</li> <li>v. <b>Effectively communicate biochemical concepts orally:</b> Students will demonstrate the ability to present and discuss topics related to lipid metabolism orally, emphasizing clarity, coherence, and depth of knowledge.</li> </ol> <p><b>8.2 Content</b></p> <ol style="list-style-type: none"> <li>1. <b>Digestion &amp; Absorption of Lipids</b> <ul style="list-style-type: none"> <li>○ Overview of lipid digestion</li> <li>○ Enzymes involved in lipid digestion (lipases)</li> <li>○ Absorption mechanisms in the intestine</li> <li>○ Role of bile salts in lipid emulsification</li> </ul> </li> <li>2. <b>Transport of Lipids</b> <ul style="list-style-type: none"> <li>○ Structure and function of chylomicrons</li> <li>○ Roles of VLDL, LDL, IDL, and HDL in lipid transport</li> <li>○ Lipid transport pathways and mechanisms</li> </ul> </li> <li>3. <b>Beta Oxidation of Fatty Acids</b> <ul style="list-style-type: none"> <li>○ Beta-oxidation process of even-chain fatty acids</li> <li>○ Differences in beta-oxidation of odd-chain fatty acids</li> <li>○ Energy yield from beta-oxidation</li> </ul> </li> <li>4. <b>Endogenous Fatty Acid Synthesis</b> <ul style="list-style-type: none"> <li>○ Biochemical pathways of fatty acid synthesis</li> <li>○ Regulatory mechanisms and key enzymes (e.g., acetyl-CoA carboxylase, fatty acid synthase)</li> <li>○ Role of insulin and other hormones in fatty acid synthesis</li> </ul> </li> <li>5. <b>Inborn Errors of Lipid Metabolism</b> <ul style="list-style-type: none"> <li>○ Disorders of fatty acid oxidation (e.g., Medium-chain acyl-CoA dehydrogenase deficiency)</li> <li>○ Lipid storage diseases (e.g., Gaucher disease, Tay-Sachs disease)</li> <li>○ Disorders associated with lipoprotein metabolism (e.g., hyperlipoproteinemias, hypertriglyceridemia, hypolipoproteinemias)</li> </ul> </li> </ol>

- Hycholesterolemia
- Ketoacidosis
- Non-alcoholic fatty liver

### 8.3 Learning Activities/Opportunities

1. **Lectures and Interactive Discussions:** Instructor-led sessions to introduce and explain key concepts in lipid metabolism.
2. **Group Presentations:** Students will work in groups to research and present on specific topics related to lipid metabolism, focusing on clear and effective oral communication.
3. **Case Study Analyses:** Examination of clinical cases related to inborn errors of lipid metabolism, fostering application of theoretical knowledge.
4. **Laboratory Sessions:** Practical experiments to illustrate lipid digestion, absorption, and analysis of lipoproteins.
5. **Peer Teaching:** Students will prepare and teach a topic to their peers, promoting mastery through teaching and enhancing oral communication skills.

### 8.4 Assessment/Assignments

1. **Oral Presentations (30%):** Students will give individual or group presentations on assigned topics, assessed on content, clarity, and communication skills.
2. **Written Exams (30%):** Midterm and final exams testing understanding of lipid metabolism concepts and mechanisms.
3. **Case Study Reports (20%):** Written reports on analyzed clinical cases related to inborn errors of lipid metabolism.
4. **Laboratory Reports (10%):** Detailed reports on findings from laboratory sessions, including experimental procedures and results.
5. **Participation and Peer Teaching (10%):** Assessment of participation in discussions, group activities, and effectiveness in peer teaching sessions.

### 8.5 References

- i. **Textbooks:**
  - a. Voet, D., Voet, J.G., & Pratt, C.W. (2016). *Fundamentals of Biochemistry: Life at the Molecular Level*. Wiley.
  - b. Berg, J.M., Tymoczko, J.L., & Stryer, L. (2015). *Biochemistry*. W.H. Freeman.
- ii. **Journal Articles:**
  - a. Brown, M.S., & Goldstein, J.L. (2009). "Cholesterol feedback: from Schoenheimer's bottle to Scap's MELADL." *Journal of Lipid Research*, 50(Suppl), S15-S27.
  - b. Watt, M.J., & Hoy, A.J. (2012). "Lipid metabolism in skeletal muscle: generation of adaptive and maladaptive intracellular signals for cellular function." *American Journal of Physiology-Endocrinology and Metabolism*, 302(11), E1315-E1328.
- iii. **Online Resources:**
  - a. National Center for Biotechnology Information (NCBI): [www.ncbi.nlm.nih.gov](http://www.ncbi.nlm.nih.gov)
  - b. Khan Academy: Lipid Metabolism [www.khanacademy.org](http://www.khanacademy.org)
- iv. **Laboratory Manuals:**

	<p>a. Plummer, D.T. (1987). <i>An Introduction to Practical Biochemistry</i>. McGraw-Hill.</p> <p>v. <b>Clinical Guidelines:</b></p> <p>a. National Institutes of Health (NIH) guidelines on lipid metabolism disorders: <a href="http://www.nih.gov">www.nih.gov</a></p>
<p><b>Week 9</b></p>	<p><b>9.0 BROWNING REACTIONS</b></p> <p><b>9.1 Learning Outcomes</b></p> <ol style="list-style-type: none"> <li>i. Demonstrate understanding of the properties and mechanisms of enzymatic and nonenzymatic browning in foods.</li> <li>ii. Analyze the factors affecting the Maillard reaction and propose methods for controlling it in various food products.</li> <li>iii. Explain the caramelization process, particularly in sucrose, and its implications for food quality and flavor.</li> <li>iv. Investigate the pathways and control methods for ascorbic acid browning and lipid browning in food systems.</li> <li>v. Develop and present a comprehensive oral report on a selected topic related to enzymatic or nonenzymatic browning, showcasing clear communication and critical thinking skills.</li> </ol> <p><b>9.2 Content</b></p> <ol style="list-style-type: none"> <li>1. <b>Enzymatic Browning</b> <ul style="list-style-type: none"> <li>○ Properties of Polyphenol Oxidase (PPO)</li> <li>○ Mechanisms of Enzymatic Browning</li> <li>○ Substrates for PPO</li> <li>○ Control of Browning</li> </ul> </li> <li>2. <b>Nonenzymatic Browning</b> <ul style="list-style-type: none"> <li>○ <b>The Maillard Reaction</b> <ul style="list-style-type: none"> <li>▪ Major phases: early, intermediate, and advanced stages</li> <li>▪ Factors Affecting the Maillard Reaction</li> <li>▪ Study of the Maillard Reaction in Foods</li> <li>▪ Control of the Maillard Reaction in Foods</li> </ul> </li> <li>○ <b>Caramelization</b> <ul style="list-style-type: none"> <li>▪ Caramelization process</li> <li>▪ Caramelization process of SUCROSE</li> </ul> </li> <li>○ <b>Ascorbic Acid Browning</b> <ul style="list-style-type: none"> <li>▪ Pathway of Ascorbic Acid Browning</li> <li>▪ Control of Ascorbic Acid Browning</li> </ul> </li> <li>○ <b>Lipid Browning</b> <ul style="list-style-type: none"> <li>▪ Protein-Oxidized Fatty Acid Reactions</li> <li>▪ Nonenzymatic Browning of Aminophospholipids</li> </ul> </li> </ul> </li> </ol> <p><b>9.3 Learning Activities/Opportunities</b></p> <ul style="list-style-type: none"> <li>• <b>Lectures and Discussions:</b> Covering the principles and mechanisms of enzymatic and nonenzymatic browning.</li> </ul>

	<ul style="list-style-type: none"> <li>• <b>Lab Experiments:</b> Conduct experiments to observe and analyze browning reactions in different food matrices.</li> <li>• <b>Group Projects:</b> Collaboratively explore a specific browning reaction and present findings.</li> <li>• <b>Oral Presentations:</b> Students will select a topic related to enzymatic or nonenzymatic browning, conduct research, and present their findings to the class.</li> <li>• <b>Case Studies:</b> Analyze real-world examples of browning in food products and discuss control methods.</li> </ul> <p><b>9.4 Assessment/Assignments</b></p> <ul style="list-style-type: none"> <li>• <b>Quizzes and Exams:</b> Assess understanding of theoretical knowledge on browning reactions.</li> <li>• <b>Lab Reports:</b> Document and analyze the results of experiments conducted on browning reactions.</li> <li>• <b>Group Project Report:</b> A comprehensive report on the group's findings from their project.</li> <li>• <b>Oral Presentation:</b> Evaluate the clarity, depth, and effectiveness of the student's presentation on a selected browning topic.</li> <li>• <b>Class Participation:</b> Engage in discussions and activities during lectures and labs.</li> </ul> <p><b>9.5 References</b></p> <ol style="list-style-type: none"> <li>i. Lee, J. H., &amp; Whitaker, J. R. (1995). "Enzymatic Browning and Its Prevention." ACS Symposium Series.</li> <li>ii. Martins, S. I. F. S., Jongen, W. M. F., &amp; van Boekel, M. A. J. S. (2001). "A review of Maillard reaction in food and implications to kinetic modelling." Trends in Food Science &amp; Technology, 11(9-10), 364-373.</li> <li>iii. Ledl, F., &amp; Schleicher, E. (1990). "New aspects of the Maillard reaction in foods and in the human body." Angewandte Chemie International Edition in English, 29(6), 565-594.</li> <li>iv. Hodge, J. E. (1953). "Dehydrated foods, chemistry of browning reactions in model systems." Journal of Agricultural and Food Chemistry, 1(15), 928-943.</li> <li>v. Wright, A. J., &amp; Hartel, R. W. (2020). "Caramelization and Caramel Products." In Handbook of Food Science and Technology 2 (pp. 463-490). Springer.</li> </ol>
<b>Week 10</b>	<p><b>10.0 FOOD SAFETY AND QUALITY: MANAGING NATURAL TOXICANTS, ADDITIVES, AND PRODUCTION PROCESSES</b></p> <p><b>10.1 Learning Outcomes</b></p> <ol style="list-style-type: none"> <li>i. Define and describe natural toxicants, their sources, biochemical mechanisms, and strategies for minimizing exposure.</li> <li>ii. Explain the principles and methods of quality control in food production and their importance in ensuring food safety and quality.</li> <li>iii. Identify and evaluate the roles, functions, benefits, risks, and regulatory aspects of food additives and preservatives.</li> <li>iv. Analyze the causes, types, prevention methods, and implications of food spoilage for food safety and public health.</li> </ol>

- v. Develop and deliver a comprehensive oral presentation on the strategies for maintaining the rheological properties and quality of food products, including changes in flavor and texture. (Oral Intensive)

### 10.2 Content

- **Natural Toxicants**
  - Definition and sources
  - Biochemical mechanisms
  - Strategies for minimizing exposure
- **Quality Control in Food Production**
  - Principles and methods
  - Importance for ensuring food safety and quality
- **Food Additives and Preservatives**
  - Role and functions
  - Benefits and risks
  - Regulatory aspects
- **Food Spoilage**
  - Causes and types
  - Prevention methods
  - Implications for food safety and public health
- **Rheological Properties and Changes in Flavor and Texture**
  - Measurement techniques
  - Factors influencing properties
  - Strategies for maintaining quality
- **Food Toxicants and Detoxification Mechanisms**
  - Sources and effects
  - Strategies for detoxifying food toxicants
- **Feed Formulation**
  - Principles and methods
  - Considerations for formulating animal feeds
  - Ensuring nutritional requirements and food safety

### 10.3 Learning Activities/Opportunities

- **Lectures and Discussions:** Interactive sessions covering each content area with opportunities for Q&A.
- **Case Studies:** Analysis and discussion of real-world examples related to food safety and quality.
- **Group Projects:** Collaborative work on topics such as food additives, spoilage prevention, and feed formulation.
- **Oral Presentations:** Students will prepare and deliver presentations on topics like rheological properties and strategies for maintaining food quality.
- **Laboratory Exercises:** Hands-on activities to measure rheological properties and investigate food spoilage mechanisms.

### 10.4 Assessment/Assignments

	<ul style="list-style-type: none"> <li>• <b>Quizzes and Tests:</b> Regular assessments to test understanding of key concepts and principles.</li> <li>• <b>Research Paper:</b> In-depth analysis of a specific topic related to food toxicants or quality control methods.</li> <li>• <b>Oral Presentation:</b> Comprehensive presentation on maintaining the rheological properties and quality of food products, including a Q&amp;A session.</li> <li>• <b>Group Project Report:</b> Written and oral report on a collaborative project related to food additives or feed formulation.</li> <li>• <b>Practical Lab Reports:</b> Documentation and analysis of laboratory exercises focusing on rheological properties and food spoilage.</li> </ul> <p><b>10.5 References</b></p> <ol style="list-style-type: none"> <li>i. Fennema, O. R., Damodaran, S., &amp; Parkin, K. L. (2007). <b>Fennema's Food Chemistry</b> (4th ed.). CRC Press.</li> <li>ii. Jay, J. M., Loessner, M. J., &amp; Golden, D. A. (2005). <b>Modern Food Microbiology</b> (7th ed.). Springer.</li> <li>iii. Coultate, T. P. (2016). <b>Food: The Chemistry of Its Components</b> (6th ed.). Royal Society of Chemistry.</li> <li>iv. Belitz, H.-D., Grosch, W., &amp; Schieberle, P. (2009). <b>Food Chemistry</b> (4th ed.). Springer.</li> <li>v. Shils, M. E., Shike, M., Ross, A. C., Caballero, B., &amp; Cousins, R. J. (2006). <b>Modern Nutrition in Health and Disease</b> (10th ed.). Lippincott Williams &amp; Wilkins</li> </ol>
<p><b>Week 11</b></p>	<p><b>11.0 FOOD PRESERVATION TECHNIQUES AND SAFETY STRATEGIES</b></p> <p><b>11.1 Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>i. Students will evaluate the importance of food processing, preservation, and storage methods in maintaining nutritional quality and safety in Kenya, engaging in oral intensive discussions.</li> <li>ii. Students will analyze the principles and techniques of physical methods for analyzing food constituents, presenting their findings orally to peers.</li> <li>iii. Students will assess the application of chemical methods for determining proximate composition, vitamins, minerals, and contaminants in foods through oral intensive communication.</li> <li>iv. Students will apply hands-on food analysis techniques, emphasizing oral intensive presentations to demonstrate proficiency in determining food constituents.</li> <li>v. Students will critically evaluate research literature and industry practices related to food processing and analysis in Kenya, presenting their findings orally to peers.</li> </ol> <p><b>11.2 Content:</b></p> <ol style="list-style-type: none"> <li>i. Food and Nutritional Policies and Programmes in Kenya: Overview, implementation, and evaluation of initiatives aimed at improving public health and nutrition.</li> <li>ii. Overview of Food Processing Techniques: Thermal processing, drying, fermentation, and irradiation, and their role in food preservation and safety.</li> </ol>

	<ul style="list-style-type: none"> <li>iii. Food Processing, Preservation, and Storage in Kenya: Techniques, challenges, and innovations in food processing, preservation, and storage to maintain nutritional quality and safety.</li> <li>iv. Importance of Food Preservation Methods: Strategies for maintaining nutritional quality and safety during processing and storage.</li> <li>v. Strategies for Safe and Efficient Food Storage: Techniques to prevent spoilage and foodborne illnesses in Kenya's context.</li> </ul> <p><b>11.3 Learning Activities/Opportunities:</b></p> <ul style="list-style-type: none"> <li>i. Oral intensive group discussions on the importance of food processing, preservation, and storage methods in Kenya's food system.</li> <li>ii. Debates on the effectiveness and sustainability of different food preservation techniques, emphasizing oral communication skills.</li> <li>iii. Hands-on exercises and demonstrations on physical and chemical methods for determining food constituents.</li> <li>iv. Interactive presentations and peer-led discussions on research findings and industry practices related to food processing and analysis in Kenya.</li> </ul> <p><b>11.4 Assessment/Assignments:</b></p> <ul style="list-style-type: none"> <li>i. Participation in oral intensive group discussions and debates on food processing, preservation, and storage methods (20%)</li> <li>ii. Individual or group presentations on specific food preservation techniques or food analysis methods, emphasizing oral communication (30%)</li> <li>iii. Demonstration of proficiency in hands-on food analysis techniques through oral intensive presentations (20%)</li> <li>iv. Written reflections on the implications of food processing and analysis techniques for food safety and nutrition in Kenya (30%)</li> </ul> <p><b>11.5 References:</b></p> <ul style="list-style-type: none"> <li>i. Fellows, P. (2016). Food processing technology: Principles and practice (4th ed.). Woodhead Publishing.</li> <li>ii. Nielsen, S. S. (2010). Food analysis (4th ed.). Springer.</li> <li>iii. Smith, J. L., &amp; Hui, Y. H. (Eds.). (2012). Food processing: Principles and applications. Wiley-Blackwell.</li> <li>iv. The Royal Society of Chemistry. (2013). Food analysis: Theory and practice. Royal Society of Chemistry.</li> <li>v. Watson, D., &amp; Tietz, A. (Eds.). (2015). Practical food analysis. Springer.</li> </ul>
<b>Week 12</b>	<p><b>12.0 NUTRITIONAL DEVELOPMENT IN KENYA</b></p> <p><b>12.1 Learning Outcomes:</b></p> <ul style="list-style-type: none"> <li>i. Students will critically analyze the impact of innovative food processing technologies on food safety and nutritional quality in Kenya, engaging in oral intensive discussions.</li> <li>ii. Students will evaluate the socioeconomic and environmental benefits of sustainable food production and distribution practices in Kenya, presenting their findings orally to peers.</li> <li>iii. Students will assess the effectiveness of nutrition-sensitive interventions in addressing food security challenges in Kenya through oral intensive communication.</li> </ul>



- iv. Students will demonstrate an understanding of the cultural significance and nutritional value of indigenous foods in Kenya through oral intensive presentations.
- v. Students will propose strategies for promoting future directions in nutritional development in Kenya, emphasizing oral intensive communication skills.

**12.2 Content:**

- i. Food Processing Innovations: Introduction to innovative food processing technologies and their impact on food safety and nutritional quality in Kenya.
- ii. Sustainable Food Production and Distribution: Overview of sustainable farming practices and food distribution systems in Kenya and their socioeconomic and environmental benefits.
- iii. Food Security and Nutrition: Examination of food security determinants and nutrition-sensitive interventions to address food security challenges in Kenya.
- iv. Indigenous Foods and Traditional Knowledge: Exploration of the cultural significance and nutritional value of indigenous foods and traditional food systems in Kenya.
- v. Future Directions in Nutritional Development: Discussion on emerging trends and potential strategies for promoting nutritional development in Kenya.

**12.3 Learning Activities/Opportunities:**

- i. Oral intensive group discussions on case studies related to food processing innovations, sustainable food production, food security, indigenous foods, and future directions in nutritional development in Kenya.
- ii. Debates on the effectiveness and feasibility of different strategies for addressing nutrition-related challenges in Kenya, emphasizing oral communication skills.
- iii. Role-playing scenarios to simulate decision-making processes in promoting sustainable food production and preserving indigenous food traditions in Kenya.
- iv. Interactive presentations and peer-led discussions on research findings and policy recommendations related to nutritional development in Kenya.

**12.4 Assessment/Assignments:**

- i. Participation in oral intensive group discussions and debates on food processing innovations, sustainable food production, food security, indigenous foods, and future directions in nutritional development (20%)
- ii. Individual or group presentations on specific aspects of nutritional development in Kenya, emphasizing oral communication (30%)
- iii. Written reflections on the socioeconomic, environmental, and cultural aspects of sustainable food production and indigenous foods in Kenya (20%)
- iv. Case study analysis and oral presentations on the application of nutrition-sensitive interventions and future strategies for promoting nutritional development in Kenya (30%)

**12.5 References:**

1. FAO. (2013). Sustainable food systems for food security and nutrition: A report by the High-Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security.
2. Kenya Ministry of Agriculture, Livestock, and Fisheries. (2017). Kenya agricultural sector transformation and growth strategy.



	<ol style="list-style-type: none"> <li>3. Kennedy, G., &amp; Burlingame, B. (2003). Analysis of food consumption, nutrition and relevant agricultural practices in Kenya.</li> <li>4. Muriuki, J. M. (Ed.). (2019). Indigenous knowledge and practices in agriculture: Application and benefits in Kenya.</li> <li>5. World Food Programme. (2020). Comprehensive food security and vulnerability analysis: Kenya.</li> </ol>
<b>Week 13</b>	<b>END SEMESTER EXAMINATION</b>

### 1.3 TEACHING METHODS

Lecture & Group presentations, PowerPoint & Video Presentations **Assignment criteria:** Students will be given several individual or group research assignments on topics relevant to the course.

### 1.4 CORE REFERENCES

- i. Sharma, D., Sharma, D. (2017). *Nutritional Biochemistry* 1st Edition. CBS Publishers. ISBN-13: 978-8123925271
- ii. Gropper, S., Smith, J. Carr, T. (2017). *Advanced Nutrition and Human Metabolism* 7<sup>th</sup>, Edition. Cengage Learning. ISBN-13: 978-1305627857
- iii. *Journal of Nutritional Biochemistry*. Elsevier. ISSN: 0955-2863

#### 1.4.1 REFERENCES FOR FURTHER READING

- i. Smolin, L. and Grosvenor, M. (2019). *Nutrition: Science and Applications*, 4th edition Wiley. ISBN-13: 978-1119495376
- ii. Thompson, J., Manore, M., Vaughan, L. (2016). *The Science of Nutrition* 4th Edition. Pearson. ISBN-13: 978-0134175096.
- iii. Gupta, A. (2020). *Biochemical Parameters and the Nutritional Status of Children: Novel Tools for Assessment* 1st Edition. ISBN-13: 978-0367419813.
- iv. *Journal of Food Biochemistry*. Wiley. ISSN:1745-4514.

#### 1.4.2 OTHER LIBRARY RESOURCES:

You can access Web Based Databases such as EBSCOhost, Ebrary, Keesings, Online, Psyc ARTICLES, JSTOR, Gale to locating articles in journals, electronic books, magazines and newspapers through the library catalog, which is available on-line from within and outside the campus via the USIU website (<http://www.usiu.ac.ke>). There are 24 workstations within the library, and Wired access points, available throughout the building with high-speed network connections. There are also other workstations in the computer labs. Accessibility of e- resources off campus is through Virtual Private Network (VPN).

### 1.5 KEY INSTITUTIONAL ACADEMIC POLICIES

Students should note the following are key policies as outlined in the University Catalogue and Students Handbook

#### 1. Academic dishonesty

- a. Any intentional giving or use of external assistance during an examination without the express permission of the faculty member giving the examination.
- b. Fabrication: any falsification or invention of data, citation or other authority in an

academic exercise;

- c. Plagiarism: any passing off of another's ideas, words, or work as one's own;
- d. Previously Submitted Work: presenting work prepared for and submitted to another course;

## 2. Class Attendance

Students are expected to attend all classes. Upon being absent from more than seven classes in a 3-credit unit course or from more than three classes for those that meet once a week, the instructor will give a student an “F” grade for that course.

### 1.6 COURSE EVALUATION

#### Distribution of Marks

1. Attendance & Participation	10%
2. Quizzes (CATs)	10%
3. Individual assignments	15%
4. Group assignment	10%
5. Mid Sem Exam	20%
6. <u>End Sem Exam</u>	<u>35%</u>

**TOTAL** **100%**

#### 1.6.1 GRADING

SCORE	90-100	87-89	84-86	80 -83	77-79	74-76	70-73	67-69	64-66	62-63	60-61	0-59
GRADE	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F

### 1.7 ACCESSIBILITY AND INCLUSION ACCESSIBILITY

The instructor is committed to creating a course that is inclusive in its design, but may have missed something. If you encounter barriers, please let me know immediately so that I can determine if there is a design adjustment that can be made or if an accommodation might be needed to overcome the limitations of the design. I will always be happy to consider creative solutions if they do not compromise the intent of the assessment or lea