**Bayero University, Kano (BUK)**

**Faculty of Agriculture**

(**Department of Agricultural Economics and Extension, Department of Agronomy, Department of Animal Science, Department of Crop Protection, and Department of Soil Science)**

**B. Agriculture**

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Level 100** | | | | | |
| Course Code | Course Title | Unit | Status | LH | PH |
| BUK-AGG 101 | Introductory Agricultural Statistics | 2 | C | 30 | - |
|  | Total | 2 |  |  |  |
|  | Grand Total | 31 |  |  |  |

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| **200 Level** | | | | | |
| Course Code | Course Title | Units | Status | LH | PH |
| BUK-AGE 201 | Household Resource Management | 2 | C | 30 | - |
| BUK-ANS 201 | Introduction to Agricultural Biochemistry | 2 | C | 30 | - |
| BUK-ANS 202 | Introduction to Animal Developmental Physiology | 2 | C | 30 | - |
| BUK-AGN 201 | Crop Anatomy, Taxonomy and Physiology | 2 | C | 30 | - |
| BUK-AGN 203 | Principles of Horticulture | 2 | C | 15 | 45 |
| BUK-CRP 201 | Introduction to Invertebrate Pests and Agricultural Microbiology | 3 | C | 30 | 45 |
| BUK-SOS 201 | Introduction to Soil Science | 2 | C | 30 | - |
| BUK-SOS 202 | Agroclimatology and Soil Conservation | 2 | C | 15 | 45 |
|  | Total | 17 |  |  |  |
|  | Grand Total | 36 |  |  |  |

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| **Level 300** | | | | | |
| Course Code | Course Title | Unit | Status | LH | PH |
| BUK-AGX 301 | Extension Teaching, Learning, Process and Methods | 2 | C | 30 | - |
| BUK-ANS 301 | Nutritional Biochemistry | 2 | C | 30 | - |
| BUK-ANS 302 | Introduction to Animal Products Processing and Preservation | 2 | C | 30 | - |
| BUK-AGN 301 | Principles of Irrigation and Drainage | 2 | C | 30 | - |
| BUK-AGN 302 | Physiology of Crop Growth & Development | 2 | C | 15 | 45 |
| BUK-CRP 301 | Introduction to Crop Pests and Diseases | 2 | C | 30 | - |
| BUK-CRP 302 | Crop Pests Ecology and Management | 2 | C | 30 | - |
|  | Total | 14 |  |  |  |
|  | Grand Total | 46 |  |  |  |

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| --- | --- | --- | --- | --- | --- |
| **Level 400** | | | | | |
| Course Code | Course Title | Unit | Status | LH | PH |
| BUK-AGG 401 | Agricultural Tour | 2 | C | 0 | 90 |
| BUK-AGG 402 | Seminar | 2 | C | 0 | 90 |
| BUK-CRP 402 | Crop Protection II | 3 | C | 0 | 135 |
| BUK-SOS 401 | Soil and Water Management | 3 | C | 0 | 135 |
|  | Total | 10 |  |  |  |
|  |  | 30 |  |  |  |

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| **Level 500 (Agricultural Economics and Extension Option)** | | | | | |
| Course Code | Course Title | Unit | Status | LH | PH |
| BUK-AGE 502 | Agribusiness Management and Finance | 2 | C | 15 | 45 |
| BUK-AGE 503 | Introduction to Econometrics | 2 | C | 30 | - |
| BUK-AGE 504 | Agricultural Policy and Development | 2 | C | 30 | - |
| BUK-AGE 506 | Agricultural Marketing and Prices | 2 | C | 15 | 45 |
| BUK-AGX 501 | Rural Community Development | 2 | C | 30 | - |
| BUK-AGX 502 | Agricultural Technology Transfer and Rural Society | 2 | C | 30 | - |
| BUK-AGX 505 | Human Right, Gender Analysis and Social Inclusion | 2 | C | 30 | - |
| BUK-AGX 506 | Agricultural Project Appraisal, Management and Evaluation | 2 | C | 30 | - |
| BUK-AGX 507 | Systems Thinking for Changing Agriculture | 2 | C | 30 | - |
|  | Total | 18 |  |  |  |
|  | Grand Total | 36 |  |  |  |
| **Level 500 (Animal Science Option)** | | | | | |
| Course Code | Course Title | Unit | Status | LH | PH |
| BUK-ANS 503 | Genetics and Biotechnology | 3 | C | 30 | 45 |
| BUK-ANS 504 | Equine and Camelid Production | 2 | C | 15 | 45 |
| BUK-ANS 507 | Feeds and Feeding Principles | 2 | C | 15 | 45 |
| BUK-ANS 508 | Animal Products and By-Products Processing and Value Addition | 3 | C | 30 | 45 |
| BUK-ANS 509 | Ruminant Nutrition | 2 | C | 15 | 45 |
| BUK-ANS 511 | Non-Ruminant Nutrition | 2 | C | 15 | 45 |
| BUK-ANS 512 | Beef and Dairy Cattle Production | 2 | C | 15 | 45 |
| BUK-ANS 513 | Introduction to Animal Behaviour | 2 | C | 15 | 45 |
|  | Total | 18 |  |  |  |
|  | Grand Total | 30 |  |  |  |
| **Level 500 (Agronomy Option)** | | | | | |
| Course Code | Course Title | Unit | Status | LH | PH |
| BUK-AGN 501 | Root, Tuber, Fibre, Sugar, Forage and Fodder Crops | 2 | C | 30 | - |
| BUK-AGN 502 | Farming Systems | 2 | C | 30 | - |
| BUK-AGN 503 | Crop Breeding & Biotechnology | 2 | C | 15 | 45 |
| BUK-AGN 504 | Seed Production Technology | 2 | C | 30 | - |
| BUK-AGN 505 | Postharvest Physiology, Processing and Storage | 2 | C | 30 | - |
| BUK-AGN 506 | Weed Science and Management | 2 | C | 15 | 45 |
| BUK-AGN 507 | Irrigation Agronomy | 2 | C | 30 | - |
| BUK-AGN 508 | Principles of Landscape Horticulture | 2 | C | 15 | 45 |
| BUK-CRP 501 | Plant Diseases Development, Epidemiology & Management | 2 | C | 15 | 45 |
| BUK-CRP 504 | Crop Protection Technology | 2 | C | 15 | 45 |
|  | Total | 20 |  |  |  |
|  | Grand Total | 33 |  |  |  |
| **Level 500 (Crop Protection Option)** | | | | | |
| BUK-CRP 501 | Plant Diseases Development Epidemiology & Management | 2 | C | 15 | 45 |
| BUK-CRP 502 | Principles of Bee-keeping and Mushroom Production | 2 | C | 15 | 45 |
| BUK-CRP 503 | Field and Storage Pests and their Management | 2 | C | 15 | 45 |
| BUK-CRP 504 | Crop Protection Technology | 2 | C | 15 | 45 |
| BUK-AGN 502 | Farming Systems | 2 | C | 30 | - |
| BUK-AGN 504 | Seed Production Technology | 2 | C | 30 | - |
| BUK-AGN 505 | Postharvest Physiology, Processing and Storage | 2 | C | 30 | - |
| BUK-AGN 506 | Weed Science and Management | 2 | C | 15 | 45 |
|  | Total | 16 |  |  |  |
|  | Grand Total | 29 |  |  |  |
| **Level 500 (Soil Science Option)** | | | | | |
| Course Code | Course Title | Unit | Status | LH | PH |
| BUK-SOS 501 | Soil Genesis and Pedometric | 3 | C | 30 | 45 |
| BUK-SOS 503 | Soil Chemistry and Mineralogy | 3 | C | 45 | - |
| BUK-SOS 504 | Soil Microbiology and Biochemistry | 3 | C | 45 | - |
| BUK-SOS 505 | Soil, Plant and Water Analyses | 2 | C | 15 | 45 |
| BUK-SOS 506 | Application of GIS and Remote Sensing in Soil Science | 3 | C | 30 | 45 |
| BUK-SOS 507 | Soil-Water-Plant Relations | 3 | C | 30 | 45 |
|  | Total | 17 |  |  |  |
|  | Grand Total | 30 |  |  |  |
| **\*Level 500 (Faculty – Electives: 4 Credits)** | | | | | |
| Course Code | Course Title | Unit | Status | LH | PH |
| BUK-AGR 501 | Food Systems, Agricultural Technology and Precision Agriculture | 2 | E | 30 | - |
| BUK-AGR 504 | Sustainable and Climate Smart Agriculture | 2 | E | 30 | - |
| BUK-AGE 502 | Agribusiness Management and Finance | 2 | E | 30 | - |
| BUK-ANS 512 | Beef and Dairy Cattle Production | 2 | E | 30 | - |

\*Students of any option at 500 Level must register a minimum of 4 Credit Units of the Faculty elective courses.

**100 Level**

**BUK-AGG 101: Introductory Agricultural Statistics (2 Unit; Core) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates who can lead agricultural statistics research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

Statistics is a familiar and accepted part of modern world that is concern with obtaining an insight into the real word by means of the analysis of numerical relationships. It is used in almost all fields of human endeavour.

Since this course Introductory Statistics entails analysis of numerical relationships, we will focus on the meaning of statistics and biostatistics (collections of quantitative information and method of handling such data, descriptive analysis of the observation). We will also discuss frequency of distribution, measures of locations and probability. This course exposes students to basic statistics and descriptive statistics, the knowledge will be helpful in further statistics at higher levels. It is indeed very interesting field of agriculture and biology.

**Objectives**

The objectives of the course are to:

1. Mention the at least 5 uses of statistics in area of agriculture.
2. Describe the different sampling methods and understand the purpose and importance of sampling
3. Mention 3 types of frequency distributions.
4. Organize data using frequency distribution.
5. Explain the normal and binomial distributions.
6. Compute correlation and regression.

**Learning Outcomes**

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

1. Outline the at least 5 uses of statistics in area of agriculture.
2. Describe the different sampling methods and understand the purpose and importance of sampling
3. Mention 3 types of frequency distributions.
4. Organize data using frequency distribution.
5. Explain the normal and binomial distributions.
6. Compute correlation and regression.

**Course Contents**

Basic concepts of statistics. Application of statistics in agriculture. Population and Sample. Frequency distribution, measures of location, measures of variation. Probability distribution, normal and binomial distributions. Histograms, means, mode and median, sampling, data collection, data processing techniques. Hypothesis testing of attributes data. Correlation and regression analysis.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**200 Level**

**BUK-AGE 201: Household Resource Management (2 Units; Core) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates who can lead in household resource management research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

Household resource management is an essential course that assist is preparing Agricultural students to understand the place and value of resources and their management process. The course is essential to assist student in understanding household as a socioeconomic unit which serves as beginning of human development to prepare the household as a contributing member for economic development.

Rural and urban household are saddled with responsibility of managing human and material resources which serves as the basis for income generation, productivity increase and overall livelihood improvement. The course was objectively designed to provide details of household management, activities for development, food security and gender inclusion, efficiency in household resources as well as sustainable approach for effective control and utilization of the available resources.

**Objectives**

The objectives of the course are to:

1. Illustrate the philosophy and significance of household resource management.
2. Describe family values and its significance in societal development.
3. Discuss the major characteristics of household resource and their management process.
4. Outline the strategies for maximizing the use of household resources.
5. Discuss food security and it’s important to developing countries.
6. Highlight the different type of food insecurity and suggest ways of reducing food insecurity.
7. Describe gender analysis and its application in participatory research approach.
8. Highlight the best approach for household resource inventory.
9. Discuss the importance of gender inclusion in decision making for household resource utilization.

**Learning Outcomes**

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

1. Identify at least 5 family values, their significance and factors that influence the value system.
2. Enumerate at least 3 major contributions of household to the economy of the nation.
3. Enumerate 5 ways of maximizing the use of household resources.
4. Define food security and highlight its dimensions.
5. Identify and discuss at least 5 ways of reducing household food insecurity.
6. Describe gender analysis as tool for household assessment.

**Course Contents**

Philosophy, scope, and objectives of home economics. Historical development of home economics. Examination of basic human needs (food clothing, shelter, and health). Programme approaches in home economic which will help meet this need. Preparation for careers in a variety of occupations. Concept of family as a social unit. Definition of terms related to household resources management. Extended roles of home economics in the face of Globalization. Global trend and household resource management. Designing and implementation of home economics research in rural areas. Socio-economic and gender analysis as a tool for conducting household resources management research. Case studies.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK-ANS 201: Introduction to Agricultural Biochemistry (2 Units; Core) (LH = 15; PH = 45)**

**Senate-Approved Relevance**

To produce graduates who can lead in Agricultural Biochemistry research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

Animal nutrition is one of the most diverse disciplines in the animal sciences. Its sub-disciplines range from the biochemistry of nutrient use and digestive physiology among other disciplines. There is a significant overlap between nutrition and biochemistry. These two disciplines are inter­dependent and closely related.

Biochemistry is the basis for studying the utilization of nutrients by animals and humans. Nutritional and biochemical studies are often indistinguishable because both are intended to understand how organic and inorganic molecules interact to support animal metabolism. In essence, biochemistry helps us understand how animals act as transformers of Dry Matter and energy into molecules that are required for all physiological functions. Generally, the course offers broader concept on the chemistry of carbohydrate, proteins, lipids, minerals and vitamins, as well as hormones.

**Objectives**

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

1. Identify the functions of macromolecules (carbohydrates, lipids, proteins, nucleic acids, enzymes, minerals, and vitamins)
2. Recognize the chemistry of macromolecules.
3. State the advances in nutrients studies.
4. Explain the nature of enzymes and hormones.
5. Classify enzymes and hormones.
6. Explain the functions of enzymes and hormones.

**Learning Outcomes**

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

1. Explain at least 5 functions of different macromolecules.
2. Identify all different functional groups of macromolecules.
3. Explain at least 3 different classifications of macromolecules.
4. Describe the nature of enzymes and hormones.
5. Mention at least five (5) enzymes and hormones.
6. Explain five (5) functions of enzymes and hormones.

**Course Contents**

Chemistry of carbohydrates. Importance of carbohydrates. General properties of carbohydrates. Classification of carbohydrates. Chemistry of lipids, Importance of lipids. Functions of lipids. Classification of lipids. Chemistry of protein. Classification of Proteins. Chemistry of nucleic acids. Functions of nucleic acids. Water chemistry. Vitamins and their coenzyme functions. Minerals. The nature, classification and functions of enzymes. The nature, classification and functions of hormones.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK-ANS 202: Introduction to Animal Developmental Physiology (2 Units; Core) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates who can lead in research and education on environmental physiology of farm animals in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

Animal growth, development and environmental physiology is a course which has important implications for domestic animal production because they significantly influence the value of the animal being produced and it also introduces the basis of livestock animals commonly grown in the region, focusing on digestive, reproduction, lactation and endocrinological aspects linking them with other systems.

The course also encompasses a comparative examination of interaction between animals and their environment including physiological adaptations to extreme environments (e.g., arctic, desert); responses to acute and chronic environmental stress (e.g., hypoxia, temperature); environmental regulation of normal physiological processes and uses of comparative models in other fields.

**Objectives**

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

1. Explain the core concepts of animal growth.
2. Describe the dynamic forces that influence early embryonic, prenatal, and postnatal growth and development of domesticated livestock and other mammalian species.
3. Discuss the fundamentals of cell biology and connective tissue, muscle, bone and fat anatomy, formation, and function.
4. Explain tissue growth in context of endocrine, paracrine, and autocrine modified.
5. Summarize factors that control and influence animal growth and development including environment, endocrine, fertility promoters and genetic engineering.
6. Explain the interaction of the animal with its environment (social and physical) rather than the mechanisms of homeostatic feedback within an individual.
7. Examine the functioning of major organs and tissues from a comparative perspective.
8. Emphasize on physiological functions as an array of evolutionary adaptation to an ecological niche.
9. Emphasize on the environment which leads us to consider the impacts of environmental disturbances, including contaminants, on the welfare of wild animals.

**Learning Outcomes**

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

1. Describe all the fundamentals of cell biology and conservation of muscle tissue, muscle bone and fat anatomy, formation, and function.
2. Mention at least 5 dynamic forces that influence early inheritance.
3. Explain the core concept of animal growth.
4. Classify 3 thermos-neutral zone.
5. Describe the physiology of heat stress.
6. Categorize the farm animals’ responses to heat stress.
7. List the mechanisms of temperature regulation.
8. Assess the magnitude of heat stress and its effects.
9. Discuss on how to improve animal comfort and performance.

**Course Contents**

General features, early development, organ formation, ectodermal, mesodermal, and endodermal derivatives, post embryonic development, maturity and death. Effects of climate on livestock production, acclimatization and adaptation, physiological basis of adaptation, sensitive and insensitive heat loss, heat stress, physiological responses to heat stress, hormonal response, sweating, panting, depressed feed intake, heart rate, respiratory rate, rectal temperature, determination of heat stress indices, behavioral responses to heat stress, modification of the microclimate to enhance animal productivity, management of exotic breed in tropical environment.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS

**BUK-AGN 201: Crop Anatomy, Taxonomy and Physiology (3 Units, Core) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates who will lead in research and education in Africa and are knowledgeable in the anatomy, taxonomy and physiology of crops which will ensure their commitment to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates

**Overview**

Introductory anatomy, taxonomy and physiology of crops is a major building block for understanding of crops response to environment and general agronomic practices. Training graduates on crop anatomy will give them an understanding of the physical attributes of major crop plants which will give justification of various technologies that needs to be adopted for crop management.

Crop physiology prepares the students for understanding the internal make up of plants and how they respond to environmental changes. The understanding of plant taxonomy prepares students on the naming convention of crops and this relates to the anatomy and physiology of the crops. A course that combines all three is sure to provide students with the basic biological background that influences agronomic decisions in crops.

**Objectives**

At the end of the course the student should be able to:

1. Describe the nature, structure and function plant cells, tissues, and organs.

2. Determine the developmental stages of plant cells and tissues and how this influences the properties of organs.

3. Describe the anatomy of major plant organs.

4. Explain the principles and system of plant classification.

5. Trace the origin, distribution, and economic importance of major crops in Nigeria.

6. Describe the process of plant identification using plant keys and their characteristics.

7. Recognize the various principles of plant organization (families, orders, classes, genus, and species names).

8. Identify the various ways of material translocation in plants.

9. Memorize the concept of enzymes and their importance in plants.

10. Describe the concept of photosynthesis in plants.

**Learning Outcomes**

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

1. Describe the structure and functions of at least 5 components of plant cells.

2. Identify at least 5 differences between collenchyma and sclerenchyma tissues, typical root and shoot anatomy, Xylem and phloem tissues.

3. Explain the 3 basic principles of plant classification

4. Identify at least 4 different plant families using the plant keys

5. State the economic importance of at least 1 member of the following families; *Gramineae*, *Fabaceae*, *Compositae*, *Dioscoraceae* and *Rutaceae*.

6. List at least 5 ways of materials translocation in plants.

7. Explain the concept of enzymes and photosynthesis

**Course Contents**

Parts of crop cell types. Plant Cell biology. Development of cells and tissues. Types of plant tissues. Pollination and Fertilization. Principles and system of plant classification. Plant Keys. Origin, characteristics, distribution and economic importance and local examples of Gramineae. Origin, characteristics, distribution and economic importance and local examples of *Leguminosae*. Origin, characteristics, distribution and economic importance and local examples of *Compositae*. Origin, characteristics, distribution and economic importance and local examples of *Dioscoraceae*. Origin, characteristics, distribution and economic importance and local examples of *Rutaceae*. Use of plant keys. Translocation and movement of materials in plants. Enzymes. Photosynthesis.

**Minimum Academic Standards (MAS)**

The required facilities for the course have been adequately captured.

**BUK-AGN203: Principles of Horticulture (2 Units, Core) (LH= 15; PH=45)**

**Senate-Approved Relevance**

To produce graduates who lead in research and education of horticultural crops in Africa who are committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates

**Overview**

Principles of horticulture refer to the fundamental concepts, theories, and practices that govern the cultivation, management, and use of horticultural crops for human purposes. It also encompasses the application of various techniques and technologies used in the cultivation and management of fruits, vegetables, and ornamentals. Techniques such as propagation, irrigation, fertilization, and pest management.

Principles of horticulture is aimed at developing and implementing sustainable and efficient methods for producing healthy, high-quality crops for food, medicine, and ornamental use. Overall, the principles of horticulture involve understanding the biology and growth of crops, as well as the appropriate techniques and practices for propagating, growing, and maintaining healthy plant, knowledge of garden design, pruning, transplanting, tree training, and production systems to create beautiful, productive outdoor spaces.

**Objectives**

At the end of the course the student should be able to:

1. Demonstrate the skills required for nursery establishment and management.

2. Explain the environmental factors affecting successful growth and development of fruits and vegetables.

3. State any 3 examples each of sexual and asexually propagated crops

4. Distinguish between sexual and asexual propagation techniques of fruits and vegetables.

5. Demonstrate the interest in horticultural (fruit, vegetables and ornamental) crops enterprise.

**Learning Outcomes**

On completion, the students should be able to:

1. List and explain 10 essential nursery management techniques.

2. List and explain all the environmental factors affecting growth and development of fruits and vegetables.

3. List at least 4 differences between sexual and asexual propagation.

4. Enumerate 5 examples each of sexual and asexually propagated crops.

5. Illustrate and differentiate between different vegetative propagations of horticultural crops

**Course Contents**

Definition of Horticulture. History of horticulture. Essentials of nursery management. Soil and water management of horticultural crops. Nursery structures. Compost preparations and application. Tools and equipment use nursery. Environmental factors affecting vegetables and fruits cultivation. Propagation of plants. Sexual and asexual reproduction. Vegetative propagation; budding, grafting, layering. Pruning, and training of horticultural plants. Ornamental gardening.

**Minimum Academic Standards (MAS)**

The required facilities for the course have been adequately captured.

**BUK-CRP 201; Introduction to Invertebrate Pests and Agricultural Microbiology (3 Units; Core) (LH = 30; PH = 15)**

**Senate-Approved Relevance**

To produce graduates who can lead in Invertebrate Pests and Agricultural Microbiology research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

The Introduction to Invertebrate Pests and Agricultural Microbiology course is aimed at preparing students to be involved in functional and collaborative teams that to characterize and differentiate different classes of Helminthes, Arthrpods, Bacteria, Fungi and Viruses for improved pests management and sustainable crop production.

The course focuses on understanding knowledge and skills on the general characteristics and morphology of invertebrate pests and agricultural microbes. The practical sessions aim to develop skills in Invertebrate pests management, Agricultural Microbiology and research techniques.

**Objectives**

On completion of the Course, the students will be able to:

1. Identify and characterize different classes of helminthes and Arthropods.
2. Describe major insect orders and diagnose their morphological features.
3. Outline the elementary insect physiology and ecology.
4. Describe the class Insecta-its abundance, variability and versatility.
5. Describe the general characteristics, morphology and reproduction of disease-causing organisms.
6. Explain the concept molecular biology and characterization of diseases pathogens.
7. Describe steps in characterization of pathogens.
8. Describe how to isolate and grow bacteria and fungi.
9. Explain the mechanisms by which microbe's infection
10. Describe the activation of plant immunity and symbiosis signaling pathways.

**Learning Outcomes**

On completion, the students should be able to:

1. List any five general characteristics and nomenclature of different invertebrate pests of crops in Nigeria.
2. Characterize at least three classes each of helminthes and Arthropods.
3. Enumerate any three major insect orders and their morphological features.
4. Describe with examples the concept of the elementary insect physiology and ecology.
5. State the general characteristics, morphology of bacteria, fungi and viruses.
6. Characterize different pathogens using molecular techniques; Isolation and growing of fungi and bacteria.
7. List at least three mechanisms by which microbe's infection occurs
8. Describe two activation methods of plant immunity and symbiosis signaling pathways.

**Course Contents**

*Helminthology*: Phylum Platyhelminthes; general characteristics and morphology of the class Trematoda and sub-classes homogenes and Digenea. General characteristics and morphology of the class Cestoda and sub-classes Cestodaria and Eucestoda. General characteristics and morphology of the class Nematoda and sub-classes Secernentea and Adenophorea. The plant parasitic nematodes. *Arthropods*: Outline of biological nomenclature; the position of the phylum Arthropoda in the Animal Kingdom. The classification of the Arthropoda; particular mention of the classes: Diplopoda, Cheilopoda, Crustaces, Arachnida and Insecta; their morphology and biology. The class Insecta-its abundance, variability and versatility and the class-Apterygotes, Exopterygotes and Endopterygotes. The major insect orders-their diagnostic morphological features; important families and species. Elementary insect physiology and ecology. General characteristics, morphology, reproduction and strain reaction of Bacteria. Principles of classification of Bacteria. Distribution, isolation and cultivation of Bacteria. Disinfectants, antiseptics and methods of sterilization. General characteristics, morphology, and cytology of Fungi. Modification of vegetative hyphae. Classifications-the Kingdom Mycetae and the divisions Gymnomycota, Mastigomycota and Amastigomycota. Brief consideration of important subdivisions, class and sub-classes. Soil-borne fungi: type, importance, distribution and mode of dispersal. Survival and competitive ability of soil-borne fungi. General characteristics, morphology and reproduction of viruses. Concepts and methods in molecular biology with emphasis on genetics of insects/microbes. Application of molecular techniques in pathogens/insect biology. Molecular biology and molecular genetics of pathogenic and symbiotic interactions between microbes and plants to explain the mechanisms by which microbe's infection and activation of plant immunity and symbiosis signaling pathways.

**Minimum Academic standards (MAS):**

The required facilities for the course have been adequately captured.

**BUK-SOS 201: Introduction to Soil Science (2 Units; Core) (LH =30)**

**Senate-Approved Relevance**

Training of high-quality graduates in any field of Agriculture requires basic knowledge of Soil Science. This is in line with BUK’s mission to address African developmental challenges in sustainable food production through production highly-skilled and knowledgeable graduates in Agriculture.

**Overview**

Introductory Soil Science course is critical in preparing the graduate of Agriculture to be able to handle and improve the developmental and infrastructural deficits for sustainable development.

This course is designed to afford the students of any field of agriculture to, first, become familiar with soils as natural units or entities and with their inherent characteristics. Second, to equip students with understanding of the significance of fundamental soil properties. Third, to set forth basic relationships between soils and plants. And finally, to appraise the students with basic principles involved in soil use and management. General principles of soil science are emphasized and explained in unambiguous terms, while most of the technical detailed are retained for students pursuing soil science at higher levels.

**Objectives**

At the end of the course the student should be able to:

1. Describe basic concepts and terms in Soil Science.

2. Describe and justify the importance of Soil Science.

3. Outline and explain basic chemical, physical and biological properties of soil.

4. Outline the origin, classification, and distribution of soils and their relationships with people and food production.

5. Appraise basic principles and management of soil fertility and plant nutrition; and

6. Categorize major types of problem soils and outline their remediation methods.

**Learning Outcomes**

On completion, the students should be able to:

1. Outline and describe basic concepts of Soil Science.

2. Describe basic physical, chemical, and biological properties of soils.

3. Classify types of problem soils and describe their remediation methods.

4. Differentiate between soil fertility and soil productivity.

5. List and describe roles of essential plant nutrients; and

6. Describe fertilizer and manure types, sources, and their methods of application.

**Course Contents**

History and development of Soil Science. Soils as a natural body. Soil components: Air, water, mineral and organic matter*. Physical properties of soil*: soil separates, texture, aggregation and structure, temperature, color, properties of soil mixture, pore space, bulk density, particle density, aeration, drainage and compaction. *Chemical properties of soil*: Soil colloids, ion exchange, soil reaction and problem soils and their reclamation. *Biological properties of soil*: Soil organism, microbial transformation of nutrients. *Soil fertility and fertilizers*: Soil fertility versus soil productivity, essential plants nutrients and their functions, manure and fertilizers (types, sources and methods of application).

**Minimum Academic Standards (MAS)**

B. Agriculture programme’s NUC-MAS requirement facilities.

**BUK-SOS202: Agroclimatology and Soil Conservation (2 Units; Core) (LH = 15; PH = 45)**

**Senate-Approved Relevance**

Training of high-quality graduates who are highly skilled and knowledgeable in understanding of climate and weather and their impacts on agriculture. This is in line with BUK’s mission to address African developmental challenges in sustainable food production through production highly-skilled and knowledgeable graduates in Agriculture.

**Overview**

Four factors-edaphic, climate, genotype and management practices shape agricultural growth and sustainability. The study of agroclimatology is fundamentally concerned with the weather and climate of any given area in relation to agriculture. Climatic and weather factors vary from place to place and beyond human manipulations except under a microenvironment. Thus, climate to a large extent, determines type of crop or livestock to be grown in an area, timing, and type of agricultural operations as well as the farming systems.

This course examines the various components of climate and weather as they affect agricultural productivity and proffer possible solutions to climate and weather-related problems confronting agriculture (especially in the tropics). It also focuses on the impact as well as the implications of climate variability/change and global warming on agriculture and how their adverse effects can be ameliorated. In addition, various methods of conserving soil and water resources for improved and sustainable agricultural production will be discussed in the course.

**Objectives**

At the end of the course the student should be able to:

1. Define agroclimatology and identify various elements of weather and climate.

2. Describe the dynamic of atmosphere and its composition.

3. Identify various wind systems and their distribution.

4. Outline the processes and measurements of hydrologic cycle.

5. Describe the characteristics of tropical climate; climate change and its impact of on agriculture and environment.

6. Examine ways to ameliorate climate change and global warming in agricultural systems and practices.

7. Explain and appraise different methods of soil conservation practices.

8. Illustrate the various techniques of water harvesting.

9. Identify various types and impacts of tillage practices with respect to soils and crops.

**Learning Outcomes**

On completion, the students should be able to:

1. Explain the meaning of agroclimatology, biogeography and climate change.

2. List the basic elements influencing weather and climate.

3. Describe the structure and composition of atmosphere.

4. Enumerate the wind systems and the pressure belts across the globe.

5. Describe the processes and measurements of hydrologic cycle.

6. Describe the characteristics of tropical climate; climate change and its impact of on agriculture and environment.

7. Illustrate the importance, classification, use and management of groundwater in agriculture.

8. Identify the various types and methods of soil and water management practices.

9. Appraise different techniques of water harvesting.

10. Explain impacts of water resource projects in agriculture and environment.

11. Explain causes, types, effects, prediction, and control of soil erosion; and

12. Present the effects of different tillage practices on soil and crops.

**Course Contents**

Basic definitions and background of agroclimatology and biogeography. Elements of climate and weather. Factors affecting weather and climate. Dynamics of earth’s atmosphere (structure and composition). Radiation and heating of the atmospheric systems. Dynamics of pressure and wind systems. Hydrologic cycle and measurements of its components. Tropical climate, effect of climate on soil, crop, livestock, irrigation, pest and diseases. Climate change, its characteristics, causes and mitigation, impact of climate changes on agriculture. Introduction to weather forecast. Variables of weather forecast and numerical weather predictions. Groundwater use and management. Water harvesting techniques. Soil and water conservation practices. Impacts of water resource projects. Soil erosion (causes, types, effects, prediction and control). Tillage effects on soil and crops.

**Minimum Academic Standards (MAS)**

B. Agriculture programme’s NUC-MAS requirement facilities.

**300 Level**

**BUK-AGX 301: Extension Teaching, Learning Process & Methods (2 Units; Core) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates who can lead in extension teaching learning process and methods research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

This course will provide students with appropriate knowledge and skills for effective technology transfer for better and sustainable agricultural development. The course will integrate theory and students’ knowledge and skills as well as experiences acquired from field practical trainings.

The overall aim of the course is to produce high-class graduates who are well trained in the applications of standard knowledge and skills for agricultural knowledge transfer to farmers for transformation, improvement and sustainable agricultural development.

**Objectives**

The objectives of the course are to:

1. Define communication and identify key elements of communication.
2. Explain the communication process.
3. Define the concept of teaching.
4. Explain the learning process in adult education.
5. Define the concept of motivation in learning process.
6. State the basic principles of teaching and learning in agricultural extension.
7. Develop learning objectives in teaching.
8. Identify and explain various extension teaching methods.
9. Identify, prepare, source and explain the use of teaching materials and aids.
10. Outline the change in the trend of technology development and transfer.
11. Describe the basic steps in participatory extension approach.

**Learning Outcomes**

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

1. Identify the key elements in communication process.
2. Explain the communication process for effective information dissemination.
3. Understand the concept of teaching in agricultural extension for technology transfer.
4. Analyze the learning processes in adult education.
5. Understand the concept of motivation in learning process.
6. State the basic principles of teaching and learning in agricultural extension.
7. Develop learning objectives.
8. Identify and analyze various extension teaching methods.
9. Identify, prepare, source and use of teaching materials and aids.
10. Understand the change in the trend of technology development and transfer.
11. Describe the basic steps in participatory extension approach.

**Course Contents**

Nature and elements of communication process. Principles of analyzing communication problems in extension. The meaning of the concepts of teaching, learning and motivation. Steps and principles of teaching and learning. Concept of E-learning. Extension teaching methods. Conditions for effective use of teaching methods. Classification of extension teaching methods. Concept of instructional materials. Preparation and use of teaching materials and aids. Improvisation of instructional materials in Agricultural extension. Sources of locally instructional materials. Concept of Participatory extension methods. Transfer of technology model. Bottom up approach. Participatory extension approaches. Basic steps and process of participatory extension approach. Concept of E-extension.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK-ANS 301: Nutritional Biochemistry (2 Units; Core) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates who can lead in nutritional biochemistry research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

Animal nutrition is one of the most diverse disciplines in the animal sciences. Its sub-disciplines range from the biochemistry of nutrient use and digestive physiology among other disciplines. Biochemistry is the science of the chemistry of living organisms, including microorganisms, ani­mals, and plants. There is a significant overlap between nutrition and biochemistry. These two disciplines are inter­dependent and closely related.

Biochemistry is the basis for studying the utilization of nutrients by animals and humans. Biochemists study the synthesis, degradation, and roles of protein, carbohydrates, lipids, vita­mins, and nucleic acids, as well as the function and metabolism of minerals at molecular, cellular, organ, and systemic levels. Generally, the course offers broader concept on the metabolism of carbohydrate, proteins, lipids, minerals and vitamins, as well as hormones.

**Objectives**

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

1. Learn the metabolisms of macromolecules (carbohydrates, lipids, proteins, nucleic acids, enzymes, minerals and vitamins)
2. Learn the causes of metabolic disorder and their symptoms.
3. Learn advances in nutrients studies.
4. Explain the nature of enzymes and hormones.
5. Classify enzymes and hormones.
6. Explain the functions of enzymes and hormones.

**Learning Outcomes**

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

1. Explain the different metabolic pathways of macromolecules.
2. Explain the synthesis and catabolism of nutrients.
3. Explain the metabolic disorder and its management.
4. Describe the nature of enzymes and hormones.
5. Mention at least five (5) enzymes and hormones.
6. Explain five (5) functions of enzymes and hormones.

**Course Contents**

Metabolism of carbohydrates, lipids, proteins and nucleic acids. Water chemistry. Vitamins and their coenzyme functions. Minerals. Chemistry and mode of action of enzymes and hormones. The nature, classification and functions of enzymes and hormones. Chemistry and analysis of selected agricultural products. Bio-energetics. Creb cycle.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK– ANS 302: Introduction to Animal Products Processing and Preservation (2 Units; Core) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates who can lead in animal products and by-products processing and value addition research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

Animal products processing and preservation is a significant course that train the graduates with the skills to handle, process and add value to the animal products and by-products for food security and agro-based industry development. This underscore the significance of training students in animal science with the knowledge and skills on proffering the solutions to the problems they may encounter in the course of their training.

This course is design to accomplish the recommendation of world health organization on the quantity of animal protein required per person per day.

**Objectives**

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

1. Differentiate between animal products and by-products.
2. Explain the state of meat, egg and milk industry in Nigeria.
3. Explain the difference between growth and development.
4. Explain the factors that influence body composition.
5. Describe the stages involved in the conversion of muscle to meat.
6. Identify properties of fresh meat and the best way to process and preserve meat.
7. Identify the importance of packaging and different types of packaging for meat.
8. Describe how egg is formed and produced.
9. Provide information on how egg can be processed and stored.
10. Describe the state of milk production in Nigeria.
11. describe the nutritional and physio-chemical qualities of good milk.
12. explain milk storage and preservation techniques.

**Learning Outcomes**

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

1. Identify animal products and by-products.
2. Explain the state of animal products industry in Nigeria.
3. Explain animal growth and development.
4. Describe body composition.
5. Describe slaughter and stages in conversion of muscle to meat.
6. Explain meat preservation, processing, and storage.
7. Describe egg formation, egg processing and storage.
8. Explain milk production, quality, nutritive value, processing, and storage.

**Course Contents**

Animal Products and By-Products. Animal Products Industry in Nigeria. Animal Growth and Development. Body Composition. Slaughter and Conversion of Muscle to Meat. Meat Preservation, Processing and Storage. Nutritive value of eggs. Parts of the Egg. Egg laying birds. Egg Formation and Production. Egg sorting and grading. Egg quality assessment. Egg Processing, preservation and Storage. Milk Production. Milk Quality. Milk Processing and Storage. Introduction to animal food microbiology. Spoilage of animal products and its control. Performance of indigenous meat, milk and egg producing animals.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK-AGN301: Principles of Irrigation and Drainage (2 Units; Core) (LH = 30**)

**Senate-Approved Relevance**

To produce graduates who will lead in research and education on irrigation and drainage that are committed to addressing African developmental challenges through, cutting-edge research, knowledge transfer, training, and increased crop production.

**Overview**

Water is one of the most important inputs in agriculture production. Since agriculture in Nigeria is majorly dependent on rainfall, there is a great connectivity between intensity and spread of rainfall to crop production. The uncertainties associated with rainfed agriculture can be met via adoption of methods of irrigation. Irrigation is the number one consumer of water globally, utilizing over 70% of the world’s freshwater. Sustainable water use for food production, human consumption and industrial use are prime global challenges at present. Since agriculture is the largest user of water, farmers must accept the challenge of making it to be more efficient in a food secure world.

Production of food, fiber, fuel and other industrial inputs with less water availability is becoming a major challenge for both rainfed and irrigated agriculture. Considering these facts, this course is designed to give thorough knowledge of water, agriculture, and their relationships so that associated challenges can be overcome.

**Objectives**

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

1. Identify the roles of water in crop production.

2. Enumerate the different methods of assessing crop water requirement.

3. Analyze the various irrigation systems, adaptabilities, merits, shortcomings, and efficiencies.

4. Enumerate the different sources of water for irrigation in Nigeria.

5. Describe soil drainage systems and their implications on irrigation efficiency.

6. Describe moisture stress and its physiological implication on the productivity of crops.

7. Categorize the different challenges associated with soil salinity and alkalinity and ways of their management.

**Learning Outcomes**

On completion, the students should be able to:

1. State at least 5 roles of water in crop production

2. List any 4 methods of assessing crop water requirement.

3. State any 4 merit and demerits of at least two irrigation systems.

4. State any 4 merit and demerit of drainage.

5. Explain at least 5 effects of moisture stress on crop production.

6. List any 3 ways of managing soil salinity and alkalinity.

**Course Contents**

Role of water in crop growth. Concepts of soil water availability. Irrigation water requirements. Irrigation scheduling. Methods of irrigation. Merits and demerits of various irrigation methods. Water deficits and crop yield. Water use efficiency. Water quality. Principles of soil salinity. Principles of soil alkalinity. Management of saline soils. Management of alkaline. Saline – alkaline and flood prone soils. Leaching and drainage. Methods of drainage. Merit and demerits of drainage methods. Irrigation resources of Nigeria.

**Minimum Academic Standards (MAS):**

The required facilities for the course have been adequately captured.

**BUK-AGN302: Physiology of Crop Growth and Development (2 Units; Core) (LH = 15; PH = 45**)

**Senate-Approved Relevance**

To produce graduates who lead in research and education via proper understanding of the physiology and development of crops who are also committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training.

**Overview**

Understanding the growth and development of major crops is an important factor for all forms of agronomic interventions. Learning the fundamental mechanisms of how crops grow and develop and the various biophysical factors that affect the two processes is of major importance. There is also needed to understand how to efficiently quantify the growth and development of major crops.

The course evaluates both internal factors that affect growth and development and how external application of different materials can affect development.

**Objectives**

The objective of the course is to:

1. Explain the various methods of measuring growth in plants by learning leaf area index, leaf area duration, net assimilation rate, crop growth rate, etc.

2. Explain the role of plant hormones (promoters and inhibitors) that can be externally applied to support growth and development of plants.

3. Demonstrate the way crops respond to the changes in the environment especially responses to temperature, moisture, light and nutrient management.

4. Demonstrate competence in crop growth assessment and crop modelling in the field.

5. Explain the physiological variables that can be explored to improve photosynthetic efficiency and improved grain yield in crops.

6. Demonstrate the developmental physiology of various crops.

**Learning Outcomes**

On completion, the students should be able to:

1. State the formula and methodology of estimating CGR, LAI, RGR, NAR, LAR and LAD)

2. List the roles of at least 4 growth hormones in crop growth and development.

3. Explain at least 3 impacts of the major environmental factors (temperature, light and nutrition) on crop growth and development.

4. State and explain at least 4 ways to improve photosynthetic efficiency and improved grain yield of crops.

5. Explain the developmental physiology of at least 3 major staple crops.

**Course Contents**

Measurement of leaf area and growth. Analysis of LAI. Analysis of CGR. Analysis of RGR. Analysis of NAR. Analysis of LAR. Analysis of LAD. Potential production of herbage crops. Classification and of growth regulators. Uses of plant growth regulators. Anti-transpirants and their properties. Effect of environmental factors on dry matter production. Physiology of grain yield in relation to LAI. Improving photosynthetic efficiency. Crop modeling. Developmental physiology of some selected cereal crops. Developmental physiology of some selected legumes crops.

**Minimum Academic Standards (MAS):**

The required facilities for the course have been adequately captured

**BUK-CRP 301: Introduction to Crop Pests and Diseases (2 Units; Core) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates who can lead in Crop Pests and Diseases research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

The Introduction to Crop Pests and Diseases course is aimed at preparing students to be involved in functional and collaborative teams that to identify and manage pests and diseases of different crops for sustainable food production.

The courses focus on acquiring knowledge and skills on the damage assessment methods and pest control methods, and general methods of managing diseases of crops. The practical sessions aim to develop skills in Crop Pests and Diseases and research techniques.

**Objectives**

On completion of the Course, the students will be able to:

1. Define the terms Pests and Diseases.
2. State the major pests and diseases of crops.
3. Describe how to assess damage caused by pests and diseases.
4. State the general methods of managing pests and diseases.
5. State causative agents, symptoms of diseases and mode of infection of common pathogens of crops.
6. Demonstrate practical skills in pests and diseases identification
7. Comprehend the basic knowledge of Integrated Pest and Disease Management
8. State the key benefits of Integrated Pest and Disease management methods.

**Learning Outcomes**

On completion, the students should be able to:

1. Explain the meaning of the terms Pests and Diseases.
2. Identify any five major pests and diseases of crops.
3. Describe how to assess damage caused by pests and diseases.
4. State the general methods of managing pests and diseases.
5. State causative agents, symptoms of diseases and mode of infection of common pathogens of crops.
6. Demonstrate at least 3 practical techniques of research in pests and diseases management
7. Write at least five basic principles of integrated pests and disease management
8. List at least five benefits of IPDM methods.

**Course Contents**

Definition of pest, the nature of modern Agriculture as a pest-including practice. Different agro-ecosystems and their influence on pest problems. Study of insect pests of major local crops (cereals, legumes, fibers, roots and tubers, horticultural and plantation crops), their significance and control. Pest management, population dynamics and the concept of economic threshold in pest damage to crops. Brief outline of different pest surveys and damage assessment methods and pest control methods. Advantages and limitations of the different control methods. Strategies of integrated pest control and pest management. Pest management and strategies to small mixed farms. Insects and other arthropods beneficial to man. Soil-borne arthropods: classification, ecology, biology, habit, mode of damage, economic importance, and control methods. General principles of plant diseases and assessment. Symptoms of infection, dissemination, mode of entry, host ranges, life history and economic importance of viral, bacterial, nematode, and fungal diseases. Types and importance of soil-borne pathogens and diseases. Dispersal and spread of soil-borne pathogens. Control of plant pathogens. An over view of the concept of the principles of Integrated Pest and Disease Management (IPDM); the concept of economic threshold and the significant/benefits of IPDM.

**Minimum Academic Standards (MAS):**

The required facilities for the course have been adequately captured.

**BUK-CRP 302: Crop Pests Ecology and Management (2 Units, Core) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates who can lead in Crop Pests Ecology and Management research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

The Crop Pests Ecology and Management course is aimed at preparing students to be involved in functional and collaborative teams that have skills on insect ecology, Insect population and dynamics and sampling from plants, air, soil and herbage to improve crop production.

The course focuses on the crop pests and diseases ecology and management for improved crop productivity. The practical sessions aim to develop skills in Crop Pests Ecology and Management and research techniques.

**Objectives**

On completion of the Course, the students will be able to:

1. Explain the concept of insect ecology.
2. Describe interspecific interactions among insects’ ecosystem and others organisms.
3. Describe insects’ population dynamics and factor affecting it
4. Estimate insects’ population and sampling from plants, soil and air
5. Explain the terms natality, mortality, migration, dispersal and other key factors.
6. Describe the plant feeding and disease transmission,
7. Identify the relationships between insects, plants and other organisms;
8. Explain insect diversity and abundance with emphasis on adaptations aiding success.
9. Identify commonly encountered insect species.
10. Explain the principles and methods of insect pests’ control
11. Describe the concept of Integrated Pest Management.

**Learning outcomes**

On completion, the students should be able to:

1. Define the term Insect Ecology
2. Explain interspecific interactions among insects’ ecosystem and others organisms
3. Describe insects’ population dynamics and factor affecting it
4. Estimate insects’ population and sampling from plants, soil and air
5. Explain the terms natality, mortality, migration, dispersal and other key factors.
6. Describe the plant feeding and disease transmission,
7. Identify at least three relationships between insects, plants and other organisms;
8. Describe insect diversity and abundance with emphasis on adaptations aiding success.
9. Identify some commonly encountered insect species.
10. Explain at least three of the principles and methods of insect pests’ control
11. List at least five principles used in Integrated Pest Management.

**Course Contents**

Overview of insect ecology; divisions of ecology; habitat and niche; intra and interspecific interactions; natural and agro-ecosystems; flow of energy in ecosystem; trophic relations: food chain, food web and food mesh concepts; ecological succession; population and its characteristics like natality, mortality, migration, dispersal, key factors, density dependent and density independent factors, introduction to life tables and diversity indices. Insect population and dynamics; factors affecting distribution and abundance of insects and their behaviour; life-tables; inference from life-tables; forecasting outbreaks. Population estimates; absolute and relative methods and population indices; marking and recapture techniques; sampling from plants, air, soil and herbage; sampling for disease organisms; mortality and dispersal of insects and mites; sampling for agronomic parameters; sample preparation and storage. Plant feeding and disease transmission, clearly identifying the relationships between insects, plants and other organisms; Insect diversity and abundance with emphasis on adaptations aiding success. Identification of commonly encountered insect species. Principles and methods of insect pests control i.e. cultural, biological, physical, mechanical, reproductive, legislative, chemical and bio-technological control, host plant resistance as a measure of insect control, insect sterilization and introduction to IPM.

**MINIMUM ACADEMIC STANDARDS (MAS):**

The required facilities for the course have been adequately captured.

**400 Level**

**BUK-AGG 401 : Agricultural Tour (2 Units ; Core) (PH = 90)**

**Senate-Approved Relevance**

To produce graduates who can lead in research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

The study tour exposes students to various aspects of the agricultural research and industrial sectors.

Students will undertake an academic tour to agricultural based farms, organizations and institutions within the country as may be suggested by the Faculty Field Practical Year Committee.

**Objectives**

At the end of the course, the students should be able to explain the functional workings of various aspects of the agricultural industry.

**Learning Outcomes**

On completion of the course, students should be able to experience the agricultural sector across various aspects.

**Course Contents**

Report writing of visitation to various agro-allied industries, agricultural organizations, agricultural development projects, etc.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK-CRP 402: Crop Protection II (3 Units; Core) (PH =135)**

**Senate-Approved Relevance**

To produce graduates who can lead in practical Crop Protection research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

The Crop Protection II course is aimed at preparing students to be involved in functional and collaborative teams that have skills on laboratory and field practical on storage entomology, beekeeping and apiary management, bio-pesticides and edible insects to protect crops against pests for sustainable crop production.

The course focuses on the skills in entrepreneurial aspects of crop protection in both field and the laboratory. The practical sessions aim to develop skills in storage entomology, beekeeping and apiary management, bio-pesticides and edible insects and research techniques.

**Objectives**

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

1. Explain the basic skills in practical beekeeping.
2. Explain the basic skills in practical Mushroom production.
3. Explain the basic skills in practical edible insects’ production.
4. List the different equipment used in the preparation and processing of bio-pesticides, beekeeping, and mushroom production.
5. To describe beekeeping and apiary management.
6. Describe how to process edible insects for human and animal nutrition.

**Learning Outcomes**

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

1. Outline basic principles of keeping of bees
2. Outline basic principles of mushroom production.
3. Outline basic principles of edible insects’ production.
4. State different equipment used in the preparation and processing of bio-pesticides, beekeeping, and mushroom production.
5. Describe methods of beekeeping and apiary management.
6. Describe how to process edible insects for human and animal nutrition.

**Course Contents**

Storage Produce Entomology. Beekeeping & Apiary Management. Edible insects their Production, Processing and Pesticide Residue Analysis. Development, Production and Application of Bio-pesticides. Mushroom production & Processing. Vermicomposting its Application for Diseases and Pests Management.

**BUK-SOS 401: Soil and Water Management (3 Units; Core) (PH = 135)**

**Senate-Approved Relevance**

Training of high-quality graduates that are well-skilled and knowledgeable in practical and effective management of soil and water resources. This is in line with BUK’s mission to address African developmental challenges in producing graduates in Agriculture. Relevance is seen in B. Agriculture graduates from BUK because all agricultural activities use the knowledge acquired to solve the problems of soil and water management during food production.

**Overview**

Knowledge of soil and water management is vital in the effective utilization of soil and water resources. Agricultural production requires practical skills in the management of soil and water resources for optimum utilization. This highlights the importance of preparing students of B. Agriculture with knowledge of the practical applications of management.

The course is planned to expose students to the application of soil and water management strategies with a view to achieve sustainable agricultural practices. This course includes a variety of methods and applications that are employed to prevent soil degradation and conserve water. This course includes both practicals and field trips. The importance of the course lies in the need for achieving sustainable development goals (SDGs) number 1 and 2 in the areas of poverty reduction and zero hunger, respectively.

**Objectives**

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

1. Identify and explain the uses of all wares and equipment in the conduct of soil, plant and water analyses in the Soil Science laboratory.
2. Describe the different methods of conducting routine soil, plant, and water analyses in the laboratory.
3. Identify, classify, and demonstrate the use of fertilizers and manures in the maintenance of soil fertility.
4. Identify plants nutrient deficiencies and toxicities; and perform nutrient omission trials.
5. Describe different methods of composting in the field.
6. Describe and measure soil physical parameters that affect crop growth in the field.
7. Perform measurements of field capacity, permanent wilting point and available water in a sample farm.
8. Estimate soil loss for a specific site and selection of best management practice to reduce it.
9. Identify and proffer management solution to problem soils.
10. Visit to soil and water conservation project sites.

**Learning Outcomes**

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

1. Recognize laboratory wares and their uses in laboratory analyses;
2. Describe different units and scales of measurements of solid and fluid samples for analyses in the laboratory;
3. Identify functions and parts of various instruments in the laboratory;
4. Conduct routine soil, plant and water analyses in the laboratory;
5. Identify different types of inorganic fertilizers and their application methods;
6. Perform calculations of fertilizer per field area under different recommendation scenarios;
7. Conduct nutrient omission trial; and observe and record effect of nutrient omission/addition on the test crop;
8. Identify different types and sources of manure and other organic amendments;
9. Prepare composts and other organic amendments using different procedures;
10. Perform particle size analyses and identify soil textural classes using different methods;
11. Determine bulk density, particle density, pore size distribution of soil samples;
12. Determine field capacity, wilting point and available water in the soil;
13. Use different methods to determine the amount of moisture in the soil;
14. Perform stability test of soil aggregates to erosive forces;
15. Conduct water infiltration and hydraulic conductivity test on soils;
16. Estimate soil erosion loss in the field; and
17. Identify problem soils in the field.

**Course Contents**

*Management of soil fertility*: Laboratory tools. Instrumentation and analytical methods. Nutrient Omission Trial (NOT). Identification of nutrient deficiency and toxicity symptoms in plants. Composting. Routine soil, plant and water analyses in the laboratory. Inorganic fertilizers and their application methods. Fertilizer calculations. Identification of different sources and types of manure and other organic amendments. Field visits. *Measurement and Management of soil physical* *quality*: Scales and units. Particle size analysis and determination of soil textural class. Determination soil bulk density, Particle density and percentage pore space in soils. Aggregate stability test. Methods of soil moisture content determination. Determination of soil moisture retention curve (soil moisture constants and potentials). Infiltration test. Hydraulic conductivity of soils. Field estimation of soil erosion. Field visits.

**Minimum Academic Standards (MAS)**

B. Agriculture programme’s NUC-MAS requirement facilities.

**Level 500**

**Department of Agricultural Economics and Extension**

**BUK-AGE 502 Agribusiness Management and Finance (2 Units; Core) (LH = 15; PH = 45)**

**Senate-Approved Relevance**

To produce graduates who can lead in Agribusiness Management and Finance research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

The agribusiness sector in developing countries presents exceptional opportunities for eradicating poverty and hunger as well as mitigating and adapting to climate change. Improved participation in agribusiness can increase the added value of agricultural raw materials, strengthen local rural economies, improve food security, and provide employment among youths (female and male) including university graduates. In line with the mission of Bayero University to address African developmental challenges, this course will contribute to producing graduates with relevant knowledge and skills for effective planning and management of agribusinesses to ensure profit margins and sustainable development.

The course will integrate theory and students’ knowledge and skills in entrepreneurship and innovation, agricultural marketing and prices, production economics, farm management, crop and livestock sciences as well as experiences acquired from field practical training. The overall aim of the course is to produce high-class graduates who are well-trained in the applications of standard knowledge and skills for agribusiness planning and management.

**Objectives**

The objectives of the course are to:

1. Discuss the concepts and theories of entrepreneurship and agribusiness,
2. Describe the characteristics of an entrepreneur and facilitate entrepreneurial thinking,
3. Explain the stages in enterprise formation and business planning,
4. Discuss the relevance of micro and small businesses in wealth creation,
5. Discuss the types of agricultural business management and organizations,
6. Discuss the public policies affecting agricultural business farm growth; and,
7. Explain how agribusinesses are financed and the government credit policy.

**Learning Outcomes**

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

1. Explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation, and risk taking.
2. State the characteristics of an entrepreneur.
3. Engage in entrepreneurial thinking.
4. Describe stages in enterprise formation, partnership and networking including business planning.
5. Analyze the importance of micro and small businesses in wealth creation, employment, financial independence; and, the organization of large-scale farms
6. Analyze types of agricultural business management and organizations, enterprise selection, production planning and public policies affecting agricultural business farm growth.
7. Understand how agribusinesses are financed, and the government credit policy and approaches to efficient credit management.
8. Identify and analyze the key records in farm accounting.
9. State the basic principles of e-commerce.

**Course Contents**

Concept of entrepreneurship (Entrepreneurship, Intrapreneurship/Corporate entrepreneurship). Theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship and creative destruction). Characteristics of entrepreneurs (opportunity seeker, risk taker, natural and nurtured, problem solver and change agent, innovator and creative thinker). Entrepreneurial thinking (critical thinking, reflective thinking, and creative thinking). The scope of agricultural business and management; types of agricultural business management and organizations; enterprise selection; production planning; public policies affecting agricultural business farm growth; organization of large scale farms; legal organization and tax strategies; economics of agricultural processing; marketing management; principles of agricultural finance; principles of farm credit; capital needs of agricultural industries; sources of loan funds and collateral security for loans; credit agencies and government credit policy and approaches to efficient credit management; farm accounting; inventory, balance sheet, cash book, cash book analysis.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK-AGE 503: Introduction to Econometrics (2 Units; Core) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates who can lead in Econometrics research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

Econometrics is the branch of economics that uses statistical methods and data analysis to test and develop economic theories. It is an essential tool for undergraduate students in economics because it allows them to use quantitative techniques to analyze and interpret economic data. This course is designed to provide students with the tools and techniques to test economic theories, model and forecast economic phenomena, and evaluate the effectiveness of policy interventions. Throughout the course, students will learn to use econometric software packages to analyze real-world economic data and interpret and communicate the results of the analysis for decisions in modern-day economic life. The students will also learn how to evaluate the reliability and validity of empirical research in economics, and how to apply econometric methods to address economic policy questions.

An introductory econometrics course is usually a required course for undergraduate students majoring in agricultural economics, and it is also useful for students interested in pursuing graduate studies in agricultural economics. It is a challenging and rewarding course that requires a strong foundation in statistics and mathematical methods, as well as critical thinking and problem-solving skills.

**Objectives**

The objectives of the course are to:

1. introduce students to the principles and methods of econometrics,
2. help students develop critical thinking and problem-solving skills,
3. provide students with hands-on experience in econometric analysis,
4. prepare students for more advanced econometrics courses,
5. help students understand and evaluate empirical research; and,
6. enhance students' understanding of economic theory

**Learning Outcomes**

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

1. show basic understanding of the statistical techniques and econometric methods used to analyze economic data,
2. apply statistical methods to real-world economic problems and develop the ability to analyze, interpret, and communicate the results of econometric analysis,
3. use econometric software packages to analyze real-world economic data,
4. read and evaluate empirical research in economics, including academic papers and reports from government and other organizations; and,
5. show an understanding of the relationship between economic theory and empirical analysis, including how empirical analysis can be used to test and refine economic models.

**Course Contents**

Introduction to econometrics and its applications in agricultural economics. Simple linear regression to estimate a linear relationship between two variables using a single regression equation, interpretation of the regression coefficients, and test of its statistical significance. Multiple regression to estimate a relationship between a dependent variable and several independent variables, interpretation of the regression coefficients, and test of its statistical significance. Use of dummy variables to incorporate categorical variables into a regression model, including binary, nominal, and ordinal variables. Model selection to choose the best set of independent variables for a regression model, including techniques such as stepwise regression and information criteria. Nonlinear regression to estimate nonlinear relationships using regression models. Endogeneity and omitted variable bias, heteroscedasticity and autocorrelation in regression models.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK-AGE 504: Agricultural Policy and Development (2 Units; Core) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates who can lead in Agricultural Policy and Development research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

Agricultural Policy and Development is a vital course which prepares graduates with skills and knowledge in agricultural policies of Nigeria to be able to effectively manage agricultural development and planning. The course exposes students to polices in all sectors of agriculture like production, marketing, processing, inputs supply, irrigation, afforestation and so on. The overall aim of the course is to produce well trained graduates with knowledge and skills in Nigerian agricultural policies for sustainable agricultural development.

**Objectives**

The objectives of the course are to:

1. Explain the role of Agriculture in Nigeria’s economy.
2. Identify the problems of Agriculture in Nigeria
3. Examine the characteristics of an underdeveloped country.
4. Explain agricultural development policy and its basic features.
5. Describe the broad objectives of the Nigeria agricultural policy.
6. Categorize the phases of past Nigerian agricultural policies and its constraints for effectiveness.
7. Explain agricultural development planning.
8. Examine the types of agricultural development plans and its phases in Nigeria.
9. Describe the institutional arrangement/framework for agricultural development planning in Nigeria.
10. Identify factors constraining effective development planning in Nigeria.

**Learning Outcomes**

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

1. Analyze the analytical basis for past agricultural policies and programs of government.
2. Discuss the policy formulation process, explain the theories and policies of agricultural development and their relevance to developing countries.
3. Appraise the past and present agriculture sector policies in Nigeria.
4. Analyze the impact of globalization on agricultural development in Nigeria.
5. Diagnose why government policies fail.

**Course Contents**

The concept of growth and development; major components of the development process. The changing roles of agriculture in the process of economic development. Sources of growth in agriculture with special reference to human skill, managerial ability, savings, investment, capital accumulation and technology. The content and significance of major models of economic development, especially the models of Lewis, Okhawa, Hayami and Ruttan; case studies of Japanese, Taiwanese and Israeli. Agricultural development in Nigeria. Analysis of government policies and programmes in relation to agricultural development in Nigeria.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK-AGE 506: Agricultural Marketing and Prices (2 Units; Core) (LH = 15; PH = 45)**

**Senate-Approved Relevance**

To produce graduates who can lead in Agricultural Marketing and Prices research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

The course will expose students to the theoretical concept and analysis of market structure, conduct and performance and study the approaches used in analyzing marketing problems in terms of functional, behavioral, institutional, commodity and economical. This is to aim at producing graduates who can solve and provide solutions to the problems of agricultural marketing and prices in developing countries. In addition, the knowledge acquired by the students will also be useful in providing recommendations to price variation and volatility as well as best practices and potentials of agricultural commodities in the international markets.

**Objectives**

1. Identify and analyze theoretical concept of market structure, conduct and performance.
2. Apply the different approaches in solving marketing problems.
3. Analyze price data, equilibrium price and price determination under different market models.
4. Estimate price variation over space and time.
5. Solve commodity price problems and access price discovery.
6. Apply principles of international trade in agricultural commodity trading in Nigeria.

**Learning Outcomes**

On completion of this course students should be able to:

1. Recall the theoretical concepts of market structure, conduct and performance.
2. Acquire knowledge of the approaches used in solving marketing problems.
3. Classify price data, equilibrium price and price determination under different market models.
4. Recognize price variation over space and time.
5. Acquire skills of solving commodity price problems and discovery
6. Recognize international trade theories as it relates to agricultural commodity trading in Nigeria

**Course Contents**

Theoretical concept and analysis to market structure, conduct and performance. Approaches used in analyzing marketing problems, functional, behavioral, institutional, commodity and economical. Analysis of price data, equilibrium price, price determination under different market models. Price variation over space and time. Commodity price problems, price discovery. International trade in agricultural commodities with particular reference to Nigerian agricultural sector.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK-AGX 501: Rural Community Development (2 Units; Core) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates who can lead in rural community development research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

This course will provide students with basic information, knowledge, skills and perspectives on social, economic and cultural policies that are linked to rural development. Students will be able to link the theories of community development with practices of social change in the rural and urban communities.

Students tend to have clear understanding of both micro and macro approaches to community development and their relevance to various situations of rural and urban communities of Nigeria. Students will be guided on identifying institutional and infrastructural problems that affects various communities. The students will also identify and describe some case studies on community development in Nigeria and other developing countries with particular interest on the effects, causes and solutions to national development.

**Objectives**

The objectives of the course are to:

1. Identify different (social, cultural and economic) policies to rural development in Nigeria.
2. Describe community development theories and their applications to social changes in Nigeria.
3. Assess micro and macro approaches of community development to social changes.
4. Discuss the relevance of micro and macro approaches of community development to different Nigerian situation.
5. Identify major problems of community development in Nigeria.

**Learning Outcomes**

On completion, students should be able

1. Identify various policies (social, economic, cultural,) and their perspectives to rural development.
2. Describe different theories of community development with particular interest to their applications to contemporary issues of national development.
3. Examine different approaches of community development to changes in structure and function of the society.
4. Explain the relevance of these approaches of community development to different Nigerian situation.
5. Identify current institutional and infrastructural issues that affect development of communities in Nigeria.
6. Compare community development activities of Nigeria and other developing countries with emphasis on the competing functions of their environments in terms of supply depot, living space and waste repository.

**Course Contents**

Sociological economic and related policy perspective as they relate to rural development. The theories of community. Community as a unit of social change. The micro and macro approaches to social change. Dimensions of innovation. Approaches to community development, and their relevance to Nigerian situation. Problems of institution and infrastructural community. Case studies on community development in Nigeria and other developing countries. The nature of communities in Nigeria

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK-AGX 502: Agricultural Technology Transfer and Rural Society (2 Units; Core) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates who can lead in agricultural technology transfer and rural society research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

This course would be offer to the 500 level students of agriculture. The course seeks to prepare students for technology transfer and generation.

It would also lay a foundation for the groundwork for an understanding of the relationship between agricultural technology transfer and the social system in the development of Agriculture knowledge systems.

**Objectives**

The major objectives of this course are to ensure that on completion of this course you should be able to:

1. Understand the basic sociological concept, social grouping and social institutions.
2. Define the term ‘technology’.
3. Explain what indigenous technology is and its effects on agricultural development.
4. Explain how technology generation affects social systems.
5. Specify the different schools of thought on the concept of social change.
6. Itemize the factors to contend with as a change agent develop competencies on efficient and effective technology transfer process.
7. State reasons for the failure of technology transfer in local communities.
8. Discuss the appropriate strategy to employ as an extension agent in introducing new technology in local communities.
9. Outline the significance of improved technology to Nigerian agricultural development.
10. Explain the promotion of technological change and agricultural transformation.

**Learning Outcomes**

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

1. Know the concept and theories of social change and also social group.
2. Describe the characteristics of social change and rural societies.
3. Understand the process of technology transfer and generation.
4. Understand the issues around defining ‘technology’, ‘innovation’ and ‘innovation management’.
5. Recognize the diversity of types of innovation, innovators, and innovation settings.
6. Understand the nature and extent of technological change and innovation.
7. Critically assess and explain key current issues in our understanding of innovation as a field of study.

**Course Contents**

Understanding social change, basic sociological concept, theories of social change, social group, technological changes, characteristics of social change, characteristics of technological change, community and technology transfer, Technological change, decision process; local institution and technological change, change agencies and agents; managing dynamics of change, skeptical voices, waves of change, research formulations on diffusion of technologies; defining innovation, characteristics of agricultural innovation, adoption rates and adopter categories, change agent and rural societies, innovation and management, types of innovation. The nature of technological change and innovation, generations’ of innovation, technology (research) push, market (demand) pull, market driving innovation, Innovation management, early development, evolution and change, defining innovation management, technological innovation and economic growth, agricultural innovation and economic growth, degrees of innovation, radical innovation, incremental innovation, disruptive innovation, product and process innovation, service innovation, diffusion of innovations and characteristics of technologies.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK-AGX 505: Human Right, Gender Analysis and Social Inclusion (2 Units; Core) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates who can lead in human right, gender analysis and social inclusion research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates

**Overview**

through a gender lens, taking into consideration intersecting relations of men, women, boys and girls and people with special need. It deploys interdisciplinary perspectives on human rights standards and principles; rights and resource use conflict, conflict management and peace building in society, gender equality and sustainable development; Food habits, intra household food distribution, seasonal aspects of food consumption; Food security, concept of social and economic inclusion.

Students will be able to explain and use key concepts in the theory and practice of gender and human rights, to understand the gendered nature of human rights principles and norms in the agricultural system, programme and project management.

**Objectives**

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

1. Explain, discuss and use key concepts in the theory and practice of gender; human rights and resource management.
2. Apply key concepts, thematic and conceptual debates to specific case studies in relation to gender participation in agriculture and rural development.
3. Identify and critically analyze the gendered dimension of human rights principles and norms in agriculture and food system.
4. Understand how to mainstream gender perspective into agriculture and economic empowerment.
5. Critically assess the need for social and financial inclusion of rural societies for sustainable agriculture and rural development.

**Learning Outcomes**

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

1. Ability to incorporate gender needs in agriculture and rural development.
2. Understand how to manage conflict and peace building process in rural societies.
3. Conflict management; networking and mediation of human conflicts in competition for resource: water, grazing and land.
4. Recognize the need for household’s food and nutritional security in Nigeria and beyond.
5. Understand gender issues in agriculture, resource access, use and management.

**Course Contents**

Definition and history of gender, meaning of human rights, human -rights based approach to programming development projects, individual and community rights, access to information and services, right to adequate food and coping mechanisms. Diversity and Intersectionality, Gender-based discrimination in agricultural land and investment, Gender stereotype, Gender Integration, Women in Agriculture Women Economic Empowerment, and Gender and Trade Custom. Gender issues in agriculture, resource access, use and management. Gender analysis: decision-making, control over resources, labor division, ownership of properties, community empowerment. Conflict management; networking and mediation of human conflicts in competition for resource: water, grazing and land. Food and nutrition security: Food habits, intra household food distribution, seasonal aspects of food consumption; Food security, concept of social and economic inclusion.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK-AGX 506:** **Agricultural Project Appraisal, Management & Evaluation (2 Units; Core) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates who can lead in Agricultural Project Appraisal, Management & Evaluation research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

In Africa, agricultural projects are the cutting edge of development. The United Nations proclaims that “programs and projects are increasingly used in developing countries in the process of economic and social development,” Without successful project identification, preparation and implementation, development and investment plans are no more than wishes and African countries would remain underdeveloped. Most developing nations simply do not have the adequate institutional capacity or trained personnel to plan and implement projects effectively. In line with the mission of Bayero University to address African developmental challenges, this course will contribute to producing graduates with relevant knowledge and skills for effective planning, preparation and management of agricultural projects to ensure profit margins and sustainable development.

The course will integrate theory and students’ knowledge and skills in entrepreneurship and innovation, agricultural marketing and prices, production economics, farm management, crop and livestock sciences as well as experiences acquired from field practical training. The overall aim of the course is to produce high-class graduates who are well-trained in the applications of standard knowledge and skills for agricultural investment preparation, implementation, management, and appraisal.

**Objectives**

The objectives of the course are to:

1. Discuss the concepts of project and program.
2. Describe elements of the project cycle.
3. Explain the types and features of agricultural projects.
4. Explain the procedure, data requirements and data sources for projects and programs appraisal.
5. Explain the methods and criteria for measure of project worth.
6. Discuss the procedure and requirements for project and program monitoring and evaluation.

**Learning Outcomes**

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

1. Discuss the conceptual framework of agricultural projects.
2. Identify, prepare and appraise agricultural projects.
3. Design monitoring and evaluation plans for agricultural projects.
4. Compare and rank projects using non-discounted measures of project worth (Payback method, accounting rate of return); and discounted measures of project worth such as the Net Present Worth (NPW), Benefit-Cost (B/C) ratio, Internal Rate of Return (IRR).
5. Assess the impacts of development projects.
6. Prepare feasibility report for an agricultural enterprise.

**Course Contents**

Introduction to project appraisal. Theories of change, application of logical framework in project design, procedure and data requirements for appraisal and evaluation of agricultural projects and programmes; The project cycle: project identification, preparation, appraisal (technical, financial, social, economic and environment analysis); implementation and monitoring, evaluation; tools of project analysis. The arithmetic of project appraisal, cost-benefit analysis; rate of return calculations, cash flow procedures. Farm and other resource valuation. Case studies and practical problems of project evaluation in developing countries.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK-AGX 507: Systems Thinking for Changing Agriculture (2 Units; Core) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates who can lead in systems thinking for changing agriculture research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

Systems thinking for changing agriculture is an essential course that assist is preparing Agricultural students to understand dynamics that is taking places in the field of agriculture. The course is necessary to assist student in understanding the global practices and direction of agricultural development couple with the climatic changes experienced all over the globe.

The course will integrate theory from discipline as well as experiences acquired from field practical training to be able to change or transform the agricultural practices for optimum production, and market-oriented agriculture. This will help in meeting the demand by the teaming population as well as that of international market leading to job creation and improvement in growth domestic product. The course was designed to provide knowledge that will broaden the perception of students to alternative ways of envisioning agricultural development.

**Objectives**

The objectives of the course are to:

1. Discuss the concept of systems thinking as a field of study.
2. Describe the basic concepts of systems thinking.
3. Describe the various approaches in system thinking.
4. Explain the application of system thinking in solving organizational problem.
5. Explain the areas of discipline of systems thinking.
6. Discuss the application of systems thinking theory in understanding the concept.
7. 7. Explain the alternative ways of envisioning agricultural development.

**Learning Outcomes**

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

1. Define various concept of systems thinking.
2. Describe various systems thinking approaches.
3. Analyze the use of systems thinking.
4. Apply systems thinking in solving organizational problems.
5. Describe various discipline of systems thinking.
6. Apply systems thinking theory in solving agricultural problems.
7. Provides alternative ways of envisioning agricultural development.

**Course Contents**

System thinking as a field of study, basic definitions of (systems, system theory, system thinking, systems principles, system tools); the system thinking approach; use of system thinking; systems thinking in organizations, organization as open systems; five disciplines of systems thinking; some application system theory; inquiry and advocacy; chaos theory. The course is also intended to provide students with critical thinking skills to broaden their perception to alternative ways of envisioning agricultural development. It is meant to modify preconceived myths that extension agents have about farmers and expose them to the basic assumption underlying farmers’ decisions and behaviors.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**Department of Animal Science**

**BUK-ANS 503: Genetics and Biotechnology (3 Units; Core) (LH = 30; PH = 45)**

**Senate-Approved Relevance**

To produce graduates who can lead in animal genetics and biotechnology research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

The knowledge of recent development in animal breeding and genetics in the 21st century is a vital study in animal science. It prepares the students in learning skills in the area of specialization that could culminate into relevant principles involved in the development of new breeds of farm animals and their management.

The course includes acquisition of basic knowledge in all aspects of genetics (developmental, quantitative, population and molecular genetics) and preparation for higher degrees in animal genetics and breeding. These will go a long way in providing large quantities and qualitative animal products for the increasing population in the century.

**Objectives**

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

1. Define the concept of variation.
2. Describe the various partitioning of variation in animals and its relevance.
3. Differentiate between quantitative and qualitative characters in animals.
4. Explain the application of genetic principles in improving livestock animals.
5. Explain statistical tools relevant to appropriate industries known for breed development, production, and distribution.
6. Describe the importance of biotechnology in relation to animal genetics and breeding.
7. Explain the importance of genetic resources accruable to indigenous farm animals.
8. Apply basic principles in developing ‘genetically modified organisms GMO’ and the laws guiding its uses.

**Learning Outcomes**

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

1. Explain the concept of variation as a basis for breeding and genetics, and its measure.
2. Mention at least two (2) of the various partitioning of variation
3. Explain the significance of variation in animal breeding.
4. Describe influence of genetic and environmental interaction on quantitative characters.
5. Apply five (5) statistical tools relevant to various aspects of genetics.
6. Explain five (5) important genetic resources accruable to indigenous farm animals
7. Apply basic principles in developing ‘genetically modified organisms GMO’ and the laws guiding its uses.

**Course Contents**

Concept of variation. Variation in Animals. Hybrid and independent assessment. Quantitative and qualitative characters. Chi-square, probability, binomial and normal distribution, extra-nuclear transmission and maternal influences. Gene modifiers and interaction. Penetrance, expressivity and pleiotropy. Genetic improvement of various livestock. Genetic resources of indigenous farm animals; Introduction to biotechnology. Phases of biotechnology, Scope and importance of biotechnology. Ethical and scientific challenges in biotechnology. Animal biotechnology; animal cell, tissue and organ culture. Nucleic acid and genetic information. The DNA; structure and technologies; transgenic animals as example of genetically modified organism (GMO). Rules and regulations in biotechnology. Bio-safety. Intellectual property right.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS

**BUK-ANS 504: Equine and Camelid Production (2 Units; Core) (LH = 15; PH = 45)**

**Senate-Approved Relevance**

To produce graduates who can lead in animal production research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

This course seeks to explain the science governing the maintenance, growth, reproduction and production of equines and camelids. Equines and camelids play a unique role in human activities, for both work and recreation, thus, an understanding of their peculiarities and needs is vital to ensure their well-being.

The technique of feeding equines and camelids has its peculiarities as opposed to ruminant animals. A proper understanding of good management and provision of adequate feeding regime are essential for normal growth, reproduction and performance of equines and camelids.

**Objectives**

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

1. Describe the housing, feeding principles of equines and camelids.
2. Discuss the routine management practices of equines and camelids.
3. Explain the techniques of handling and care of equines and camelids.
4. Recognize marketing strategies for stock and products of equines and camelids.
5. Describe draught and recreational uses of equines and camelids.

**Learning Outcomes**

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

1. Identify the available breeds of equines and camelids and their uses.
2. Mention the fundamentals of handling and breeding of equines and camelids.
3. State the peculiarities of equines and camelids compared to other classes of animals.
4. Identify the basic needs of equines and camelids for optimum production.
5. Demonstrate a good understanding of management considerations important to the comfort and health of equines and camelids.

**Course Contents**

History and development of breeds. Breeding and housing management of equines and camelids. Breeds identification. Age determination. Handling and conformation. Modern trends in commercial equine and camelid production. Horse and Camel management. Concepts in equine and camel facilities, their feeding principles and digestion. Health management. Care of young, growing and lactating equine and camelid. Equine and camelid products marketing. The equine industry. Application of welfare principles to equines and camelids. Current and future trends in equine and camelid production. Stud management and sanitation. Basic requirements of equines and camelids for optimum production. Draught and recreational uses of equines and camelids. Peculiarities of equines and camelids compared to other classes of animals.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK-ANS 507: Feeds and Feeding Principles (2 Units; Core) (LH = 15; PH = 45)**

**Senate-Approved Relevance**

To produce graduates who can lead in feed ingredients and quality research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

The ever-increasing world population and the attendant competition between humans and livestock on conventional feed resources has made it mandatory to design a course like this one which seeks to imbue the students with knowledge of additional feed resources for feed formulation in the face of escalating prices of feeding stuffs, measurement of quality and utilization techniques and storage safety of feed ingredients.

It is envisaged that the students will be well grounded in the area of feeds and feeding so much as to contribute towards meeting the sustainable development goal of reducing hunger and poverty.

**Objectives**

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

1. Identify the various types of feed resources for livestock feeding.
2. Describe the methods of feed evaluation and utilization.
3. Explain the relationship between environmental condition and feed quality.
4. Discuss principles of livestock feeding.
5. Explain the economics involved in ensuring the utilization of quality feed at a minimal cost.

**Learning Outcomes**

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

1. List the various classes of feed for livestock feeding.
2. Describe the methodologies involved in measurement of feed quality and utilization.
3. Compare the relationship between environmental condition and feed quality.
4. Explain the factors that may affect nutritive value of feed.
5. Explain the economics involved in practical livestock feeding.

**Course Contents**

Classification of feeds. Feeding stuffs; concentrate feeds, cereals, legumes and oil seeds. Chemistry of succulent feeding stuffs. Nutritive values of succulent feeding stuffs. Chemistry of some Nigerian grasses and legumes. Nutritive values of some Nigerian grasses and legumes. Storage and quality control of feeding stuffs. Economics of livestock feeding. Principles of feeding. Factors affecting the nutritive values of feeds. Feed supplementation. Feed formulation. Measurement of digestibility. Forage conservation.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK– ANS 508: Animal Products and By-products Processing and Value Addition (3 Units; Core) (LH = 30; PH = 45)**

**Senate-Approved Relevance**

To produce graduates who can lead in crop breeding and biotechnology research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

Animal products processing and by-products processing, and value addition is an important course that equip the Nigerian graduates with the knowledge and ability to handle, process and add value to the animal products and by-products for food security and agro-based industry development. This underscores the significance of training students in animal science with the knowledge and skills on proffering the solutions to the myriads problems they may come across in the course of their training.

This course is design to accomplish the recommendation of world health organization on the quantity of animal protein required per person per day. The objectives of the course, learning outcomes and contents are provided below.

**Objectives**

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

1. Identify abattoir design and operations.
2. Differentiate meat and dairy producing animals.
3. Explain pre-slaughter handling of meat animals.
4. Describe slaughtering methods, dressing and handling of carcasses.
5. Describe meat hygiene and composition of meat.
6. Provide information on dairy farm operations.
7. Explain milk collection, hygiene and quality control.
8. Identify the importance of meat and milk processing.
9. Provide information on egg laying, collection, and quality control.
10. Describe the composition and nutritional value of egg.
11. Explain hides, skin and wool processing and preservation.
12. Identify the marketing and distribution strategies of animal products and by-products.

**Learning Outcomes**

1. Mention types of abattoir design and operation.
2. Explain the pre-slaughter handling of different species of meat animals.
3. Describe the slaughtering, dressing and handling of carcasses post-slaughter.
4. Explain the meat inspection, meat quality and preservation.
5. Describe the dairy farm operation, milk collection, hygiene and quality control.
6. List the indigenous and foreign meat and milk products processing.
7. Explain the egg formation and laying.
8. Describe the egg collection, handing, grading and quality parameters.
9. Explain the egg processing and human nutrition.
10. Explain the hides, skin and wool processing.
11. Discuss the marketing and distribution of animal products.

**Course Contents**

Meat producing animals. Abattoir design and operation. Slaughtering and dressing of meat animals. Carcass cutting. Meat hygiene. Gross and chemical composition of meat. Milk producing animals. Dairy farm operations. Milk collection. Composition of milk. Milk hygiene and quality control. Meat and milk processing. Indigenous and foreign meat and milk products. Indigenous and foreign meat and milk products and their preparations. The process of egg formation and laying. Anatomy of the egg. Egg collection and handling. Egg quality parameters. Egg and human nutrition. Egg processing and grading. Quality of hides and skins of indigenous livestock and factors affecting them. Quality of wool and factors affecting it. Hides, skin and wool processing. Animal by-products processing.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK-ANS 511 : Non-Ruminant Nutrition (2 Units ; Core) (LH = 15 ; PH = 45)**

**Senate-Approved Relevance**

To produce graduates who can lead in monogastric nutrition and management research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

This course seeks to explain the science governing the ingestion, mastication, digestion, absorption and excretion of feed ingredients that results in the maintenance, growth, reproduction and production of the Non-ruminant animal. Non-ruminant feeding has its peculiarities that those animals which include poultry, pigs and rabbits are simple stomached.

A proper understanding of the composition, availability, and utilization of the nutrients contained in feedstuffs utilized in Non-ruminant animal feeds is vital in adopting the appropriate design and formulation of rations. Adequate nutrition is also vital, as nutrition and its use are the basis of production and, if not accounted for, could lead to sub-optimal nutritional efficacy and disorders.

**Objectives**

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

1. Understand the non-ruminant animal.
2. Illustrate the animal's digestive tract and the function of its different constituents.
3. Identify the classes of feed ingredients, their potentials, limitations, methods of preparation and combination in feed formulation.
4. Identify why substances are added to non-ruminant feed.
5. Understand the impact of substances added to foods on the final product.

**Learning Outcomes**

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

1. Compare the peculiarities of the digestive system of the non-ruminant animal relative to other classes of animals.
2. Identify the parts of the digestive system of non-ruminants and explain their functions.
3. Identify the types of feedstuffs utilized in the formulation of feeds for these animals.
4. Formulate feeds for these classes of animals.
5. Evaluate performance of non-ruminant animal.
6. Evaluate the efficacy of various feedstuffs.

**Course Contents**

Principle involved in feeding of Non-ruminant animals. Feeding standards and their limitations. Nutrient requirements for the different classes of livestock. Substances that are added to feeds to achieve various production purposes. Water in relation to nutrition. Evaluation of feedstuffs. Feed industry. Feed mixing and manufacture on a large scale. Dietary allowance, anti-nutritional factors and toxins in feedstuffs. Alternative feed resources for non-ruminants. Digestion in non- ruminant animal. Nutritional disorders. Processing of products and by products of non-ruminants. Various technologies to improve low nutrient quality feeds. Marketing of products and by products. Food survey. Food balance sheets

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK-ANS 509 : Ruminant Nutrition (2 Units ; Core) (LH = 15 ; PH = 45)**

**Senate-Approved Relevance**

To produce graduates who can lead in nutrition of ruminant animal research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

The inhabitants of the tropics rely to a large extent on traditional livestock production as a means of increasing the dietary protein requirements of the populace. However, rapid increase in human population and the resultant competition between man and animals for feed resources makes it imperative to explore and utilize the available plant-based forage resources not utilizable by man.

This highlights the importance of preparing undergraduate animal science students to better understand the nutrition of ruminant species being valuable livestock resources in meeting the nutritional requirements of Man. There is an increasing interest in the utilization of feed resources used as livestock feed not to be in competition with [human nutrition](https://www.sciencedirect.com/topics/food-science/human-nutrition). Ruminants are specialized livestock species with the ability to utilize plant-based materials in specialized stomach through fermentation by the activities of microbes.

This course is designed to expose students to understanding the nutritional peculiarities of the ruminant species and further build the capacity of students in ruminant nutrition particularly on the potential and use of lignocellulosic biomass in ruminant nutrition. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

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

1. Describe the anatomy and physiology of digestion in ruminants.
2. Explain and discuss the different rumen microbes and their roles in fermentation and utilization of fibrous feed materials by the host animal.
3. Describe the interrelationships that exists between and among rumen microflora and fauna.
4. Discuss the metabolic processes and pathways in relation to ruminant nutrition.
5. Explain the systems for energy evaluation in ruminants.
6. Describe the concept of non-protein nitrogen (NPN) utilization by ruminants.
7. Classify and explain the proximate constituents of feeds and the principles of formulating rations for ruminants.
8. Explain the various types and uses of feed additives in the nutrition of ruminant.
9. Discuss the various types and forms of nutritional disorders.

**Learning Outcomes**

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

1. Describe the anatomy and physiology of ruminant digestion.
2. Identify the different rumen microbes and their roles in fermentation and utilization of fibrous feed materials by the host animal.
3. Explain interrelationships that exists between and among rumen microflora and fauna.
4. Describe metabolic processes and pathways in relation to ruminant nutrition.
5. Describe the systems for energy evaluation in ruminants.
6. Explain the concept of non-protein nitrogen (NPN) utilization by ruminants.
7. Classify the proximate constituents of feeds and formulate rations for ruminants.
8. Distinguish the various forms of additives used in the nutrition of ruminant animals.
9. Identify types of feed additives used in the nutrition of ruminant animals.
10. Describe at least five (5) common nutritional disorders in ruminants.
11. Describe various ways and methods of manure management.

**Course Contents**

Anatomy and physiology of ruminant digestive system. Microbiology of rumen action. Physiology of rumen action. Metabolic processes. Metabolic pathways. Non-protein nitrogen (NPN) utilization. Determination of digestion co-efficient. Balance trials. Systems for energy evaluation. Schemes for protein values. Water metabolism and requirements. Water and its inter-relationship in nutrition. Feed additives. Proximate analysis. Ration formulation. Nutritional disorders. Manure management.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK– ANS 512: Beef and Dairy Cattle Production (2 Units; Core) (LH = 15; PH = 45)**

**Senate-Approved Relevance**

To produce graduates who can lead in beef and dairy cattle production research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

Beef and dairy cattle production are a vital course that equips the Nigerian graduates with the knowledge and skills on management of meat and milk producing animals to cater for animal protein requirements of the teeming Nigerian populace and provide job for youth.

The course prepares the animal science graduates with the ability to provide a lasting solution to the problems they may encounter in real world. This course was designed to cater for the need of enhancing animal protein production to meet the recommendation of FAO.

**Objectives**

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

1. Describe the state of beef and dairy industry in Nigeria.
2. Explain the feeding and management principles of meat and milk producing animals.
3. Identify the housing and equipment requirements for beef and dairy animals.
4. Describe the principles of calf-rearing, growing, and finishing operations.
5. Provide information on milk production, handling and processing in the farm.
6. Explain the criteria for efficient production and lactation in cows.
7. Describe the procedure of animal judging, herd recording, castration and dehorning.
8. Identify the marketing strategies of meat and milk products.

**Learning Outcomes**

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

1. Describe the problems and prospects of Nigerian beef and dairy industry.
2. Explain the feeding and management of meat and milk producing animals.
3. Describe the housing and equipment of beef and dairy animals.
4. Explain calf-rearing, growing, and finishing operations.
5. Discuss milk production, handling and processing.
6. Explain the management of lactating cows.
7. Mention the basic production management such as identification, judging, herd recording, castration and dehorning.
8. Describe the marketing of meat and milk products.

**Course Contents**

The beef and dairy industry. selection of dairy and meat breeds of cattle. Feeding and management of cattle; Housing and equipment; Calf-rearing; growing and finishing operations; Milk production, handling and processing. Beef and dairy cattle identification. Beef and dairy cattle ageing. Beef and dairy cattle judging; herd recording, castration and dehorning. Milk synthesis, secretion and lactation in cows; Marketing milk and meat products.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK-ANS 513: Introduction to Animal Behaviour (2 Units; Core) (LH = 15; PH = 45)**

**Senate-Approved Relevance**

To produce graduates who can lead in Animal Behaviour research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

Animal behaviour is an important course that serves as the bridge between the molecular and physiological aspects of biology and the ecological. Behaviour is the link between organisms and environment and between the nervous system, and the ecosystem. This course will make the animal science graduates to appreciate behaviour as one of the most important properties of animal life.

Behaviour plays a critical role in biological adaptations. Behaviour is that part of an organism by which it interacts with its environment. Behaviour is as much a part of an organisms as its coat, wings etc. The beauty of an animal includes its behavioral attributes. The objectives of the course, learning outcomes and contents are as provided below.

**Objectives**

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

1. 1. Describe the integrated approach to understanding animal behaviour by drawing on related knowledge from animal physiology and molecular biology.
2. Explain the general concept that govern the way animals behave throughout their lives.
3. Mention the range of mechanisms by which animals adapt to their environmental conditions using behavioural actions.
4. Explain different views on emotion in animals with examples.
5. Explain forms of communication with examples.
6. State the component of nervous system.
7. Explain types of phototaxes.
8. Explain biological clock.
9. Compare exogenous and endogenous rhythm.

**Learning Outcomes**

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

1. Explain the behavioural pattern of animals in relation to productivity and health.

2. Discuss the animal response to environmental variation.

3. Explain emotion in animals under ethology with examples in farm animals.

4. Explain different views on emotion in animals with examples in farm animals.

5. Explain forms of communication with examples in farm animals.

7. State the component of nervous system.

8. List and explain types of phototaxes.

9. Explain biological clock in livestock animals.

10. Differentiate between exogenous and endogenous rhythm in animals

**Course Contents**

Brief history of animal behaviour, scientific approaches to the study of animal behaviour; ethogram, ethology versus comparative physiology, behaviourism and cognitive psychology. Behavioural ecology; from mechanism to function. Neuroethology and cognitive neuroscience, cognitive ecology, animal welfare, conservation biology and evolutionary psychology. Component of animal behaviour: nature/innate and nurture/learned. Emotions. Forms of communication. Phototaxes. Biological clock. Rhythm in animals

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**Department of Agronomy**

**BUK-AGN501: Root, Tuber, Fiber, Sugar, Forage and Fodder Crops Production (3 Units; Core) (LH = 30)**

**Senate-Approved Relevance**

To produce high quality graduate that well trained and knowledgeable in crop production, research and education in Africa that are Committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates

**Overview**

Root, tuber, fiber and sugar are important crops produced mostly in Nigeria. Crops like cassava are produced in all parts of the country and forms the subsistence crops in marginal areas. The importance of root and tuber crops in alleviating poverty and hunger cannot be overemphasized. The course is designed to expos the student to practical demonstrations of how these crops are produced, processed, and marketed. Agronomic practices involved in the production of the crops are well elucidated. The pasture crop production and range land management in agriculture are important component of ensuring food security in African continent. The course introduces the students to management practice of some forage legumes and grasses pasture to increase the availability of animal feeds.

The course will equip the students with necessary knowledge of root, tuber, fiber, sugar forage and fodder crops production with a view of becoming self-reliant after graduation. The student will have opportunity of contributing to food security and economic growth. Processing, storage and storage facilities of these crops will improve their abundance and regular supply throughout the season. Market and marketing strategies of these will improve the economic status of farmers.

**Objectives**

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

1. State the origin and distribution of major root, tuber, fibre and sugar crops produced in Nigeria.
2. Outlines the importance and utilization of major root, tuber, fibre and sugar crops produced in Nigeria.
3. Demonstrate clear understanding of major agronomic practices in the management of root, tuber, fibre and sugar crops.
4. Explain the storage facilities and processing of important root, tuber, fiber and sugar crops grown in Nigeria.
5. Explain the marketing strategies of major root, tuber and fiber crops grown in Nigeria
6. Outline the agronomic practices involve in the production of a named legumes and pasture grass
7. Differentiate between rangeland and pasture

**Learning outcomes**

On completion, the students should be able to:

1. State at least 2 examples each of root, tuber and fiber crops grown in Nigeria and their geographical spread.
2. List any 5 major agronomic practices involved in yam, cassava, and cotton production.
3. State and explain any 2 marketing strategies for cotton and cassava production in Nigeria.
4. Mention any 3 storage facilities of cassava and yam.
5. List and explain the 5 stages of processing sugarcane into sugar.
6. State any 6 major cultural practice required for high yield of any named legumes and pasture grass
7. State any two differences between rangeland and pasture

**Course Contents**

Origin and distribution of root, tuber, fibre and sugar crops. Importance and utilization of root, tuber, fibre and sugar crops. Ecological requirements root, tuber, fibre and sugar crops. Improved varieties and varietal characteristics of root, tuber, fibre and sugar crops. Production practices, of root, tuber, fibre and sugar crops. Maturity and harvesting of root, tuber, fibre and sugar crops. Processing of root, tuber, fibre and sugar crops. Storage and marketing of important root, tuber, fibre and sugar crops in Nigeria. Definition of terms (pasture, rangeland, fodder, forage and herbage). Differences between rangeland and pasture; Nigerian vegetation zones; characteristics of grass family and legumes; potentialities of grassland; rangeland management (systems of grazing, burning and fertilizer application);

**Minimum Academic Standards (MAS)**

The required facilities for the course have been adequately captured.

**BUK-AGN 502: Farming Systems (2 Units; Core) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates that are well versed in understanding farming systems and who lead in research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training.

**Overview**

Farming Systems is an inter-disciplinary course that pushes students to explore systems approaches to farming. This includes understanding of how various components of a farm are linked to broader social-economic and agro-ecological factors that influence how a farm operates.

The course introduces students to systems thinking and systems practices in a farming context. It uses local and international case studies to teach students learn how different systems approaches can be used in problem analysis creating solutions. The course also focuses more specifically on the decision-making context of a farm business and how the integration of crops and livestock affect the entire system. The course looks at the different concepts of cropping systems and cropping patterns and how they can be integrated for optimal productivity.

**Objectives**

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

1. Enumerate the various farming systems in Nigeria as well as their characteristics.

2. Determine the various cropping systems and cropping patterns and explain how one may evolve into another.

3. State the advantages and disadvantages of mixed cropping and mixed farming

4. Identify the best agricultural practices and strategies for optimizing agricultural systems.

5. Explain the concept of crop-livestock integration in sustainable agricultural systems

6. Explain the practices in ranching and diary in Nigeria

**Learning Outcomes**

On completion, the students should be able to:

1. State any 4 farming systems and list their major features in Nigeria.

2. List any 3 major cropping systems and cropping patterns commonly practiced in Nigeria.

3. State 3 advantages and disadvantages of mixed cropping and mixed farming.

4. Describe at least 3 concepts and advantages of crop-livestock integration.

5. Identify 3 ranching and dairying methodologies used in Nigeria

**Course Contents**

Concepts of farming system. Systems Approach. Factors determining farming systems. Physical, biological and socio – economic characteristics of typical small-scale farming systems. Shifting cultivation, fallowing and crop rotation. Cropping systems: multiple -, inter-, sequential- and sole cropping. Mixed farming. Crop and livestock integration. Land tenure systems. Types of Nomadism. Permaculture. Agro-forestry. Ranching. Dairying. Farm planning. An overview of Nigerian farming systems.

**Minimum Academic Standards (MAS)**

The required facilities for the course have been adequately captured.

**BUK-AGN 503: Crop Breeding & Biotechnology (2 Units; Core) (LH = 15; PH = 45)**

**Senate-approved Relevance**

To produce graduates who can lead in crop breeding and biotechnology research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

The Plant Breeding and Genetics course is aimed at preparing students to be involved in functional and collaborative teams that design and select plants with desirable phenotypic, and hence underlying genetic, variation that leads to crop improvement. The course focuses on understanding the procedures involved in breeding crops and the role of genetics in the process.

The integration of conventional breeding approaches and the use of gene technologies in breeding new crop varieties are explored. Emphasis is placed on how plant breeders identify priority traits and the management of breeding programs in a commercial setting. The practical sessions aim to develop skills in plant breeding methodologies and research techniques.

**Objectives**

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

1. Appreciate the Impact of plant breeding on agricultural crop production.

2. State the different variability traits in plant for crop improvement.

3. Describe the concept of gene inheritance in crop plants.

4. Explain the basic concepts of genetic variability and combining ability in plant.

5. Describe the sexual and asexual methods of plant propagation.

6. Outline the techniques of crop improvement through genetic engineering and tissue culture.

**Learning outcomes**

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

1. Mention at least 3 benefits of plant breeding to the society

2. Describe any 3 procedures of crop improvement.

3. Identify the mode of inheritance in a named cereals and legume crops.

4. Explain combining ability and its application in breeding.

5. Describe sexual and asexual reproduction in plants

6. Explain the application of genetic engineering and tissue culture in crop improvement

**Course Contents**

Impact of plant breeding on agriculture. Variation in plants. Qualitative and quantitative inheritance. Heritability. Genetic variability. Hybrid vigour. Combining ability. Plant reproduction. Apomixis; Pollination. Methods of breeding self-fertilized crops. Methods of breeding cross-fertilized crops. Recurrent selection. Introduction to biotechnology. DNA markers. Genetic code. Genetic engineering. Tissue culture techniques. Application of biotechnology in Agriculture. Genetically modified organism.

**Minimum Academic Standards (MAS)**

The required facilities for the course have been adequately captured.

**BUK-AGN504: Seed Science and Technology (2 Units; Core) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates who will lead in research and education in Africa on seed science and technology that are committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

Seeds are the most basic and vital input in agriculture. Seeds became the backbone of modern agriculture with the advent of green revolution, because they contribute to 20% of yield improvement. Modern varieties and hybrids need strict production methodologies to maintain their genetic purity and vitality. Quality checks during production must be strictly followed during pre and postproduction and distribution. Seed technology is a science that treats seeds as a living entity and ensures the quality and productivity of seeds.

This course was designed to enhance the knowledge of seed biology, seed quality, seed production, seed storage and seed certification. Starting with seed as a biological organism the course will teach students the quality parameters, enumerate the production techniques, and procedures for certification. Seed production techniques of several important crops will be demonstrated through classroom teaching and practical thereby equipping those who would like to venture into seed production. Latest seed enhancement techniques like pelleting, priming and coating are also taught for improved knowledge. On completion, one can possess sufficient knowledge on seed quality, its production strategy, processing methodology, distribution links and even legal issues.

**Objectives**

At the end of the course students will be able to:

1. Explain the concept of seed as a living entity.

2. Describe the processes involved in handling and packaging methods for seed viability sustenance.

3. State the different methods of seed testing.

4. Identify the different ways of breaking seed dormancy for enhanced germination.

5. Outline the seed laws, learn seed certification procedures and different seed control procedures.

6. Describe seed testing procedures and principles of seed marketing.

**Learning Outcomes**

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

1. Mention at least 3 components of a seed that makes it a living entity

2. List and explain at least 4 methods of breaking seed dormancy.

3. Identify at least 5 procedures involved in production, processing, and management of seeds.

4. Identify at least 3 components of the seed legislations in Nigeria.

5. List and explain at least 3 procedures of seed testing.

**Course Contents**

Structure and nature of seed. Functions of parts of seed. Seed quality; classes and types of seeds. Seed viability. Seed vigour. Seed dormancy. Seed germination. Seed deterioration. Methods of breaking seed dormancy. Seed Production. Seed processing and drying. Treatment, packaging and production of seeds of field crops. Hybrid seed production. Storage of improved seed. Distribution of improved seed. Seed testing. Seed certification. Procedures for field inspections. Seed legislation and control. Seed testing procedures. Seed programs in Nigeria. Seed marketing. Plant variety protection act.

**Minimum Academic Standards (MAS)**

The required facilities for the course have been adequately captured.

**BUK-AGN505: Postharvest Physiology, Processing and Storage (2 Units; Core) (LH = 30)**

**Senate-Approved Relevance**

Training of high-quality graduates that are well skilled and knowledgeable in the required post-harvest physiology, processing and storage skills in Nigeria which is in line with BUK’s mission to address African developmental challenges in producing graduates in the fields of Agriculture.

**Overview**

The study of post-harvest physiology of fresh fruits and vegetables is very important in increasing the effectiveness of their storage measures. There is the need to understand the nature and causes of losses which lead to wastage and reduced quality between harvest and consumption. This course is designed to prepare students with the technology aimed at reducing to the barest minimum both quantitative and qualitative losses occurring during the postharvest phase of crops handling.

The field of postharvest technology has of recent became so important because of the realization of the fact that increased production must be complemented with better postharvest handling practices if the values of perishable products are to be maximally utilized. The importance of this course lies in meeting the need for achieving the sustainable development goals numbers 1 and 2 in areas of reducing poverty and zero hunger. The objectives, learning outcomes and contents were designed to address these needs.

**Objectives**

At the end of the course the student should be able to:

1. Explain the storage life of harvested field crops.
2. Describe how the tropical environment affects the maturity, ripeness and senescence of various crops.
3. Identify the physical and chemical indices of quality in fruit and vegetables crop products.
4. Outline the fundamentals and principles of crop storage and transportation.
5. Identify the issues around storage and shelf-life of crops.
6. Ascertain the ideal climatic variables for storing of harvested produce.

**Learning Outcomes**

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

1. Mention and explain at least 5 complementary postharvest handling practices for increased crops production that will add value to perishable products for maximum utilization.
2. Describe at least 5 quantitative and qualitative losses occurring during the post-harvest phase of crops handling.
3. Describe any 3 conventions and practices that are employed to increase the shelf life of harvested produce.
4. Discuss any 3 climatic variables that are ideal for storage of a named harvested produce.
5. Explain how temperature can affect maturity and ripening of mango fruit.

**Course Contents**

Storage life of harvested fruits. Seeds, vegetables and flowers. Tropical environment in relation to maturity, ripeness and senescence. Physical and chemical indices of quality in fruits. Physical and chemical indices of seeds. Physical and chemical indices of vegetables, flowers and other crop products. Storage of crop materials. Traditional methods of vegetable processing and storage. Fundamentals and principles of crop storage and transportation. Storage and shelf-life problems. Ideal atmosphere for storing fruits, seeds, vegetables, flowers and other crop products. Controlled environment for transit and long-term storage. Protective treatment, design and operation of equipment for storage and preservation.

**Minimum Academic Standards (MAS)**

The required facilities for the course have been adequately captured.

**BUK-AGN 506: Weed Science and Management (2 Units; Core) (LH = 15; PH = 45)**

**Senate-Approved Relevance**

To produce high quality graduate that well trained and knowledgeable in the management and control of weeds in crop production that are Committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

Weed control is the most fundamental requirement for successful crop production. Weed is the most important single biotic constraint to food production. To increase crop yield weed management and control is not only important but necessary. Weed can only effectively be manage and control if they are properly identified and understood. The course was designed to make the student to understand and appreciate the significance of weeds in crop production.

The course exposed the student to various method of weed control and management, their merits and demerits were investigated. This is to give the students and farmers an opportunity to select the best weed control options that are efficient and cost effective. Herbicides have been the primary control technique but because of their efficacy and ease of use there has been an overreliance on them at the expense of other weed-control methods. If the only or primary goal is to increase production, then the quest for better herbicides must continue. If the goal is sustainable weed management in a sustainable environment and society, then other control techniques must be investigated.

**Objectives**

On completion of the Course, the students will be able to:

1. Describe the concept of weed in crop production.
2. Classify weeds and state the loses cause by weed.
3. State different methods of weed management and control.
4. Classified herbicide into various group.
5. Explain the basis of herbicide selectivity.
6. State different types of herbicides and why herbicides are formulated.
7. Explain precautionary measures taken during, before and after herbicide application

**Learning Outcomes**

On completion, the students should be able to:

1. State any 2 examples each of broadleaf, narrow leaf and sedges weed.
2. State at least 4 losses cause by weed in agriculture.
3. Enumerate at least 4 methods of weed management and control, and state merits and demerits of each method.
4. State at least two examples each of the following types of herbicides; selective, non-selective, pre-emergence, post-emergence, pre-plant, soil and foliar applied herbicide.
5. State and explain at least 4 basis of herbicide selectivity.
6. State at least 5 methods of herbicide application.
7. Enumerate at least 4 precautionary measures to be taken before, during and after herbicide application.

**Course Contents**

Concept of weed in crop production. Characteristics of weeds. Classification of weeds. Weed biology. Reproduction in weeds. Losses due to weeds. Weed control methods and problems associated with them. Integrated weed management. Classification, chemistry and selectivity of herbicides. Factors affecting herbicides selectivity. Herbicides formulation. Types of herbicides and reasons why herbicides are formulated. Herbicides application, storage, and mode of action of herbicides. Herbicides and environmental interaction. Safety factors in the use of herbicides; basis for herbicidal selectivity. Herbicides application equipment and techniques. Practical methods of controlling weeds in Nigeria.

**Minimum Academic standards (MAS):**

The required facilities for the course have been adequately captured

**BUK-AGN 507: Irrigation Agronomy (2 Units; Core) (LH = 30)**

**Senate-Approved Relevance**

To produce high quality graduate that well trained and knowledgeable in the irrigation management in crop production that are Committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates

**Overview**

The course is intended to acquaint the students with knowledge on the basic procedures and processes involved in carrying out irrigated Agriculture with emphasis on determination of crop water requirements, different strategies used for scheduling irrigation and the different methods of irrigation to be adopted in different cropping scenarios. Similarly, the course is also aimed at making students to understand problems associated with poor drainage conditions and the resulting negative consequences to crops, environment, livestock and human lives.

Crop irrigation technology is the most fundamental way for ensuring sustained food production with current trend of climate change. The judicious use of limited water available to increase food production is necessary in sub-Saharan Africa. The course was designed to make the student to understand and appreciate the significance efficient and judicious use of limited amount of water in crop production. The course also goes further to equip students with relevant knowledge of problem soils arising from improper irrigation practices leading to evolution of conditions such as salinity, saline alkaline and Sodic soils, as well as ways/methods of correcting/reclaiming them for soil and water conservation, nutrient management for sustainable crop growth and development.

**Objectives**

On completion of the Course, the students will be able to:

1.Stae the importance of water in crop production

2. Outline the factors affecting transpiration and evapotranspiration

3. List the various methods of assessing crop-water requirement

4. Enumerate the various methods of irrigation scheduling

5.Identify the various methods of water application techniques in crop production

6. State the advantages of irrigation scheduling

7. Outline the various ways of increasing water use efficiency in crop production

8. State the various effects of soil salinity in crops and soil.

**Learning Outcomes**

On completion, the students should be able to:

1. State at least 5 importance of water in crop production
2. Outline any 4 factors affecting transpiration and evapotranspiration
3. List any 3 methods of assessing crop-water requirement
4. Enumerate any 7 methods of irrigation scheduling
5. Identify any 4 methods of water application in crop production
6. State any 6 advantages of irrigation scheduling
7. List any 6 ways of increasing water use efficiency
8. Identify any 3 effects of salinity on crops and soil.

**Course Contents**

Assessment of water requirements for crops including meteorological approach. Critical growth stages for water of different field crops. When and how to irrigate crops. Soil – water – plant – atmosphere relationships. Crop water requirements. Consumptive water use efficiency, daily consumptive water us efficiency and seasonal consumptive water use efficiency. Factors affecting evaporation and transpiration. Method of assessing crop-water requirements. Irrigation scheduling. Importance of irrigation scheduling. Water application methods. Ways of increasing water use efficiency. Agronomic management of irrigated cereal crops (wheat, maize, rice). Agronomic management of irrigated vegetables crops (tomato, onion, garlic, watermelon, carrots). Agronomic management of irrigated tree crops. Fertigation. Agronomic practices of crops in problem soils. Soil drainage. Water pricing and economy in crop irrigation. Weed and problems of weed in irrigation structures.

**Minimum Academic Standards (MAS)**

The required facilities for the course have been adequately captured.

**BUK-AGN 508: Principles of Landscape Horticulture (2 Units; Core) (LH = 15; PH = 45)**

**Senate-Approved Relevance**

To produce high quality graduate that are well trained and knowledgeable in land scaping design and floriculture management that are Committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

The course is one of the four branches of horticulture that deals with the production of ornamental plants and garden design to produce a beautiful and functional landscape. The students will be exposed to the history of gardening, the principles and elements of garden design. The course intends to explain the various part a garden and the way they are produced and assigned to their appropriate uses.

The course give emphasis on the importance of landscaping in the world. The purpose of gardens human and environment were highlighted. Landscaping is done with a view to create a natural scene by planting of lawn, trees and shrubs. Landscape horticulture improves the total living environment of the people. We live in a vast planet and or polluted which is characterized by different types of landscaping depending upon prevailing geographical and agroclimatic conditions. There are mountains, hills, glens, valleys, seas, rivers, forests, plains, deserts, lakes, swamps, streams etc. which comprise major part of natural landscape. Man has copied the natural elements for improving landscape around him and converted certain areas in the form of garden for his pleasure.

**Objectives**

On completion of the Course, the students will be able to:

1.Describe the history and principles of land scape design

2. Explain different types of garden design

3. Enumerate the importance and uses of garden

4. Identify typical examples of ornamental trees, shrubs and creepers use in gardening

5. State the characteristics features of any named ornamental trees, shrubs and creepers

6. Establish a home and other types of garden

**Learning outcomes**

On completion, the students should be able to:

1. State any 4 principles of land scape design
2. Describe any 3 types of garden design
3. Outline any 5 uses of garden
4. List any 3 examples each of ornamental trees, shrubs and creepers used in garden establishment
5. List any 3 characteristic features of a named ornamental trees, shrubs and creepers

**Course contents**

Principles of landscape gardening. History of a garden. Importance and uses of gardens. Parts of a garden. Hard and soft landscaping. Landscape Designs. Sketches, plans and construction specifications of ornamental trees and shrubs. Description, characteristics and identification of various ornamental trees, shrubs, creepers and annual flowers. Practices of producing, lifting and transplanting of ornamental plants. Planning and maintenance of public parks, schools and home compounds. Maintenance of lawns, cut flowers and their significance. Flower album.

**Minimum Academic Standards (MAS)**

The required facilities for the course have been adequately captured.

**Department of Crop Protection**

**BUK-CRP 501: Plant Diseases Development Epidemiology & Management (2 Units; Core) (LH = 15; PH =45)**

**Senate-Approved Relevance**

To produce graduates who can lead in Plant Diseases Development Epidemiology & Management research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

The Plant Diseases Development Epidemiology & Management course is aimed at preparing students to be involved in functional and collaborative teams that have skills on the epidemiology and management of pathogenic plant diseases as well as their diagnosis for sustainable crop production.

The course focuses on the epidemiology and management of pathogenic plant diseases. The practical sessions aim to develop skills in epidemiology and management of pathogenic plant diseases and research techniques.

**Objectives**

On completion of the Course, the students will be able to:

1. Define disease epidemiology and pathogens.
2. Explain the development and spread of different diseases organisms.
3. Differentiate the different fungal, bacterial and viral diseases and
4. List at least five factors influencing distribution and abundance of plant parasitic nematodes.
5. Explain the principles or philosophies behind the use of exclusion, eradication, protection and therapy as control measures.
6. Describe the principles and methods used in disease control & management.
7. Describe the Host-parasite relationships and influence of environmental factors
8. Explain the interaction that exists between nematodes and other pathogens.

**Learning Outcomes**

On completion, the students should be able to:

1. Define disease epidemiology and pathogens.
2. Explain the development and spread of different diseases organisms.
3. Differentiate the different fungal, bacterial and viral diseases.
4. Describe at least five factors influencing distribution and abundance of plant parasitic nematodes.
5. Explain the principles or philosophies behind the use of exclusion, eradication, protection and therapy as control measures.
6. Describe the principles and methods used in disease control & management
7. Describe at least two factors that acts in Host-parasite relationships and influence of the environment.
8. Explain at least three ways of the interaction between nematodes and other pathogens.

**Course Contents**

The importance of disease pyramid in disease management; prerequisites for disease management; methods of plant disease diagnosis and importance in disease management; importance of bacterial and fungal diseases of some selected cereals, legumes, fibre, roots and tubers, fruits and vegetables; principles of control of plant pathogenic bacteria and fungi. The development and spread of plant diseases; host pathogen and environmental relationships, and disease physiology; elements of plant disease epidemiology; disease resistance and immunity. Principles or philosophies behind the use of exclusion, eradication, protection and therapy as control measures. Principles and methods used in disease control & management: legislative, cultural, biological, chemical and breeding for disease resistance. Host-parasite relationships and influence of environmental factors. Interaction between nematodes and other pathogens. Important nematodes. History, purification and replication of plant viruses. Multicomponent plant viruses. Transmission of plant viruses. Etiology of viruses’ diseases in Nigeria. ***Practical*** Sampling, handling and processing techniques in nematology. Pathogenicity tests. Nematicides application methods. Factors influencing distribution and abundance of plant parasitic nematodes.

**Minimum Academic standards (MAS)**

The required facilities for the course have been adequately captured.

**BUK-CRP 502: Principles of Bee-Keeping and Mushroom Production (2 Units; Core) (LH = 15; PH =45)**

**Senate-Approved Relevance**

To produce graduates who are highly skilled and knowledgeable in Beekeeping: Colony structure and behaviour; hive and hive management as well as the production of mushroom, research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

The Principles of Bee-keeping and Mushroom Production course is aimed at preparing students to be involved in functional and collaborative teams that have skills on beekeeping and mushroom production.

The course focuses on capacity building through. The practical sessions aim to develop skills in basic knowledge of the apicultural industry and the investment techniques for capacity building and socio-economic enhancement.

**Objectives**

On completion of the Course, the students will be able to:

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

1. Define apiculture and apiary.
2. Describe the colony structure, behavior and management.
3. Describe the bee biology, species and morphology.
4. List the importance of honey and mushrooms.
5. Outline steps by steps procedures of producing mushrooms.
6. Identify pests and diseases of mushrooms
7. Demonstrate skills in basic knowledge of the apicultural industry
8. Explain basics of the investment techniques for capacity building and socio-economic enhancement

**Learning outcomes**

On completion, the students should be able to:

1. Differentiate between apiculture and apiary.
2. list any five basic tools for beekeeping and apiary management
3. Enumerate 5 benefits of beekeeping and honey.
4. Mention five importance of honey and mushrooms.
5. List steps by steps procedures of producing mushrooms.
6. Identify pests and diseases of mushrooms
7. Describe the basic components of the apicultural industry
8. List any three basics of the investment techniques for capacity building and socio-economic enhancement

**Course contents**

Bee-keeping: Colony structure and behaviour; hive and hive management; hive products; harvesting and quality control. Importance, scope of apiculture industry, bee species and their biology, morphology, behaviour and products, bee flora their distribution and flowering time; beekeeping equipment, seasonal management, uniting, dividing and preparation for shifting colonies; bee stings, queen rearing and swarming; pest and diseases of bees and their management; honey extraction; factors affecting honey yield; importance of bees in pollination; honey, its properties and uses; granulation, fermentation and storage of honey, uses of other bee products; beekeeping as an enterprise. Introduction to insects of medicinal, food and aesthetic value; insect pollinators and environmental indicators; scavengers, entomophagous (predators and parasitoids). Introduction to other entomological industries such as sericulture and lac-culture; Mushroom Production: Morphology, taxonomy, ecology, life cycle, benefits of mushrooms; substrate, spawn production; cultivation input and output; ***Practical:*** climate control, indoor and outdoor cultivation; post-harvest handling; pests and diseases of mushrooms. Colony structure and behaviour; hive and hive management; hive products; harvesting and quality control; Beekeeping & Apiary Management; Mushroom production & Processing.

**Minimum Academic Standards (MAS)**

The required facilities for the course have been adequately captured.

**CRP 503: Field and Storage Pests and their Management (2 Units; Core) (LH = 15; PH =45)**

**Senate-Approved Relevance**

To produce graduates who are highly skilled and knowledgeable who are highly knowledgeable storage and field pests and their management, research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

The Field and Storage Pests and their Management course is aimed at preparing students to be involved in functional and collaborative teams that have skills for identification and management of field and storage pests.

The course focuses on management of field and storage pests. The practical sessions aim to developing practical skills on pest identification and damage symptoms both in the field and store.

**Objectives**

On completion of the Course, the students will be able to:

1. Introduce the students to the concepts of stored products pest management in Nigeria,
2. Describe the storage principles and storage losses due to insect pests.
3. Explain the concept of agricultural insect pests of cultivated Nigerian crops and their management to the students.
4. Identify field and storage pests and their damage assessment.
5. Assess the damage caused by the vertebrate pests and their control measures.
6. List factors predisposing crops and stored produce to vertebrate pest damage;
7. Describe the assessment methods of damage by vertebrate pests.
8. State factors affecting microbial decay in storage.
9. Describe the mode of infestation of agricultural produce in storage by microorganisms.
10. State four fungi producing mycotoxins during storage of crops.

**Learning Outcomes**

On completion, the students should be able to:

1. Describe the concepts of stored products pest management in Nigeria,
2. List at least three storage principles and storage losses due to insect pests.
3. Explain a clear concept of agricultural insect pests of cultivated Nigerian crops
4. Enumerate at least five pests’ management methods with their merits and demerits
5. State at least five key field and storage pests.
6. Assess the damage caused by field and storage pests.
7. Elucidate any three factors responsible for the distribution and abundance of vertebrate pests’ species.
8. Explain at least five factors affecting microbial decay in storage.
9. Describe the mode of infestation of agricultural produce in storage by microorganisms.
10. State four fungi producing mycotoxins during storage of crops.

**Course Contents**

Distribution and abundance of vertebrate pest species in Nigeria; factors predisposing crops and stored produce to vertebrate pest damage; assessment of damage by vertebrate pests; management and control of vertebrate pests. Causes and extent of damage of agricultural products in storage by insect pests; natural enemies of stored product pests; methods of storage pests control; introduction to infestation of agricultural produce in storage by microorganisms; sources and mode of infection/infestation of stored produce; nature and biology of pests and pathogens causing damage to stored products; factors affecting microbial decay in storage; mycotoxins; control of stored product pathogens; Identification, biology, life histories, and control of insects and mites attacking arable crops such as millet corn, cotton, rice, sorghum, sunflower, soybean, fruits, nuts, vegetables and other crops. The damage they cause and alternatives for their control. Overview on insects of agricultural importance like ants, grasshoppers, etc., in various crops like cocoa, cowpea, rice, etc. Other important vertebrate pests of crops and their management. Principles and practice of the pest management including pesticide application, economic basis for decision making; Introduction; identification, biology and management of different stored product pests including cereals, pulses and other important agricultural products. Ecology of their pests, population management and wise control strategies. Principles and types of storages. Factors affecting grain and other products in storage. Stored product losses and their prevention; ***Practicals:*** Identification of vertebrate pests; activities and damage on arable and permanent crops in the tropics. Assessment of vertebrate control methods in the field. Visit to stores, e.g. silos, to determine nature of damage, demonstration of damage by pests to maize, cowpea, fish, etc; Visits to different godowns and demonstration of sampling methods and estimation; collection, identification and management of different stored product pests; culture of some stored products insect pests under different conditions in the laboratory.

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**Minimum Academic Standards (MAS)**

The required facilities for the course have been adequately captured.

**CRP 504: Crop Protection Technology (2 Units; Core) (LH = 15; PH =45)**

**Senate-Approved Relevance**

To produce graduates who can lead in Pesticides application research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

The Crop Protection Technology course is aimed at preparing students to be involved in functional and collaborative teams that are skillful in the application techniques for control of filed and storage pests for sustainable crop production. Knowledge of forensic entomology is vital in agricultural productions via the introduction of the use of insects and other arthropods in investigations of human and animal deaths, thefts, illegal drug trade and in court of-law proceedings resulting from such investigations. It also involves Bio-security vs. Biosafety; Bio-terrorism vs. Bio-crimes; globalization; international trade and emerging insect organisms; invasive species; quarantine; responses; surveillance; detection and diagnostics; risk analysis.

The courses focus on acquiring knowledge and skills on crop protection equipment, usage, and maintenance as well as plant health and environmental safety. The practical sessions aim to develop skills in controlling pests through application of pesticides and research techniques.

**Objectives**

On completion of the Course, the students will be able to:

1. Classify pesticides according to target organism, chemical composition, and mode of action.
2. Give examples of different pesticides
3. State methods of controlling pests of crops.
4. Calibrate a sprayer before pesticide application.
5. Enumerate some equipment used in pesticides application.
6. Describe safety precautionary measures for the application of pesticides.
7. State the effects of pesticides application to the ecosystems.
8. Define the concept of forensic entomology.
9. Understand on the nature and mechanisms of forensic science involving insects and other arthropods.
10. Equip students on the skills of biosecurity, bio-safety, quarantine and international trade.

**Learning outcomes**

On completion, the students should be able to:

1. State at least five different types of pesticides according to target organism, chemical composition and mode of action.
2. Write five examples of different pesticides.
3. State six methods of controlling pests of crops.
4. List at least three steps to Calibrate a sprayer before pesticide application.
5. Outline and Describe any five-equipment used in pesticides application.
6. Write 10 safety precautionary measures for the application of pesticides.
7. Explain five effects of pesticides application to the ecosystems.
8. State any five importance of forensic entomology to National development.
9. List at least any three tools and techniques in forensic entomology.
10. Describe at least three insect species used in forensic entomology.

**Course Contents**

Pre-requisites for pest control - detection; identification and economic significance. Methods of control: cultural, mechanical, biological, legal, chemical and integration of control methods. Types, chemical compositions, mode of action and other characteristics of pesticides. Formulations of pesticides. Principles of pesticides application and significance of droplet size. Application techniques for control of filed and storage pests. Pesticide application, crop protection equipment, usage and maintenance, calibration and dosage calculation; health and safety precautions in pesticide application, protective clothing, systemic movement of pesticides in plants/ insects. Degradation of pesticides in soil and water; An overview of the principles, procedures, and concepts of forensic and investigative sciences. The definitions, scope, and use of tools, techniques and protocols in forensic applications used to resolve social, regulatory and legal disputes; for instance, introduction to the use of insects and other arthropods in investigations of human and animal deaths, thefts, illegal drug trade and in court of-law proceedings resulting from such investigations. Bio-security vs. Biosafety; Bio-terrorism vs. Bio-crimes; globalization; international trade and emerging insect organisms; invasive species; quarantine; responses; surveillance; detection and diagnostics; risk analysis. ***Practical*:** Laboratory-based activity offering students practical experience using scientific information, methodology, technology and legal procedures inherent to the field of forensic entomology; visit to international entry/exit points in the country for on the spot assessment on the prevention of deliberate/accidental importation of insect species.

**Minimum Academic Standards (MAS)**

The required facilities for the course have been adequately captured.

**Department of Soil Science**

**BUK-SOS501: Soil Genesis and Pedometrics (3 Units; Core) (LH = 30; PH = 45)**

**Senate-Approved Relevance**

Training of high-quality graduates who are highly skilled and knowledgeable in genesis, evaluation, classification and mapping of soils for appropriate planning, use and management strategies of agricultural lands. This agrees with BUK’s mission to address African developmental challenges in producing graduates of agriculture (Soil Science option). Relevance is seen in B. Agriculture (Soil Science option) graduates from BUK to use the knowledge acquired to solve the problems of soil capability and suitability classification in achieving sustainable soil use in agriculture.

**Overview**

Soil is the collection of natural bodies occupying the part of earth surface capable to support plants and having properties derived from the integrated effect of climate and living organisms acting upon parent material as modified by topography over periods of time. The study of soil genesis and pedometrics deals primarily with (i) the formation and evolution of soils, (ii) their organization and categorization as natural bodies being a product of natural and anthropogenic factors and processes, and (iii) their evaluation, planning and use over space.

This course will prepare students to evaluate and interpret information on soil type and characteristics, telling them what has happened in the past, and simultaneously guide them toward soil management strategies that will be successful now and in the future.

The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

At the end of the course the student should be able to:

1. Appraise different components of soil and evaluate their interrelationships.
2. Describe basic soil description terms.
3. Interpret and relate different types of pedogenic processes.
4. Explain the differences between various soil moisture and temperature regimes for soil classification.
5. Illustrate the types of surface and subsurface diagnostic horizons.
6. Appraise soil classification pyramid and soil orders.
7. Indicate the basic principles of soil classification systems.
8. Differentiate between various soil mapping units.
9. Describe soil formation models
10. Classify the soil based on multicriteria decision support method (MDSM).

**Learning Outcomes**:

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

1. Describe pedogenic processes in soil.
2. Outline various components of soil and describe their roles and relationships.
3. List and describe common soil profile description terms
4. Classify soil moisture and temperature regimes.
5. List and explain diagnostic surface and subsurface horizons.
6. Draw the pyramid of soil classification.
7. Explain the differences between the soil orders.
8. Classify the soils based on USDA soil taxonomy and FAO (WRB) classification approaches.
9. Define pedometric and digital soil mapping.
10. Apply remote sensing data in soil survey.
11. Describe various soil formation models.
12. Delineate soil mapping units.
13. Classify soils using multicriteria decision support method (MDSM).

**Course Contents**

Components of soil. Soil description terms. Concepts of soil genesis and pedogenic processes. Principles of soil classification. Soil moisture regimes. Soil temperature regimes. Characteristics of diagnostic surface horizon. Characteristics of diagnostic subsurface horizons. Pyramid of soil classification tree. Detailed USDA soil Taxonomy and FAO (WRB) soil classification approaches. Applications of remote sensing in soil survey. Introduction to pedometrics. Concept and procedures of digital soil mapping. Data acquisitions and usage in digital soil mapping. Statistical methods used in pedometrics. Soil formation models. Use of pedometrics techniques in soil survey. Delineation of soil units. Use of multicriteria decision support tools in suitability analysis {Pairwise comparison matrix (PCM), Analytical Hierarchical processes (AHP), reclassification and model builder.

**Minimum Academic Standards (MAS)**

B. Agriculture programme’s NUC-MAS requirement facilities.

**BUK-SOS 503: Soil Chemistry and Mineralogy (3 Units; Core) (LH = 45)**

**Senate-Approved Relevance**

Training of high-quality graduates who are highly skilled and knowledgeable in the chemical composition, properties and reactions of soils is critical to the productivity of soils and waste management. This agrees with BUK’s mission to address African developmental challenges in producing B. Agriculture graduates (Soil Science option) capable of correcting soil chemical imbalances and ameliorate problem associated with soil such as acidity, alkalinity, etc.

**Overview**

This course will review previous knowledge of chemistry and some of the basic terminologies. It will provide information on different types of chemical bonds and how they influence properties of minerals. Different types of charges and their development, characteristics and modellings of exchange reactions will also be taught. Factors governing soil reaction processes as well as applications of soil chemical processes in agriculture and environment will be discussed.

Overall, the course is designed to equip students with knowledge and skills to apply soil chemical properties and processes to improve productivity of soil and mitigate environmental hazards through the use of fertilizers, agrochemicals, amendments and other related waste products in soils.

The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of this course are to:

1. Classify and interpret different types of chemical bonds;
2. Classify and identify soil minerals;
3. Describe soil organic matter and its chemical transformations in soils;
4. Identify different types of charges in soils;
5. Illustrate characteristics of soil exchange reactions; and
6. Identify the applications of soil chemistry in agriculture and environment.

**Learning Outcomes**

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

1. Differentiate between silicates and aluminosilicates soil minerals;
2. Mention basic properties of both silicates and aluminosilicates soil minerals;
3. Explain the components of organic matter and its characteristics in soils;
4. Describe the concept of charge and charge development in soils;
5. Explain the concept and application of diffuse double layer theory in soils;
6. Differentiate between cation and anion adsorption in soils;
7. Describe the concept of soil solution and its importance in crop production;
8. Explain the concept of chemical equilibria in soils;
9. Describe the different kinetic models and their distinguishing features in soil chemical reactions;
10. Explain oxidation-reduction reactions and their importance in nutrient availability to plants; and
11. Appraise application of soil chemistry in agriculture and environment.

**Contents**

*Review of fundamental concepts in chemistry*: Periodic table. Atoms and ions. Ionic size in relation to chemical properties of cations. Chemical bonds. Atomic theory and structure. Acids and bases **(**strengths, relationship and interactions). *Chemistry of soil***:** Elemental composition of soil. Chemistry, classification and properties of soil minerals. Chemistry of soil organic matter: Components, transformation and chemistry. Methods of quantification of organic matter in the soil. *Surface chemistry***:** Charge development. Permanent and variable charges. Diffuse double layer (theory and application). *Chemical equilibria***:** Characteristics and modelling of ion exchange reactions. Adsorption of ions. *Oxidation and reduction***:** Concepts and factors governing redox reactions in soils. Application of soil chemistry to agriculture and environmental protection.

**Minimum Academic Standards (MAS)**

B. Agriculture programme’s NUC-MAS requirement facilities.

**BUK-SOS 504: Soil Microbiology and Biochemistry (3 Units; Core) (LH = 45)**

**Senate-Approved Relevance**

Skills and knowledge in soil microbiology and biochemistry familiarizes students with types, roles, use and enhancement of microorganisms living in and through the soils to creates healthy soil conditions for practical and effective management of agricultural crops. This is line with BUK’s mission to address African developmental challenges in sustainable food production and environmental quality through production highly-skilled and knowledgeable graduates in agriculture (specializing in soil science).

**Overview**

Microbes are the hidden players in the environment. They are numerous and encompass highly diverse species. Microbes play crucial roles in biogeochemical cycling, nutrient status, food web interactions, soil aggregation, soil and plant health, and many more important functions.

In this course, students will gain an understanding of soil is a medium for microbial growth, the relation of microbes to important mineral transformations in soil, importance of biological equilibrium and significance of soil microbes to environmental quality.

The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of this course are to:

1. Describe soil microorganisms based on their growth characteristics and their roles in soil plant system;
2. Describe the microbial transformation of the following nutrients elements; C, N, S, P, Fe, and Mn;
3. Outline the factors influencing rhizosphere colonization in soils;
4. Analyze microbe-plant interactions in the soil rhizosphere;
5. Compare and contrast between the key features of different soil mycorrhizal types;
6. Explain the functions of soil mycorrhiza in ecosystems;
7. Enumerate the different types of soil-plant biological nitrogen fixation;
8. Describe the process of symbiotic nitrogen fixation in soils;
9. Describe formation and biodegradation of soil organic matter;
10. Identify sources and classify basic contaminants in soil; and
11. Outline and relate between the different methods of bioremediation of contaminated soils.

**Learning Outcomes**

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

1. Classify soil microorganisms based on their growth characteristics;
2. Explain the interactions between soil organisms;
3. Describe the microbial transformation of the following nutrients elements; C, N, S, P, Fe, and Mn;
4. State the factors influencing rhizosphere colonization;
5. Illustrate microbe-plant interactions in the rhizosphere;
6. Compare the key features of mycorrhizal types;
7. Explain the functions of mycorrhiza in ecosystems;
8. Enumerate the different types of biological nitrogen fixation;
9. Describe the process of symbiotic nitrogen fixation;
10. Describe formation and biodegradation of soil organic matter;
11. Identify sources and classify basic contaminants in soil; and
12. Outline and relate between the different methods of bioremediation of contaminated soils.

**Contents**

*Soil microbial ecology*: classification of soil microorganisms based on growth characteristics. The interactions between soil organisms. *Microbial metabolism*: Microbial transformation of Carbon (C). Microbial transformation of Nitrogen (N). Microbial transformation of Sulfur (S). Microbial transformation of Phosphorus (P). Microbial transformation of Iron (Fe). Microbial transformation of Manganese (Mn). *Microbiology of the rhizosphere*: Factors influencing rhizosphere colonization. Microbe-plant interactions in the rhizosphere. *Mycorrhizal symbiosis*: Key features of mycorrhizal type. Functions of mycorrhiza in ecosystems. *Nitrogen fixation*: Types of biological nitrogen fixation. Processes in symbiotic nitrogen fixation. *Soil organic matter*: Formation and biodegradation. *Bioremediation of contaminated soils*: Types of contaminants, bioremediation processes.

**Minimum Academic Standards (MAS)**

B. Agriculture programme’s NUC-MAS requirement facilities.

**BUK-SOS 505: Soil, Plant and Water Analyses (2 Units; Core) (LH15; PH 45)**

**Senate-Approved Relevance**

Skills and knowledge of soil, plant and water analyses are critical in diagnosing limitations and in recommending management practices for soil, crop and water in order to achieve sustainable agricultural production and environmental safety. This is critically needed especially in Africa because of the continent’s low level of Agricultural development. Achieving this is line with BUK’s mission to address African developmental challenges in sustainable food production and environmental quality through production of highly-skilled, knowledgeable and research-oriented graduates in Agriculture.

**Overview**

The course introduces students to soil, plant and water sampling procedures, sample preparation, units and their conversions. It also exposes students to laboratory instruments for soil, plant and water analyses, their accuracy and sources of error. The course will also identify different types of extractants, their uses and their suitability based on soil types and characteristics.

Overall, the course is designed to equip students with knowledge and skills to: i) Collect, prepare, and analyze soil, plant and water samples, ii) Interpret chemical results for soil management and environmental quality, and, iii) Choose analytical methods and maintain laboratory quality control.

**Objectives**

1. Outline the importance of soil, plant and water analyses.
2. Compare and contrast between different soil, plant and water sample collection procedures.
3. Describe different methods of determination of soil physical and chemical properties.
4. Outline advantages and limitations of different methods of determination of soil physical and chemical properties.
5. Describe and perform soil, plant and water analyses. and
6. Interpret results of soil, plant and water analyses and make appropriate recommendations on use and management.

**Learning Outcomes**

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

1. Mention the importance of soil, plant and water analyses.
2. Develop a soil sampling plan based on the characteristics of the field/farm.
3. Describe different methods of determination of soil physical and chemical properties.
4. Outline advantages and limitations of different methods of determination of soil physical and chemical properties.
5. Describe and perform soil, plant and water analyses in group/individually. and
6. Interpret results of soil, plant and water analyses and make appropriate recommendations on use and management.

**Contents**

**Theory component**

Soil analysis: Definition and importance. Soil sampling: Importance, methods and mechanics, preparation and processing. Principles and significance of measurement of soil physical properties: Particle size. Bulk density. Particle density. Soil water content. Hydraulic conductivity. Aggregate stability. Principles and significance of measurement soil chemical properties: pH. CEC. Organic carbon. Phosphorus. Nitrogen. Potassium. and Micronutrients. Plant analyses: Plant sampling (importance, methods, precautions, preparation and processing). Methods of plant analysis. Principles and significance of water quality analyses. Instrumental methods: Principles and operation of some common instruments (spectrophotometer, flame photometer, atomic absorption spectrophotometer): Interpretation and application of soil, plant and water analytical data. Operation and management of a soil, water and plant testing laboratory.

**Practical component**

Collection, preparation and analyses of soil, water and plant samples. Principles and operation of some common instruments (spectrophotometer, flame photometer, atomic absorption spectrophotometer).

**Minimum Academic Standards (MAS)**

B. Agriculture programme’s NUC-MAS requirement facilities.

**BUK-SOS 506: Application of GIS and Remote Sensing in Soil Science (3 Units; Core) (LH30; PH 45)**

**Senate-Approved Relevance**

Training of high-quality graduates who are highly skilled and knowledgeable in the applications of GIS and Remote Sensing in respect of the use and management of soil resources for improved and sustainable agricultural production and environmental quality. This agrees with BUK’s mission to address African developmental challenges in producing high-quality graduates in B. Agriculture programme, Crop/Soil Science option.

**Overview**

Currently Geographic information system (GIS) and Remote Sensing are playing a pivotal role in the evaluations, monitoring and development of optimal management practices of soil and other related agricultural biophysical resources. Geographic information system and Remote Sensing in combination with other digital technologies are enabling the realization of precision farming, sustainable food production goals and risk management. These highlights the importance of exposing the students of B. Agriculture programme (Soil Science option) to the application of GIS and Remote Sensing in the use and management of soil resources to achieve improved and sustainable agricultural production.

This course is designed to equip students with knowledge and skills on applications of GIS and Remote Sensing to solve basic Agricultural and Environmental problems. This will permit the students to understand the basic concepts of GIS and Remote Sensing; and enable them to identify and use GIS and Remote Sensing principles and tools in appraising soil and related agricultural biophysical resources. It will also allow them develop effective and sustainable monitoring and management decisions to improve agricultural production and environmental quality.

The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objective**

The objectives of the course are to:

1. Understand basic concepts of GIS and Remote Sensing.
2. Recognize and differentiate GIS data systems (raster, vector and TIN).
3. Identify different scales, resolution, projections and coordinate systems of GIS data.
4. Convert GIS data into different scales, resolution, projections and coordinate systems.
5. Perform and interpret spatial interpolation and surface analyses of various soil and related agriculture biophysical GIS data.
6. Apply GIS decision making models to solve geospatial agricultural and environmental problem. and
7. Apply the Remote Sensing concepts and tools in land use and land cover mapping and classification.

**Learning Outcomes**

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

1. Describe, relate and differentiate between Geographic Information Systems (GIS) and Remote Sensing.
2. Identify, compare and contrast vector and raster GIS.
3. Apply cartographic principles of scale, resolution, projection and data management to a problem of a geographic nature.
4. Apply spatial analysis functions on a GIS to solve a geospatial agricultural and environmental Soil Science problem.
5. Outline and describe basic GIS-based decision-making models use to appraise and solve geospatial agricultural and environmental Soil Science processes and problems. and
6. Apply the use of Remote Sensing in land use and land cover mapping and classification.

**Contents**

Introduction to GIS and Remote Sensing: Definition and history of GIS and Remote Sensing. Vector and raster systems. Scale and resolution. Map projections and coordinate systems. Applications of GIS (its purpose and scope). Georeferencing and Global Positioning Systems (GPS). Converting digital data to a uniform projection and scale. Vector-to-raster and raster-to-vector data conversions. Spatial Analysis: Map algebra. Buffering. Interpolation and Surface analysis. Applications in Decision-Making in geospatial agricultural and environmental Soil Science problem. Application of Remote Sensing in soil and water resource mapping, estimations and management. Image processing. Land use and landcover mapping and classification.

**Minimum Academic Standards (MAS)**

B. Agriculture programme’s NUC-MAS requirement facilities.

**BUK-SOS 507: Soil-Water-Plant Relations (3 Units; Core) (PH = 30; LH = 45)**

**Senate-Approved Relevance**

Training of high-quality graduates who are highly skilled and knowledgeable in the understanding and applications of soil-water-plants relations in the use and management of soil, crop and water in drylands. This agrees with BUK’s mission to address African developmental challenges in producing high-quality graduates of B. Agriculture programme (Soil Science option). Relevance is seen in graduate of BUK B. Agriculture (Soil Science option), because soil water use, quantification, and management are critical to enhance and sustain crop production especially in drylands in the midst of climate change and variability.

**Overview**

Crop growth depends on two important natural resources — soil and water. Soil provides the mechanical support and water/nutrient reservoir necessary for plant growth. Water is essential for plant life processes. Effective management of these resources for crop production especially in drylands requires understanding of relationships between soil, water, and plants. This highlights the importance of preparing students in B. Agriculture programme (soil science option) with knowledge on concepts and applications of soil-water-plants relations in designing effective and site-specific soil and water management strategies.

The course is planned to expose students to the factors affecting, and the techniques of measuring, the entry, retention, and movement of water into and through the soil-plant system. It also covers the accessibility and significance of water to plants, atmospheric moisture and the transport of water through plants and various ways of describing and improving crop and field water use efficiency. The importance of the course lies in meeting the need in achieving sustainable development goals (SDGs) number 1 and 2 in the areas of poverty reduction and zero hunger, respectively, through efficient and sustainable crop water use to maximize cop yield and profitability.

The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

At the end of the course the student should be able to:

1. Explain basic concepts and measurements of soil water potentials and soil moisture constants.
2. Demonstrate mechanisms of water flows in soils under saturated and unsaturated conditions.
3. Illustrate pathways and potentials affecting water movement in and through soil-plant-atmosphere continuum.
4. Explain processes, factors and measurement of infiltration, percolation and groundwater recharge.
5. Identify various processes and ways of water uptake by plants and factors affecting them.
6. Analyze different ways of quantifying transpiration and crop water use efficiency and its improvements in drylands.
7. Outline various effects of water deficit on crop growth and productivity.
8. Recognize the importance of drainage in crop production and soil productivity.
9. Appraise ways to control soil water erosion.
10. Recognize methods to prevent development of secondary soil salinity.

**Learning Outcomes**

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

1. Describe the concept and measurement of soil water potentials and soil moisture constants.
2. Outline processes and factors affecting water flows in soil under saturated and unsaturated conditions.
3. Sketch water movement in and through soil-plant-atmosphere continuum and describe factors affecting it.
4. Explain processes, factors and measurement of infiltration, percolation, and groundwater recharge.
5. Explain various processes of water uptake by plants and factors affecting them.
6. Identify different ways of quantifying transpiration and crop water use efficiency and its improvements in drylands.
7. List various effects of water deficit on crop growth and productivity.
8. Identify the importance of drainage in crop production and soil productivity and ways to enhance it.
9. Identify ways to control soil water erosion.
10. Identify methods to prevent development of secondary soil salinity.

**Course Contents**

Soil water potentials. Soil water constants. Soil moisture characteristics curve. Hysteresis. Water flow in unsaturated soil. Water flow in saturated soil. Measurements of soil water contents. Water movement in the soil-plant-atmosphere continuum. infiltration models. Transport and losses of water in soils. Water uptake by plants. Transpiration and water use efficiency. Soil physical factors affecting plant root growth. Soil water deficit and plant growth. Soil drainage. Control of soil water erosion. Prevention of secondary salinization in soils.

**Minimum Academic Standards (MAS)**

B. Agriculture programme’s NUC-MAS requirement facilities.

**Faculty of Agriculture-Based (500 Elective Courses)**

**BUK-AGG 501: Sustainable and Climate Smart Agriculture (2 Units; Elective) (LH = 30)**

**Senate-Approved Relevance**

To produce graduates who are knowledgeable in sustainable and climate smart agriculture and can lead in research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Overview**

Agriculture is a major recurring factor in the drive for sustainability. Industrial agriculture is one of the sectors that are responsible for the dreaded climate change. Today, roughly 38 per cent of the world’s land is used for agriculture – one third of this is for crops, with the rest used for grazing livestock. And with agriculture (and forestry) responsible for 23 per cent of global greenhouse gas emissions, it is clear that changes need to be made to how we manage our land, while at the same time safeguarding our food and farmers’ livelihoods. With food security set to become more and more challenging as natural resources are stretched thin – both by overuse and climate change – it is vital we examine how we manage our land and produce our food.

This course will prepare students on sustainable use of resources in agricultural systems and adoption of the principles of production that are beneficial to the environment and thus making the entire agricultural systems more regenerative instead of the current degenerative approaches.

**Objectives**

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

1. Describe the concept and practices of regenerative agriculture.
2. Explain agroforestry and appraise its relationship to climate change.
3. Explain the concept of organic farming and its governing principles.
4. Explain soil health and the relationship with climate sequestration.
5. Describe climate financing in sustainable agriculture.
6. Outline the various aspects of environmental economics.
7. Explain manure production and its management.
8. Explain the concept of GHG emission in plant and animal agriculture.

**Learning Outcomes**

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

1. Describe at least 3 concepts of regenerative agriculture and the and the principles governing it.
2. Explain the concepts and practices of organic agriculture.
3. Explain at least 5 components of soil health and carbon sequestration.
4. Define the major components of climate finance financing and environmental economics.
5. Outline at least 3 procedures of manure production and management.
6. Describe the concept of GHG emissions in agricultural systems.

**Course Contents**

Regenerative Agriculture: Concepts and practices. Agroforestry and climate change. Organic farming concepts and practices. Soil health. Carbon sequestration. Integrated Soil fertility Management (ISFM). Climate financing in sustainable agriculture. Environmental economics. Manure Management. Manure production. Factors affecting manure characteristics. Environmental effects of manure production. GHGs emissions in crop and animal agriculture. Precision feeding. Composting. Vermicomposting, Biogas production.

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.

**BUK-AGG 502: Food Systems, Agrotechnology and Precision Agriculture (2 Units; Elective) (LH = 30)**

**Overview**

To produce graduates who are knowledgeable in management of agricultural food systems, agrotechnology and precision agriculture and can lead in research and education in Africa. The students will be committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training of high-quality graduates.

**Objectives**

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

1. With specific examples, describe the concept and framework of sustainable food systems.
2. Outline basic strategies to develop an agricultural technology.
3. Outline basic strategies to transfer an agricultural technology.
4. Identify the relevance of precision agriculture amidst of biophysical and socioeconomic variability condition.
5. Understand drivers and components of value chain of major crops.
6. Outline application of GIS and remote sensing in achieving precision agriculture.
7. Identify applications of Internet of Things (IoT) and Artificial Intelligence (AI) in agriculture.

**Learning Outcomes**

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

1. With specific examples, describe the concept and framework of sustainable food systems.
2. Outline basic strategies to develop an agricultural technology.
3. Outline basic strategies to transfer an agricultural technology.
4. Identify the relevance of precision agriculture amidst of biophysical and socioeconomic variability condition.
5. Understand drivers and components of value chain of major crops.
6. Outline application of GIS and remote sensing in achieving precision agriculture.
7. Identify applications of Internet of Things (IoT) and Artificial Intelligence (AI) in agriculture.

**Course Contents**

Concept and framework of sustainable food systems. Basic Strategies for the Development and Transfer of Technology. Concept of variability and precision agriculture. Factors that affect precision agriculture’s adoption. Steps in precision agriculture decision making. Value chain and enterprise analyze of major crops. GIS and remote sensing application in agriculture. Drone technology and its agricultural applications. Internet of Things (IoT) applications in Agriculture. Artificial Intelligence (AI) applications in Agriculture. Protected Agriculture (Green House, Screen House, Tunnels etc).

**Minimum Academic Standards (MAS)**

If needed as addition as what is contained in the CCMAS.