**Bayero University, Kano (BUK)**

**Faculty of Agriculture**

**Department of Food Science and Technology**

**B. Tech Food Science and Technology**

**Proposed 30% addition to the CCMAS Course Structure/Summary**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S/N** | **CODE** | **COURSE TITLE** | **UNITS** | **STATUS** | **LH** | **PH** |
| 1. | BUK-FST 107 | Elements of Business Management | 2 | C | 30 | - |
| 2. | BUK-FST 108 | Introductory Food Biochemistry | 3 | C | 45 | - |
| **Total** | | | **5** |  |  |  |
| **Grand Total** | | | **31** |  |  |  |

**LEVEL 200**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S/N** | **CODE** | **COURSE TITLE** | **UNITS** | **STATUS** | **LH** | **PH** |
| 1 | BUK-FST 203 | Engineering Materials in food systems | 3 | C | 30 | - |
| 2 | BUK-GET 203 | Engineering Graphics and Solid Modeling II | 3 | C | 30 | 45 |
| 3 | BUK-GET 204 | Students Workshop Practice | 2 | C | 15 | 45 |
| 4 | BUK-FST 205 | Introductory Food Microbiology | 3 | C | 30 | - |
| 5 | BUK-FST 206 | Food Categories and Composition | 3 | C | 30 | - |
| 6 | BUK-FST 207 | Introduction to Food Engineering | 2 | C | 30 | - |
| **TOTAL** | | | **16** |  |  |  |
| **GRAND TOTAL** | | | **36** |  |  |  |

**LEVEL 300**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S/N** | **CODE** | **COURSE TITLE** | **UNITS** | **STATUS** | **LH** | **PH** |
| 1 | BUK-FST 307 | Transport Phenomena and Thermodynamics | 3 | C | 45 | - |
| 2 | BUK-FST 308 | Food Packaging | 3 | C | 30 | 15 |
| 3 | BUK-FST 309 | Research Methods and Technical writing | 3 | C | 45 | - |
| 4 | BUK-FST 310 | Human Nutrition | 2 | C | 30 | - |
| 5 | BUK-FST 311 | Industrial Food Microbiology | 3 | C | 45 | - |
| 6 | BUK-FST 312 | Food Safety | 3 | C | 45 | - |
| 6 | BUK-FST 313 | Food Policy and Regulations | 2 | C | 30 | - |
| **TOTAL** | | | **16** |  |  |  |
| **GRAND TOTAL** | | | **36** |  |  |  |

**LEVEL 400**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S/N** | **CODE** | **COURSE TITLE** | **UNITS** | **STATUS** | **LH** | **PH** |
| 1 | BUK-FST 406 | Fluids Transport Phenomena | 3 | C | 45 30 | - |
| 2 | BUK-FST 407 | Food Toxicology | 3 | C | 45 | - |
| 3 | BUK-FST 408 | Food Plant Design and Pilot Demonstration | 3 | C | 30 | - |
| 4 | BUK-FST 409 | Laboratory Practicals | 2 | C | - | 90 |
| 7 | BUK-FST 410 | Stability and Shelf life of Foods | 3 | C | - | - |
| **TOTAL** | | | **14** |  |  |  |
| **GRAND TOTAL** | | | **32** |  |  |  |

**LEVEL 500**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S/N** | **CODE** | **COURSE TITLE** | **UNITS** | **STATUS** | **LH** | **PH** |
| 1 | BUK-FST 506 | Food Process Engineering II | 3 | C | 45 | - - |
| 2 | BUK-FST 507 | Food Biotechnology | 2 | C | 30 | - |
| 3 | BUK-FST 508 | Food Processing Machinery | 2 | C | 30 | - |
| 4 | BUK-FST 509 | Beverages and Confectionary Technology | 2 | C | 30 | - |
| 5 | BUK-FST 510 | Food Dehydration Technology | 3 | C | 45 | - |
| 6 | BUK-FST 511 | Food Analysis | 3 | C | 30 | - |
| **TOTAL** | | | **15** |  |  |  |
| **GRAND TOTAL** | | | **36** |  |  |  |

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 107: Elements of Business Management (2 Units C: LH 30; Total 30)**

**Senate-approved relevance**

Training of high-quality graduates with knowledge and skills in Elements of Business Management agrees with BUK’s mission to address African developmental challenges in producing graduates in the field of food science and technology that will have managerial relevance in the food industry. It is relevant to produce graduates of food science and technology with skills in this area.

**Overview**

The knowledge of the rudiments of business is very critical to the food technologists, for managing responsibilities that are complimentary to food production in the food industry. It builds capacity in the graduate of easily fitting into any section of the food industry, and also having a comprehensive knowledge of the activities of food production.

This is necessary in food processing sector for the production of wholesome food products, which is in line with BUK’s mission of addressing Africa’s developmental challenges of producing food technologists that aid in combating hunger.

**Objectives**

The objectives of the course are to:

1. Describe the management of resources

2. Express the different forms of business ownership

1. Identify the different types of hierarchy structure in an organization or business outfit

4. Outline the different types of record keeping methods

5. Identify different purchasing methods

1. Explain stock control

**Learning outcomes**

At the end of this course, students should be able to:

1. Explain the importance of management in a food industry
2. List and describe at least three different forms of business ownership
3. Describe the different types of organizational structure
4. Outline the different forms of record keeping in a food industry
5. Explain the basics of international food trade
6. Express an understanding of food laws and international food standards

**Course content**

Definition and importance of business management. Forms of business ownership. Limited liability company. Business Partnerships. Leasing. Hire Purchase. Organisational structure. Organizational chart. Planning. Leadership. Coordination. Influence and Power. Chains of Authority. Business records and records keeping. International trade. Local and International Food laws. Codex Alimentarius. Purchasing. Stock control.

**Minimum Academic Standards**

Food Science and Technology programme NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 108: Introductory Food Biochemistry (3 Units C: LH 45; Total 45)**

**Senate-approved relevance**

Training of high-quality graduates with knowledge of introductory food biochemistry will provide a background knowledge to some important courses in food processing and preservation. This will aid in producing graduates with foundational knowledge needed for the development of methods of food processing and preservation. This agrees with BUK’s mission to address African developmental challenges in producing graduates in the field of food science and technology that will have managerial relevance in the food industry.

**Overview**

The knowledge of the food biochemistry is important to the food technologists in the areas of raw materials handling and pre-processing. It is also important in the areas of enzymes and their biochemical reactions, human nutrition and food toxicology.

This knowledge is useful in solving simple to complex biochemical problems either with the raw material or its preservation method. This enables the graduate of food science and technology to build the skills that are related to biochemical activities of food production, which is necessary in the food processing sector for the production of wholesome food products, and is in line with BUK’s mission of addressing Africa’s developmental challenges of combating hunger.

**Objectives**

The objectives of the course are to:

1. Describe the biochemistry of protein, lipids, carbohydrates, and nucleic acids
2. Explain Enzymes and Enzymatic reactions
3. Discuss the process of protein isolation
4. Outline the process of quantification of amino acids and peptides
5. Explain the effects of processing on proteins
6. Explain the process of starch modification
7. Describe changes in quality due to lipid deterioration

**Learning outcomes**

At the end of this course, students should be able to:

1. Explain the importance of the biochemistry of the major food components
2. Discuss the role of enzymes in food processing and preservation
3. Describe enzyme kinetics
4. Review the effect of processing on proteins, starch and lipids
5. Explain biochemical reactions of water with food
6. Express an understanding of the biochemical changes that occur in foods during handling, processing and storage.

**Course content**

Introduction to the Biochemistry of Carbohydrates, Lipids, Proteins, and Nucleic acids. Enzymes and Enzymatic reactions. Elementary treatment of enzyme kinetics. Bioenergetics and energy transfer. Isolation of proteins. Quantification of amino acids and peptides. Protein functionality in foods. Effects of processing on proteins. Starch and starch modifiers. Starch gelatinization. Pectic substances and their applications. Lipid deterioration and attendant quality changes. Water based dispersions. Biochemical reactions of water and food. Water for food processing operations. Flavours. Pigments. Organoleptic changes that occur in foods during handling, processing, and storage.

**Minimum Academic Standards**

Food Science and Technology programme NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 203: Engineering Materials in Food Systems (3 Units C: LH 45; Total 45)**

**Senate-approved relevance**

Training students of Food Science and Technology in engineering materials in food systemsis necessary, to provide the students with knowledge that is useful in studying all materials used in processing and packaging foods, which is necessary for food industrial practices in Nigeria. This is in order to produce safe and wholesome food products for satisfying the sustainable development goals of Nigeria and Africa.

**Overview**

The study of engineering materials in food systems gives the students the basic working knowledge required for food manufacturing and packaging challenges. It provides the basic knowledge required for the materials used in the fabrication and applications of different equipment, packaging materials machines used in the food industry.

The knowledge provides them with the minimum requirements needed in relevant areas that aid the food manufacturing process, which is required for tackling post-harvest losses and thus aiding the SDG goal of zero hunger in the world.

**Objectives**

The objectives of the course are to:

1. Identify engineering materials important to the food industry
2. Differentiation between crystals of metals and crystals of amorphous substances
3. Discuss expansion or contraction of metallic and non-metallic substances.
4. Enumerate types of metals and alloys in the food Industry.
5. Explain metal defects and their causes in the food industry
6. Analyse the use of protective coatings for metals used in food processing
7. Analyze causes and methods of protection of corrosion in the food industry
8. Discuss the types, composition, properties, uses and chemical resistance of glass used in the food industry.

**Learning Outcomes**

At the end of this course, students should be able to:

1. Identify basic engineering materials such as metals, ceramics, glass, and plastic polymers and composites and describe their structures, properties and uses in the food industry;

2. Describe expansion and contraction of metallic and non-metallic engineering materials in food systems

3. Identify the relationships between the different engineering materials for food systems

4. Describe the different manufacturing processes of engineering materials in the food industry.

5. Analyse types and causes of metal defects in packaging materials and equipment in the food industry

6. Discuss corrosion and its methods of protection in the production lines of the food plant

**Course Content**

Definition of engineering materials with their properties and uses in the food industry. Difference between crystals of metals and crystals of amorphous substances. Non-uniform expansion or contraction of metallic and non-metallic substances. Metals and alloys in Food Industry (types of metals and alloys used in the food industry, general composition and properties). Metal defects and their causes in the Food Industry (occurrence of dislocations, and occurrence of point defects). Use of protective coatings for metals used in food processing. Corrosion in the food industry (definition and cause, types and nature of various metallic corrosion). Methods of protection against corrosion. Effect of high temperature on metals in the Food industry. Polymeric materials used in the food industry. Types, composition, Properties, uses and chemical resistance of glass used in the food industry.

**Minimum Academic Standards**

Food Science and Technology programme NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-GET 203: Engineering Graphics and Solid Modeling II (3 Units C: LH 30; PH 45; Total 75)**

**Senate-approved relevance**

Training the students on engineering drawing is critical because it provides the requirements needed to manufacture a product or an equipment part. Engineering drawings are also known as mechanical drawings, manufacturing blueprints and drawings. This course provides the students with the vital knowledge required for design and specification of food plants, processes, packages and to some extent equipment. This provides the students with a comprehensive approach to food industrial practices in Nigeria.

**Overview**

Engineering drawings are used to communicate design ideas and technical information to engineers and other professionals throughout the design process. An engineering drawing represents a complex three-dimensional object on a two-dimensional piece of paper or computer screen by a process called projection.

This course is critical to the students of Food Science and Technology BUK so as to provide them with the basic knowledge required for the design and specification of equipment appropriate for handling foods. This aids the food manufacturing process, which is required for tackling post-harvest losses and thus aiding the SDG goal of zero hunger in the world.

**Objectives**

The objectives of the course are to:

1. Explain the relevance of drawing instruments

2. Demonstrate the use of scales and orthographic projections, and projections of points & simple lines.

3. Describe the projections of the lines that incline to both planes.

4. Illustrate the projections of the plane inclined to both planes.

5. Explain the projections of the various types of solids in different positions inclined to one of the planes.

6. Reproduce and convert the isometric view to orthographic vie and vice versa.

**Learning Outcomes**

Students should be able to:

1. Apply mastery of the use of projections to prepare detailed working drawing of objects and designs;

2. Develop skills in parametric design to aid their ability to see design in the optimal specification of materials and systems to meet needs;

3. Analyze and optimize designs on the basis of strength and material minimization;

4. Express theoretical perspectives in design and optimization.

5. Produce shop drawings for multi-physical, multidisciplinary design.

**Course Contents**

Projection of lines, auxiliary views and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface and shell modeling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting and CNC machinery. Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

**Minimum Academic Standards**

All engineering programmes NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45; Total 60)**

**Senate-approved relevance**

Training students of Food Science and Technology on the basic workshop practices is necessary to provide the students with a comprehensive approach to food industrial practices in Nigeria for

**Overview**

The study of workshop practice gives the students the basic working knowledge required for various manufacturing challenges. It provides the rudiments required in the construction, functions, use and applications of different work tools, equipment, machines as well as techniques involved in the manufacturing a product from its raw material.

This discipline teaches the students some basic knowledge for example in carpentry, fitting, plumbing, electrical wiring and welding. This knowledge provides them with the minimum requirements needed in relevant areas that aid the food manufacturing process, that is required for tackling post-harvest losses and thus aiding the SDG goal of zero hunger in the world.

The objectives of the course, learning outcomes, and contents are provided below.

**Objectives**

The objectives of the course are to:

1. Apply the knowledge of workshop practice in food science and technology

2. Design equipment and facilities and supervise their fabrication and implementation respectively

4. Design and develop new products from exogenous technologies to be adopted in our local food industries;

5. Improve on indigenous technology to solve problems pertaining to food science and technology.

6. Demonstrate skills necessary in managing materials, equipment and technologies.

**Learning outcomes**

1. Identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;

2. Apply basic engineering technologies to CNC machining technology;

3. Explain workshop and industrial safety practices, accident prevention and ergonomics;

4. Identify different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;

5. Connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and

6. Determine household and industrial energy consumption, and understand practical energy conservation measures.

**Course Contents**

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice. Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes (welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.

Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

**Minimum Academic Standards**

All engineering programmes NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 205: Introductory Food Microbiology (3 Units C: LH 45; Total 45)**

**Senate-approved relevance**

Training of high-quality graduates with knowledge and skills in introductory food microbiology agrees with BUK’s mission to address African developmental challenges in producing graduates in the field of food science and technology. It is relevant to produce graduates of food science and technology with skills in this area. It also serves as a pre-requisite course to other courses.

**Overview**

The science of food microbiology is concerned with the microorganisms that inhabit, create or contaminate food. This includes pathogens that may cause food related diseases in the human body. Defining these microorganisms with their characteristics as related to food requires adequate preliminary or introductory knowledge in the science of food microbiology.

It is necessary in food processing and preservation, for the production of wholesome food products, which is in line with BUK’s mission of addressing Africa’s developmental challenges of producing food technologists that aid in combating hunger.

**Objectives**

The objectives of the course are to:

1. Define the microorganisms of importance in foods
2. Discuss the characteristics of pathogenic and non-pathogenic food microorganisms
3. Enumerate the subgroups of bacteria that affect food
4. Assess the behaviour of indicator, pathogenic and spoilage microorganisms
5. Explain food microbiological testing

**Learning outcomes**

At the end of this course, students should be able to:

1. Identify the natural microbiological flora of importance in foods
2. List and describe the indicator, pathogenic, and spoilage microorganisms in foods
3. Describe the incidence and types of micro-organisms in some foods
4. Explain the spoilage of some fresh and preserved foods
5. Identify foodborne illnesses and their prevention
6. Discuss food fermentation

**Course content**

Natural flora of importance in foods; The behaviour and uses of some microorganisms in the food industry. Incidence and types of micro-organisms in some foods: Meat, Fish, Vegetables and Fruits, Seafood and Dairy products. Indicator microorganisms. Pathogenic and spoilage microorganisms. Spoilage of some fresh and preserved foods (fruits, vegetables, milk, meat, fish, cereals, eggs, and their products). Foodborne illnesses and their prevention (Food intoxication and food poisoning). Food fermentation.

**Minimum Academic Standards**

Food Science and Technology programme NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 206: Food Categories and Composition (3 Units C: LH 45; Total 45)**

**Senate-approved relevance**

Training of high-quality graduates with knowledge in food categories and composition is necessary, in order to acquaint them with the basic components and characteristics of food. This makes it easy to address African developmental challenges in providing sustainable food products for combating hunger.

**Overview**

The course food categories and composition give the student the basic knowledge of what food comprises of, its character and composition. It will give them a thorough knowledge of foods, which are the raw materials for processing and preservation purposes.

This makes the application of processing and preservation methods easy, which is necessary in the food processing sector for the production of wholesome food products, that will help in addressing Africa’s developmental challenges in the area of sustainable food security.

**Objectives**

The objectives of the course are to:

1. Understand the properties and significance of food constituents

1. Differentiate between the different food constituents
2. Identify the un-common or additional food constituents

4. Understand the role of carbohydrates, protein and fats in nutrition

5. Identify different roles of each constituent

6. Explain the bioavailability of nutrients

**Learning outcomes**

At the end of this course, students should be able to:

1. Explain the different food constituents
2. List and describe nutritive aspects of food Constituents.
3. Discuss food and energy.
4. Enumerate the additional roles of carbohydrates, proteins, and fats in nutrition.
5. Explain the effect of processing methods on protein quality.
6. Understand the concept of bioavailability of nutrients

**Course content**

Properties and significance of food constituents. Carbohydrates. Proteins. Fats and Oils. Additional Food constituents. Nutritive Aspects of Food Constituents. Food and Energy. Additional Roles of Carbohydrates, Proteins, and Fats in Nutrition. Protein Quality. Bioavailability of Nutrients. Vitamins. Minerals. Fiber. Water in food systems. Stability of nutrients during processing and storage. Diet and Chronic Disease.

**Minimum Academic Standards**

Food Science and Technology programme NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 207: Introduction to Food Engineering (2 Units C: LH 30; Total 30)**

**Senate-approved relevance**

Training of high-quality graduates with knowledge of introduction to food engineering will provide a background knowledge to some important courses in food process engineering, that agrees with BUK’s mission to address African developmental challenges in producing graduates in the field of food science and technology that will have managerial relevance in the food industry.

**Overview**

The knowledge of introduction to food engineering is important to the food technologists as a prerequisite to other technology-based courses. This course is important in laying the foundational knowledge of courses that train the student in the preliminaries of processing methods, and in the solving of simple to complex quantitative problems.

It enables the graduate of food science and technology to build the skills that are required by the food processing sector that plays an important role in addressing Africa’s developmental challenges of combating hunger.

**Objectives**

The objectives of the course are to:

1. Define the scope of food process engineering.
2. Review base and derived units.
3. Explain mass and force concept
4. Describe material and energy balances.
5. Explain the fundamentals of heat transfer.
6. Relate engineering principles to food processing and storage
7. Determine the importance of water in foods and food stability

**Learning outcomes**

At the end of this course, students should be able to:

* + - 1. Explain the fundamentals of food process engineering
      2. Describe base and derived units and their derivations
      3. Explain the conservation of mass
      4. Describe the concept of thermodynamics
      5. Explain the concept of mass and force
      6. Express an understanding of the mechanical properties of foods
      7. Explain the importance of water in foods and food systems

**Course content**

Introduction. Scope of food process engineering. Review of base and derived units. Mass and force concept. Material balances. Fundamentals of heat transfer. Energy balances. Application of engineering principles in food processing and storage. Density of foods. Specific gravity of foods. Viscosity of foods. Surface activity of foods. Structural properties of foods. Electrical properties of foods. Water activity and its determination. Effect of water activity on food quality and stability. Sorption isotherms. Phase transition phenomena.

**Minimum Academic Standards**

Food Science and Technology programme NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**Buk-FST 307: Transport Phenomena and Thermodynamics (3 Units C: LH 45; Total 45)**

**Senate-approved relevance**

Coaching students of Food Science and Technology into graduates with knowledge in fundamental concepts of thermodynamics and heat transfer, impacts greatly on food processing by instilling acquired skills into food manufacturing practices that improve food security and sufficiency, and a renewed commitment to general self-reliance in Nigeria and Africa in general.

**Overview**

The study of thermodynamics and heat transfer can be understood as the discipline of the physical sciences, that studies theoretically and practically the different manifestations of energy. The study of thermodynamics is important in relation to the understanding of thermal systems in the food industry like the mechanisms of heat and mass transfer, heat exchange, efficient heat energy utilization, heat processing methods and equipment, and effective heat utilization for the maintenance of food quality during the manufacturing of food products.

This is in line with Nigeria’s renewed commitment for food security, through the turning out of graduates that are adequately equipped with the comprehensive theoretical knowledge and practical skills required for self-reliance and meaningful, valuable engagement in the general society. The course is important for achieving the sustainable development goals (SDGs) in the areas of poverty reduction and zero hunger.

**Objectives**

The objectives of the course are to:

1. Discuss the basic principles of heat and mass transfer.
2. Explain the basic relations in transport phenomena and the basic laws of transport.
3. Describe the mechanisms of heat and mass transfer in terms of (Conductive, convective, and radiation heat and mass transfers).
4. Explain heat transfer mechanisms in some food processing operations
5. Describe heat exchange within the context of food processing
6. Identify the operation and uses of heat exchangers within the scope of the food industry.

**Learning outcomes**

On completion of the course, students should be able to:

1. Explain the basic principles of heat and mass transfer

2. Discuss basic transport phenomena and laws of transport.

3. Evaluate the mechanisms of heat and mass transfer

4. Explain conductive, convective, and radiation heat and mass transfer

5. Explain and evaluate heat exchangers in the food industry

6. Describe heat exchange in food processing operations

**Course contents**

Heat and mass transfer, basic principles. Basic relations in transport phenomena. Basic laws of transport. Mechanisms of heat and mass transfer: Conductive heat and mass transfer (The Fourier and Fick laws, Integration of Fourier’s and Fick’s laws for steady-state conductive transport, thermal conductivity, thermal diffusivity and molecular diffusivity, examples of steady-state conductive heat and mass transfer processes, transient conduction transfer in finite solids). Convective heat and mass transfer (film (or surface) heat and mass transfer coefficients, empirical correlations for convection heat and mass transfer, steady-state interphase mass transfer, unsteady state heat and mass transfer, the 2nd Fourier and Fick laws, solution of Fourier’s second law equation for an infinite slab, transient convective transfer in a semi-infinite body, unsteady state convective transfer). Heat transfer by radiation (interaction between matter and thermal radiation, radiation heat exchange between surfaces, radiation combined with convection). Heat exchangers (overall coefficient of heat transfer, heat exchange between flowing fluids, fouling, heat exchangers in the food process industry).

**Minimum Academic Standards**

Food Science and Technology programme NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 308: Food Packaging (3 Units C: LH 30 PH 15; Total 45)**

**Senate-approved relevance**

Training students of food science and technology in food packaging is necessary to provide the students with a comprehensive insight especially on package integrity, and the types of interactions between the food being processed with the packaging material and the reactions between them, which is very important for the production of safe wholesome foods that will aid food security and sound industrial practices in Nigeria and Africa.

**Overview**

The study of food packaging gives the students the basic working knowledge required for various manufacturing challenges. It provides the rudiments required in the construction, functions, use and applications of different packaging materials as well as techniques involved in the manufacturing of a product from its raw material. This discipline teaches the students some basic knowledge in the design of food packaging materials and their functions.

The knowledge provides students with the minimum requirements needed in relevant areas that aid the food manufacturing process, that is required for tackling post-harvest losses and thus aiding the SDG goal of zero hunger in the world.

**Objectives**

The objectives of the course are to:

1. Define and enumerate the scope of Food packaging.
2. List the types of packaging materials and their characteristics
3. Demonstrate test for quality on different types of food Packaging
4. Discuss the different packaging requirement for both fresh and processed food materials for each class of food
5. Discuss the relationship that exist between packaging and marketing of foods
6. Discuss the relationship between packaging and public Health
7. Discuss the recent advancement in food packaging such as active packaging, intelligent packaging and edible packaging

**Learning Outcomes**

At the end of this course, students should be able to:

1. Define and enumerate the scope of Food Packaging;

1. List major types of packaging materials both local and conventional;
2. Explain the attributes of a good packaging material
3. Indicate test for quality of packaged foods;
4. Understand the permeability properties of different packaging materials
5. Explain the concept of vacuum packaging
6. List packaging requirement for fresh and processed foods;
7. Establish relationship between packaging and marketing of foods;
8. Explain some recent development in packaging of foods.
9. Differentiate between controlled and modified atmosphere packaging
10. Relate laboratory practicals to theory

**Course content**

Definition and scope of Food Packaging. Major types of packaging material. Indication tests for structural quality and performance. Packaging requirement for fresh and processed foods for local and export markets. Relationship of packaging to marketing of foods. Hermetically sealed food containers. Vacuum packaging. Closures for metal containers structures and characteristics. (Double seam containers, Seam defects). Design of packages / containers for agricultural produce such as. Fruits, Vegetables, Dairy, Fish and meat. Packaging material and Public Health. Active and intelligent packaging, Modified and controlled atmosphere packaging.

**Food packaging laboratory**

Identification of different types of packaging materials along with their physical characteristics. Determination of water absorption of paperboard and Corrugated fibre board (CFB). Determination of thermal shock resistance of glass bottles. Determination of water vapor transmission rate of different packaging materials. Determination of wax content and grease resistance of different packaging materials.

**Minimum Academic Standards**

Food Science and Technology programme NUC-MAS requirement facilities

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 309 Research Methods and Technical writing (3 Units C: LH 45; Total 45)**

**Senate-approved relevance**

Coaching students of Food Science and Technology into graduates with knowledge in fundamental concepts of research methods and technical writingwill help in the proper conduct of researches and the translation of results into industrial practices that are required for tackling post-harvest losses creating food security and sufficiency in Nigeria and Africa in general.

**Overview**

Studying research methods and technical writing will impart knowledge of the principles of research design and methodology, experimental design and interpretation of data generated.

Producing graduates that are adequately equipped with comprehensive theoretical knowledge required for self-reliance and meaningful, valuable engagement in the general society cannot be overemphasized especially where food sufficiency and security are the targets.

**Objectives**

The objectives of the course are to:

1. Define and differentiate between types of research
2. Discuss and demonstrate how to write a research proposal in detail.
3. Discuss how to conduct a literature search both offline and online including citation methods
4. Discuss the principles of research design and methodology including experimental design and questionnaires
5. Explain how to interprete and discuss data generated through research.
6. Discuss referencing styles and identify the recommended one.

**Learning Outcomes**

At the end of this course, students should be able to:

1. Define and understand types of research;

2. Demonstrate ability to write research proposal;

3. Explain literature review including materials to review, reasons for literature review, compilation of reviewed material;

4. Describe the principles of research design and methodology;

5. Enumerate methods or writing references

**Content**

General introduction, definition, scope and types of scientific researches. Specific Introduction of the research, research proposal, (title, Objectives, statement of the problem, Justification). Reviewing the state of knowledge (background information, materials to review, reasons for literature review, compilation of reviewed material, guidelines on writing literature review, citation methods). Research design and methodology (experimental designs, guidelines on experiment design and example, sampling techniques, research tools, interviews, questionnaires and observations). Data interpretation and Discussing research findings and. Conclusions and recommendation. References (types and institution recommendation) Appendices.

**Minimum Academic Standards**

Food Science and Technology programme NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 310 Human nutrition (2 Units C: LH 30; Total 30)**

**Senate-approved relevance**

Training of high-quality graduates with knowledge and skills in human nutrition agrees with BUK’s mission to address African developmental challenges in producing graduates in the field of food science and technology. It is relevant to produce graduates of food science and technology with skills in this area, in order to comprehensively address these challenges.

**Overview**

The science of nutrition is concerned with the various constituents within food that are referred to as nutrients, which are required for the health and maintenance of the human body. Defining what constitutes adequate consumption of these nutrients and what processing methods affects their availability requires adequate knowledge in the science of human nutrition.

The study of human nutrition balances the knowledge of partitioning and processing of food for the improvement of processing machinery, with saving indigenous nutrients or their addition to fortify processed foods. This is necessary in the production of wholesome food products that is in line with BUK’s mission of addressing Africa’s developmental challenges of producing food technologists that aid in combating all types of hunger.

**Objectives**

The objectives of the course are to:

1. Define and differentiate between Macro and micro nutrients
2. Define and differentiate between Basal and Rest Metabolism
3. Explain the meaning of Recommended dietary allowance and its significance
4. Explain the classifications, functions and deficiency symptoms of vitamins.
5. Explain the classifications, metabolic functions, relationships and deficiency symptoms of some major vitamins.
6. Discuss food fortification and supplementation and identify areas where it is applied

**Learning Outcomes**

At the end of this course, students should be able to:

1. Explain basal and rest metabolism

2. Define Recommended Dietary Allowance (RDA)and its significance

3. Enumerate the classifications, functions and deficiency symptoms of vitamins;

4. Enumerate the classification, metabolic functions, relationships and deficiency symptoms of Ca, P, Mg, Na, K, Al, Fe, Cu, Co, Mn, Mo, F, Zn

5. Ddescribe food fortification and supplementation

**Course content**

Micronutrients: general reasons for being essential. Factors governing micronutrients deficiencies. Basal and Rest metabolism. Food composition tables. Recommended Dietary Allowance (RDA). Essential mineral elements. General functions of Mineral elements. Classification and metabolic functions of mineral elements. Relationships and deficiency symptoms of Ca, P, Mg, Na, K, Al, Fe, Cu, Co, Mn, Mo, F, and Zn. Vitamin classification. General physiological functions of water-soluble vitamins. Fat soluble vitamins classification and general physiological functions. Food fortification. Food supplementation.

**Minimum Academic Standards**

Food Science and Technology programme NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 311: Industrial Food Microbiology (3 Units C: LH 45; Total 45)**

**Senate-approved relevance**

Training of high-quality graduates with knowledge and skills in industrial food microbiology trains them on the application of microbiology in the food industry, which agrees with BUK’s mission to address African developmental challenges in producing graduates in the field of food science and technology.

**Overview**

The science of industrial food microbiology is concerned with the microorganisms that are used for the production of important food products or food ingredients. Understanding these processes and the microorganisms responsible for them requires adequate knowledge in the science of industrial food microbiology.

The production of wholesome food products with increased shelf life is in line with BUK’s mission of addressing Africa’s developmental challenges of producing food technologists that aid in combating hunger.

**Objectives**

The objectives of the course are to:

1. Enumerate the microorganisms beneficial to food processing

1. Describe the habitats, taxonomy, and growth parameters of these microorganisms
2. Explain the sanitization processes prior to and after processing of meats
3. Discuss the processing methods of fermented fruits and vegetables products
4. Explain the concept of fermentation and fermented dairy products
5. Describe the processing methods of fermented fish products

**Learning outcomes**

At the end of this course, students should be able to:

1. Identify the microbiological flora of importance in industrial food processing
2. Describe the sanitization procedures in the food industry.
3. Enumerate the types of micro-organisms in some specific food processing methods
4. Explain the spoilage of some fresh and preserved foods
5. Discuss the fermentation process of some specific foods

**Course content**

The uses of some microorganisms in the food industry. Incidence and types of micro-organisms in some foods. Microbiological processing of Meat, Fish, Vegetables and Fruit products. Microbiological processing of Seafood. Pathogenic and spoilage microorganisms of processed foods. Indicators of microbial spoilage of some fresh and preserved foods (fruits, vegetables, milk, meat, fish, cereals, eggs, and their products). Food fermentation. Fermentation of dairy products. Microorganisms in the production of cheeses.

**Minimum Academic Standards**

Food Science and Technology programme NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 311: Food Safety (3 Units C: LH 45; Total 45)**

**Senate-approved relevance**

Training students of Food Science and Technology in Food Safety is necessary to provide the students with a comprehensive approach to food industrial practices that are required for the safety of processed foods.

**Overview**

Provision of safe, wholesome food products is the consumer’s right. The course equips the student with knowledge of food safety management systems for the production of safe, nutritious and wholesome food products to consumers.

The manufacturing of safe food products that conform to local, regional as well as global standards aids in tackling food insecurity as well as the SDG goal of zero hunger in the world, and particularly in Nigeria and West African sub region.

**Objectives**

The objectives of the course are to:

1. Discuss food safety, its laws and management systems.
2. Determine the different sources of food hazards
3. Explain how to protect the food supply from harmful contamination
4. Describe the prevention, development and spread of harmful contamination
5. Enumerate the methods of effective removal of contamination and contaminants from food
6. Describe the management system of the hazard-analysis critical control point (HACCP).
7. Introduce and explain the codex standards.

**Learning Outcomes**

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

1. Explain the definition of food safety
2. Determine the different sources of food contamination
3. Enumerate and explain the advantages and disadvantages of the various types of food safety methods
4. List the groups of food contaminants citing specific examples
5. Explain the structure and application of the HACCP
6. Explain the food safety management systems
7. Assess the hazards associated with food processing

**Course Content**

The definition and importance of food safety. Biological Hazards; Bacteria, Viruses, Fungal Toxins, Parasites, Protozoa, Nematodes. Chemical Hazards; Non-Biological Contaminants (Contaminants Produced During Processing, Contaminants from Food-Contact Materials, Environmental Contaminants, Veterinary Residues). Biological toxins (Fungal Toxins, Plant Toxins, Fish Toxins). Allergens (Food and specific Allergens, Allergen-Control Options, Allergen Legislation). Food Safety laws and Legislation. Food safety management systems. Foodborne illnesses and their prevention. laws. The codex Alimentarius standards. Hazard Analysis Critical Control Points (HACCP).

**Minimum Academic Standards**

Food Science and Technology NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 313: Food Policy and Regulations (2 Units C: LH 30; Total 30)**

**Senate-approved relevance**

Training students of Food Science and Technology in Food Policy and Regulations is necessary to acquaint the students with legal bodies that regulate food processing activities, which is required as a comprehensive approach to food industrial practices needed for the safety of processed foods.

**Overview**

The course equips the student with knowledge of food regulatory bodies that are responsible for enforcing rules and regulations of food processing practices, for the production of safe, nutritious and wholesome food products.

The manufacturing of safe food products that conform to local, regional as well as global standards and regulations aids in tackling food insecurity as well as the SDG goal of zero hunger in the world, and particularly in Nigeria and West African sub region.

**Objectives**

The objectives of the course are to:

1. Describe food policies, laws and management systems.

1. Enumerate the different regulatory agencies
2. Explain how to protect the food supply chain from unethical practices
3. Describe the prevention, development and spread of harmful practices
4. Express the methods of effective food regulation
5. Identify the management system of local, regional and international food regulatory agencies.
6. Explain the different food standards.

**Learning Outcomes**

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

1. Explain the meaning of food policy and regulations

1. Determine the different types of food policies and regulations
2. Explain the legal implications of unsafe practices
3. Enumerate the prominent groups of food regulatory agencies in Nigeria and West Africa
4. Describe the structure of the global food regulatory agencies
5. Explain the alliances between the national, regional, and international food regulatory agencies

**Content**

General food laws in Nigeria. Regulatory bodies and their constitutional mandates. Fair trade (SPS agreements, WTO). Global G.M.P processes and guidelines. Iso standards and codex regulations. FDA and EU regulations. Standards (NAFDAC and son’s roles in food safety and standards). Patents and legal requirements. Role of legal bodies in maintaining standards. Licensing of food manufacturing premises. Registration of food products and issuance of marketing authorization. Importation & exportation of food. Labeling of food products. Advertisement of food products. Inspection for GMP and GHP of foreign importers. Health control of quick-service restaurants. Marketing of infant milk and/or food.

**Minimum Academic Standards**

Food Science and Technology NUC-MAS requirement facilities

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 406: Fluids Transport Phenomena (3 Units C: LH 45; Total 45)**

**Senate-approved relevance**

Teaching students of Food Science and Technology on the fundamentals of fluid behaviour under static and dynamic situations, helps to instill acquired skills that prepares them for food manufacturing practices thereby improving food security and sufficiency in Nigeria and Africa in general

**Overview**

The study of fluid mechanics gives the students an understanding of the basic concepts of fluid dynamics. It recognizes the various types of fluid flow situations encountered practically in the food industry, that support efficiency in the manufacturing of especially fluid food products.

This is in line with Nigeria’s renewed commitment for food security, through the turning out of graduates that are adequately equipped with the comprehensive theoretical knowledge and practical skills required for self-reliance and meaningful, valuable engagement in the general society.

**Objectives**

The objectives of the course are to:

1. Describe the properties of Newtonian and non-Newtonian fluids
2. Explain the flow properties of fluids
3. Explain the principles of the transportation of fluids
4. Describe the flow of particulate solids, or powder flow
5. Analyse types of fluid flow behavior
6. Express analytical solutions to a variety of simplified problems

**Learning outcomes**

On completion of the course, students should be able to:

1. Explain the industrial food processes that involve fluid movement.
2. Describe how essential utilities such as water, steam and various gases are distributed about the plant in properly designed pipelines.
3. Describe important unit operations such as filtration, pressing and mixing to particular applications of fluid flow.
4. Explain rate of energy and mass transfer
5. Describe the distribution of fluid concentration, temperature, and velocity in food systems;

**Course content**

Introduction. Elements of fluid dynamics. Viscosity. Fluid flow regimes. Typical applications of Newtonian laminar flow. Turbulent fluid flow. Flow properties of fluids. Types of fluid flow behavior. Non-Newtonian fluid flow in pipes. Transportation of fluids. Energy relations. Pump types and operation. Pump selection. Ejectors. Piping systems. Flow of particulate solids or powder flow. Flow properties of particulate solids. Fluidization. Pneumatic transport).

**Minimum Academic Standards**

Food Science and Technology NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 407: Food Toxicology (3 Unit; C: LH 45; Total 45)**

**Senate-approved relevance**

Training students of Food Science and Technology in food toxicology is necessary to provide the students with a comprehensive approach to food industrial practices that are required for tackling post-harvest losses as well as manufacturing safe and wholesome products that conform to local, regional as well as global food regulatory bodies.

**Overview**

Food toxicology is the study of the nature, properties, effects and detection of toxic substances in food and water, and their disease manifestation in humans. The study of Food Toxicology enlightens on the hazards associated with naturally existing and introduced toxicants in foods.

The knowledge is necessary for the production of safe, nutritious and wholesome food products to consumers particularly in Nigeria and West African sub region for food security.

**Objectives**

The objectives of the course are to:

1. Explain the basic principles of food toxicology
2. Determine the types of food toxicants that occur in foods
3. Assess the chemical hazards associated with endogenous toxicants in foods
4. Discuss naturally occurring toxicants in foods of animal origin
5. Enumerate synthetic toxicants
6. Describe toxicants from pesticide residues.

**Learning Outcomes**

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

1. Define food toxicant

1. Determine the different sources of food toxicants
2. Enumerate the various types of food Toxicants with specific examples
3. Evaluate toxicity test results
4. Carryout a risk assessment for chemical harzards
5. Assess the modes of action of toxicants.
6. Assess dose response.
7. Understand carcinogen testing

**Course Content**

Principles of Toxicology. Determination of Toxicants in Foods. Qualitative and Quantitative Analyses of Toxicants in Foods. Sample Preparations for Determination of Toxicants. Toxicity Testing. Natural Toxins in Animal Foodstuffs. Natural Toxins in Plant Foodstuffs. Fungal Toxins Occurring in Foods. Toxic Food Contaminants from Industrial Wastes. Chlorinated Hydrocarbons.

Pesticide Residues in Foods. Insecticides. Food Additives. Risk assessment for chemical hazards. Modes of action of toxicants. Assessing dose response. Carcinogen testing.

**Minimum Academic Standards**

Food Science and Technology NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 408: Food Plant Design and Pilot Demonstration (3 Units; C: LH 45; Total 45)**

**Senate-approved relevance**

Training students of Food Science and Technology on food plant design and Pilot Demonstrationis necessary to provide the students with relevant peculiar knowledge, in the identification of food plant location, and design of plant layout and structure, for a comprehensive approach to food industrial practices in Nigeria.

**Overview**

The course food plant design and pilot demonstration is critical to the students of Food Science and Technology BUK so as to provide them with the basic knowledge required for understanding the general procedure/stages in the design of food plants and identification of plant location.

It also provides them with the peculiar knowledge of a food plant layout and structural design, for determining equipment requirements and their critical design features in the food plant. This aids the food manufacturing process, that is required for food stability and for tackling post-harvest losses, and thus aiding the SDG goal of zero hunger in the world

**Objectives**

The objectives of the course are to:

1. Determine the general procedure/stages in the design of food plants and identification of Plant location.
2. Discuss the food plant layout and structural design
3. Determine equipment requirements in the food plant.
4. Explain the critical design features of equipment used in the food plant
5. Describe health and safety issues to be considered in the design and construction of a food plant.

**Learning Outcomes**

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

1. Identify the differences between food processing plants and other processing plants
2. Determine the proper location of food processing plants
3. Design the structure and effective layout of a food plant
4. Identify the peculiarities in the building construction of a food plant
5. Determine the requirements in processing methods for the design of processes and equipment installations
6. Identify the health and critical safety factors important in the design of food plants
7. Explain the accessible and restricted areas to different categories of staff in the food plant

**Course Content**

Introduction. Meaning and scope. General procedure/stages in the design of food plants. Plant location. Technical feasibility study on setting up a food plant. Food plant layout. Food plant structural design. Construction of Buildings. Equipment requirements. Critical equipment design features in the food plant. Review of the economics of process design. Process optimization. Health aspects to be considered in the design and construction of a food plant. Critical safety factors in the design of food plants. Group project work on pilot project plans and submission of technical reports. Simulated food process plants design.

**Minimum Academic Standards**

Food Science and Technology NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**FST 409: Laboratory Practicals (2 Units C: PH 90; Total 90)**

**Senate-approved relevance**

Training students of Food Science and Technology in Laboratory Practicals II (Animal Products, Plant Products, Food Analysis, Food Microbiology)is necessary to provide the students with practical experience and knowledge based on generated and analysed results, which agrees with BUK’s mission to address African developmental challenges through research-based approaches.

**Overview**

The course will help in developing the skills in trained students that is needed to assist the nation in its efforts to achieve self-sufficiency in the processing and preservation of agricultural produce needed for industrialization, food stability and for tackling post-harvest losses, and thus aiding the SDG goal of zero hunger in the world.

**Objectives**

The objectives of the course are to:

1. Apply theoretical knowledge acquired in developing and processing products from foods of plant and animal origin
2. Apply theoretical knowledge acquired in analysing developed products from foods of plant and animal origin
3. To instill knowledge in basic food analysis.
4. Introduce food microbiology practical methods
5. Describe the interrelationships of the different relevant fields in food processing

**Learning Outcomes**

At the end of this course, students should be able to:

1. Develop products from plant and animal sources

2. Evaluate the chemical constituents and quality of the developed products

3. Evaluate the chemical the basic microbiological quality of foods

4. Understand different basic processing methods

5. Differentiate the appropriate processing methods that can be practically used in different types of foods, based on their constituents

**Course Contents**

Preparation and processing of meats. Processing of milk into dairy products; Ice cream. Yoghurts. Cheeses. Butter. Whey. Cream. Condensed milk. Evaporated milk. Powdered milk. Pasteurized skimmed milk. Pasteurised whole milk. Quality tests in milk and milk products. Evaluation of shell egg quality including external appearance. Preparation and processing of fruits. Preparation and processing of roots and vegetable products. Preparation of canned and bottled fruits and vegetables. Spiced and fermented vegetables. Dehydrated fruits. Dehydrated Vegetables. Quality evaluation of dehydrated products.

**Minimum Academic Standards**

Food Science and Technology NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 412: Stability and Shelf life of Foods (3 Units; C: LH 45; Total 45)**

**Senate-approved relevance**

Coaching students of Food Science and Technology into graduates with skills on how to determine the stability and shelf life of foods forms a part of the required knowledge for the technology of processing and preservation of foods.

**Overview**

The course Stability and Shelf life of Foods is critical to the students of Food Science and Technology BUK. The course plays a vital role in addressing post processing changes that occur during storage of packaged food.

These changes are influenced by the chemical and physical changes in the internal environment created by the packaging system and the external environment in which the food is stored. This is very relevant for quality maintenance of the packaged foods before the expiration of their storage period, and it helps in ensuring safe wholesome foods that improves food stability.

**Objectives**

The objectives of the course are to:

1. Describe the importance of maintaining quality during the shelf life of foods
2. Examine the types of deterioration that occurs during the shelf life of products
3. Explain methods of Measuring or predicting shelf-life of foods
4. Describe the design of shelf-life experiments
5. Discuss methods of extending the shelf life of foods
6. Explain sensory evaluation methods for assessment of shelf life
7. Predict packaging characteristics to improve shelf-life

**Learning outcomes**

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

1. Explain the importance of predicting shelf life of foods
2. Explain the deterioration that occurs during the shelf life of products
3. Describe the methods of predicting shelf-life of foods
4. Explain how to design shelf-life experiments
5. Discuss sensory evaluation methods for assessment of shelf life
6. Predict packaging characteristics for the improvement of shelf-life

**Content**

Definition of shelf-life. Factors influencing shelf-life. Types of deterioration

Measuring shelf-life. Predicting shelf-life. The design of shelf-life experiments. Extending of shelf-life. Sensory evaluation methods for shelf-life assessment. Predicting packaging characteristics to improve shelf-life. The role of packaging in extending shelf-life. Integrating packaging and other methods of extending shelf-life. Predicting packaging characteristics for particular foodstuffs. Measuring shelf-life. Predicting shelf-life. The design of shelf-life experiments.

**Minimum Academic Standards**

Food Science and Technology NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 506: Food Process Engineering II (3 Units; C: LH 45; Total 45)**

**Senate-approved relevance**

Coaching students of Food Science and Technology into graduates with knowledge of Food Process Engineering II forms a part of the required knowledge for the technology of processing of foods.

**Overview**

The course Food Process Engineering II is critical to the students of Food Science and Technology BUK. Food process engineering is a quantitative as well as a descriptive science that deals with the quantitative analysis of food processes.

The course plays a very important role in the transformation and preservation of foods, with preservation being specific to processed foods, as emphasized by the International Union of Food Science and Technology (IUFoST). The food processing and manufacturing industry improve food security, sufficiency, and self-reliance in Nigeria and the world over.

**Objectives**

The objectives of the course are to:

1. Explain the concept of refrigeration and freezing
2. Discuss refrigeration equipment, methods, cold storage and refrigerated transport.
3. Discuss mechanical separation in food processing
4. Evaluate the concept of energy utilization and renewable energy in food processing.
5. Describe heat exchangers (types, features, advantages and maintenance).
6. Explain process automation and control in the context of food processing.

**Learning outcomes**

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

1. Describe refrigeration to some thermodynamics principles
2. Explain how low temperature is generated and maintained for the purpose of food preservation
3. Differentiate between refrigeration and freezing and their effect on microorganisms and enzymes
4. Explain the relationship between low temperature on the physical and sensory properties of foods
5. Describe the principles, design features, operations and maintenance of machineries used in food industries for mechanical separations
6. Explain the concept and applications of heat exchange with regards to the food industry
7. Explain the importance of mechanical separation in the food industry
8. Appraise energy utilization and the prospects of renewable energy in food processing;
9. Explain how to maintain specific variables for automatic process control

**Course Content**

Refrigeration, equipment and methods. Chilling. Cold storage and refrigerated transport. Food freezing. Phase transition and freezing point. Solute concentration. Freezing kinetics. Freezing time. Effect of freezing on product quality. Mechanical separations. Sedimentation. Centrifugation. Filtration. Distillation. Size reduction. Screening and particle size analysis. Concepts of energy utilization and renewable energy in food processing. Heat exchangers (types, features, advantages and maintenance). Elements of process control and automation.

**Minimum Academic Standards**

Food Science and Technology programme NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 507: Food Biotechnology (2 Units C: LH 30; Total 30)**

**Senate-approved relevance**

Training students of Food Science and Technology in Food biotechnology increases the students with versatility in approach to food product development and research methods that are required for tackling post-harvest losses, which aids in tackling the food insecurity issue in Nigeria, as well as the SDG goal of zero hunger in the world.

**Overview**

The study of food biotechnology deals with an understanding of its application in food processing and production. It provides appropriate skills to solve technical problems using microbial strains and enzymes.

It also equips the student with knowledge of enzyme sources, production techniques and applications in foods, for the production of safe, nutritious and wholesome food products to consumers particularly in Nigeria and West African sub-region for food security

**Objectives**

The objectives of the course are to:

1. Discuss the principles and scope of food biotechnology.
2. Review the bacteria and fungi of biotechnological importance (cultivation, maintenance and storage)
3. Explain the role of biotechnology in improving the texture and appearance of food
4. Study strain improvement techniques of microorganisms of importance in food biotechnology
5. Demonstrate plant and animal cell culture techniques.
6. Discuss enzyme sources, production techniques and uses in foods.

**Learning Outcomes**

At the end of this course, the students should be able to:

1. Explain the application of biotechnology in food production

2. Describe practical skills in using nucleic acids sequences

3. Recommend appropriate measures to solve technical problems using microbial strains and enzymes.

4. Explain the use of biotechnology in slowing down the process of food spoilage

5. Describe the application of biotechnology in vitamin production

6. Describe the application of biotechnology in amino acid production

**Course Contents**

Scope and principles of biotechnology. Bacteria and fungi of biotechnological importance (cultivation, maintenance and storage). Strain improvement techniques. Selection of appropriate techniques. Mutation techniques. Recombination and gene manipulation. Plant and animal cell culture techniques. Enzymes in food biotechnology and their sources. Production techniques of enzymes and their uses in foods.

**Minimum Academic Standards**

Food Science and Technology programme NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 508 Food Processing Machinery (2 Units C: LH 30; Total 30)**

**Senate-approved relevance**

Coaching students with fundamental knowledge of food processing machinery impacts greatly on food processing by instilling acquired knowledge and skills into food manufacturing practices that improve food security and sufficiency, and a renewed commitment to general self-reliance in Nigeria and Africa in general.

**Overview**

The study of food processing machinery gives an in-depth knowledge into the design concept, features and functions of food processing equipment needed in the manufacturing of food products. This course is critical to the students of Food Science and Technology BUK so as to provide them with some basic knowledge required for the design and specification of equipment appropriate for handling foods.

This aids the food manufacturing process that is required for tackling post-harvest losses and thus aiding the SDG goal of zero hunger in the world.

**Objectives**

The objectives of the course are to:

1. Describe the design features of equipment used in the food Industry
2. Enumerate the functions of equipment used in the food Industry
3. Describe the basic design and specification methods of food processing equipment
4. Design simple food processing machinery or equipment.
5. Design and specify food machinery processing sequence of operations in the food industry

**Learning Outcomes**

At the end of this course, the students should be able to:

1. Describe the different food processing equipment available

2. Explain mechanical processes involving compression, shear or impact force;

3. Discuss the required equipment in a particular food processing plant

4. Sequence the mode of a process based on the equipment and the end product

5. Explain the process of cleaning in the food industry based on installed equipment.

**Contents**

Design features of equipment used in the food Industry. Functions of equipment used in the food Industry. Equipment for cleaning. Equipment for sorting. Equipment for grading. Equipment for size reduction. Equipment for mixing. Equipment for homogenization. Equipment for filtration. Equipment for distillation. Equipment for centrifugation. Equipment for sedimentation. Equipment for evaporation. Equipment for dehydration. Equipment for extrusion. Design of simple food processing machineries. Equipment for process control.

**Minimum Academic Standards**

Food Science and Technology programme NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**FST 509 Beverages and Confectionary Technology (2 Unit; C: LH 30; Total 30)**

**Senate-approved relevance**

Training students of Food Science and Technology in beverages and confectionary technologyprovides the students with knowledge that will help in developing the skills needed to assist the nation to achieve self-sufficiency in the processing and preservation of developed and improved beverages and confectionary using local agricultural raw materials. This is needed for industrialization, food stability and for tackling post-harvest losses, and thus aiding the SDG goal of zero hunger in the world.

**Overview**

The course beverages and confectionary technologyprovide**s** the students of Food Science and Technology of BUK with the basic knowledge required in skilled technical and managerial manpower for agro-allied industries. This is needed for the production, processing and preservation of beverages and confectionary using locally available raw materials, or for upgrading local and/or existing products.

It builds capacity in the students for setting up cottage food processing industries (to reduce post-harvest food losses especially in fruits and vegetables), as well as making nutritious and wholesome shelf stable beverages available to consumers, particularly in Nigeria and the West African sub region, thereby solving relevant societal problems.

**Objectives**

The objectives of the course are to:

1. Explain the classification of Carbonated and non-carbonated drinks.
2. Discuss water treatment for industrial food processing.
3. Review mineral water and table water production.
4. Discuss the manufacture of carbonated and non-carbonated beverages especially from local raw materials.
5. Determine the categories of local Beverages
6. Discuss the manufacture of tea, coffee, cocoa and allied drinks.
7. Compare the local with the conventional confectionery industry.
8. Review traditional beverages and confectionaries.

**Learning Outcomes**

At the end of the course, students are expected to:

1. Describe the processes involved in water treatment
2. Explain the carbonation process in carbonated beverages
3. Describe syrup production
4. Explain the pasteurization process as applicable to non-carbonated beverages
5. Differentiate between the processing methods of different beverages
6. Differentiate between the different categories of confectionaries
7. Analyse the quality characteristics of confectionary products
8. Compare the processing methods and equipment used in the production of conventional and traditional products

**Course Content**

Introduction. Water treatment for industrial food processing. Mineral water and table water production. Classification and manufacture of Carbonated beverages. Classification and manufacture of non-carbonated beverages. Categories of Local Beverages. Reconstitutable and ready to consume beverages. The manufacture of tea. The manufacture of coffee. The manufacture of cocoa and allied drinks. Review of the conventional confectionery industry. Chocolates manufacture. Fondants. Icing sugar. Candies. Prospects in traditional confectionaries and sweeteners.

**Minimum Academic Standards**

Food Science and Technology programme NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 510 Food Dehydration Technology (3 Units; C: LH 45; Total 45)**

**Senate-approved relevance**

Training students of Food Science and Technology in **Food Dehydration Technology**

provides the students with knowledge that will help in developing the skills needed to assist the nation to achieve self-sufficiency in through processing and preservation of dehydrated products for industrialization, food stability and for tackling post-harvest losses, and thus aiding the SDG goal of zero hunger in the world.

**Overview**

The course Food Dehydration Technologyprovide**s** the students of Food Science and Technology of BUK with the basic knowledge required in skilled technical and managerial manpower for agro-allied industries. This is needed for the production, processing and preservation of agricultural produce using locally available raw materials, or for upgrading local and/or existing products.

It builds capacity in the students for setting up cottage food processing industries (to reduce post-harvest food losses especially in fruits and vegetables), as well as in making nutritious and wholesome shelf stable products available to consumers, particularly in Nigeria and the West African sub-region, thereby solving relevant societal problems.

**Objectives**

The objectives of the course are to:

1. Explain the thermodynamics of moist air

2. Describe the Basic principles of drying

3. Explain the mechanisms of convective drying

4. Discuss the effect of external conditions on the drying

5. Evaluate drying under varying external conditions

6. Explain the rehydration characteristics of different foods

7. Discuss new issues in food drying technology

**Learning outcomes**

At the end of the course, students are expected to:

1. Explain the basic principles of food Dehydration
2. Describe the thermodynamics of moist air
3. Explain the different drying stages
4. Describe the three different types of drying methods
5. Enumerate at least ten different types of industrial dryers
6. Discuss pre-drying and post drying treatments
7. Explain the rehydration characteristics of different groups of foods

**Content**

Introduction. Thermodynamics of moist air (psychrometry). Basic principles. Humidity. Saturation, relative humidity (RH). Adiabatic saturation. wet-bulb temperature. Dew point. Convective drying (air drying). The drying curve. The constant rate phase. The falling rate phase. Calculation of drying time. Effect of external conditions on the drying rate. Characteristic drying curves. Drying under varying external conditions. Batch drying on trays. Through-flow batch drying in a fixed bed. Continuous air drying on a belt or in a tunnel. Conductive (boiling) drying. Dryers in the food processing industry. Issues in food drying technology. Pre-drying treatments. Effect of drying conditions on quality. Post-drying treatments. Rehydration characteristics. Agglomeration. Energy consumption in drying. Osmotic dehydration.

**Minimum Academic Standards**

Food Science and Technology programme NUC-MAS requirement facilities.

**Bayero University, Kano (BUK)**

**Agriculture**

**Food Science and Technology**

**B. Tech Food Science and Technology**

**BUK-FST 511 Food Analysis (3 Unit; C: LH 45)**

**Senate-approved relevance**

Training students of Food Science and Technology in food analysis will help in developing the skills needed to assist the nation to achieve self-sufficiency in the processing and preservation of developed and improved products. This is needed for industrialization, food stability and for tackling post-harvest losses, and thus aiding the SDG goal of zero hunger in the world.

**Overview**

The course food analysisprovide**s** the students of Food Science and Technology of BUK with the basic knowledge required in skilled graduates for the agro-allied industries. It is needed for the analysis of raw materials, work in progress, and finished products. Food analysis is necessary for achieving end products with high quality, which is necessary for setting up cottage food processing industries, as well as for making wholesome shelf stable end products available to consumers, particularly in Nigeria and the West African sub region.

**Objectives**

The objectives of the course are to:

1. determination of food composition and characteristics
2. to ensure the quality and safety of the food supply.
3. quality management program throughout the development process
4. problem samples and competitor products
5. for regulatory purposes and typical quality control
6. Validation of the method for the specific food
7. Making an appropriate choice of the analytical technique for a specific application

**Learning outcomes**

At the end of the course, students are expected to:

1. Understand Government Regulations and International Standards Related to Food Analysis
2. Evaluate analytical data
3. Understand sampling and sample preparation.
4. Carry out compositional analysis of foods
5. Understand the methods of fat characterization
6. Carry out protein separation and characterization procedures
7. Analyse food contaminants, residues, and chemical constituents of concern in foods.

**Content**

Introduction to Food Analysis. United States Government Regulations and International Standards Related to Food Analysis. Nutrition Labeling. Evaluation of Analytical Data. Sampling and Sample Preparation. Compositional Analysis of Foods. Moisture and Total Solids Analysis. Ash Analysis. Fat Analysis. Protein Analysis. Carbohydrate Analysis. Vitamin Analysis. Traditional Methods for Mineral Analysis. pH and Titratable Acidity. Fat Characterization. Protein Separation and Characterization Procedures. Application of Enzymes in Food Analysis. Immunoassays. Analysis of Food Contaminants, Residues, and Chemical Constituents of Concern. Analysis for Extraneous Matter. Determination of Oxygen Demand.

**Minimum Academic Standards**

Food Science and Technology programme NUC-MAS requirement facilities