**Bayero University, Kano (BUK)**

**Faculty of Engineering**

**Department of Agricultural and Environmental Engineering**

**B. Eng. Agricultural and Biosystems Engineering**

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Level 100** | | | | | |
| **Course Code** | **Course Title** | **Unit** | **Status** | **LH** | **PH** |
| BUK-ABE 101 | Elementary Mathematics III (Vectors, Geometry and Dynamics) | 2 | C | 30 | - |
| BUK-ABE 102 | Basic Statistics | 3 | C | 45 | - |
|  | **Total** | **5** |  |  |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Level 200** | | | | | |
| **Course Code** | **Course Title** | **Unit** | **Status** | **LH** | **PH** |
| BUK-ABE 201 | Applied Mechanics | 3 | C | 45 | - |
| BUK-ABE 202 | Strength of Materials | 3 | E | 45 | - |
|  | **Total** | **6** |  |  |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Level 300** | | | | | |
| **Course Code** | **Course Title** | **Unit** | **Status** | **LH** | **PH** |
| BUK-ABE 301 | Agricultural Wastes Management Systems | 2 | C | 30 | - |
| BUK-ABE 302 | Agricultural Land Development | 2 | C | 30 | - |
| BUK-ABE 303 | Emerging Technologies in Agriculture | 2 | C | 30 | - |
| BUK-ABE 304 | Agricultural and Biosystems Engineering Practical I | 2 | C | - | 90 |
| BUK-ABE 305 | Farm Structures and Environmental Control | 2 | C | 30 | - |
|  | **Total** | **10** |  |  |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Level 400** | | | | | |
| **Course Code** | **Course Title** | **Unit** | **Status** | **LH** | **PH** |
| BUK-ABE 401 | Irrigation Practices and Drainage | 2 | C | 30 | - |
| BUK-ABE 402 | Soil and Water Conservation Engineering | 2 | C | 30 | - |
| BUK-ABE 403 | Agricultural and Biosystems Engineering Practical II | 2 | C | - | 90 |
| BUK-ABE 404 | Agricultural Power and Machinery | 3 | C | 45 | - |
| BUK-ABE 405 | Hydrology and Hydraulics Engineering | 3 | C | 45 | - |
| BUK-ABE 406 | Properties and Handling of Agricultural Products | 3 | C | 45 | - |
|  | **Total** | **15** |  |  |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Level 500** | | | | | |
| **Course Code** | **Course Title** | **Unit** | **Status** | **LH** | **PH** |
| BUK-ABE 501 | Application of GIS and Sensor Technologies in Agriculture | 2 | C | 30 | - |
| BUK-ABE 502 | Processing and Storage of Agricultural Products | 2 | C | 30 | - |
| BUK-ABE 503 | Food Processing Engineering | 2 | C | 30 | - |
| BUK-ABE 504 | Design of Agricultural Machinery | 3 | C | 45 | - |
| BUK-ABE 505 | Design of Irrigation and Drainage Systems | 3 | C | 45 | - |
| BUK-ABE 506 | Indigenous Technologies for Agricultural Value Chain | 3 | E | 45 | - |
|  | **Total** | **15** |  |  |  |
|  | **Total of 30% addition core courses** | **45** |  |  |  |
|  | **Total of 30% addition elective courses** | **6** |  |  |  |
|  | **Grand total of 30% addition** | **51** |  |  |  |

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B. Eng. Agricultural and Biosystems Engineering

**BUK–ABE 101 Elementary Mathematics III (Vectors, Coordinate Geometry and Dynamics) (2 Units; Core; LH = 30)**

**Senate-approved relevance**

Training of high-quality graduates that are well-skilled and knowledgeable in the required mathematical skills in Nigeria is in line with BUK’s mission to address African developmental challenges in producing graduates in agricultural and biosystems engineering.

**Overview**

Vectors coordinate, geometry and dynamic is a vital course that prepares the graduate in agricultural and biosystems engineering to be able to handle and improve on the infrastructural deficit for sustainable development. This highlights the importance of preparing students in agricultural and biosystems engineering with the knowledge and skills on how to solve problems that they will encounter in the course of their training.

This course is designed to introduce and prepare students ahead of various agricultural and biosystems engineering courses in design, process, and production. The importance of the course lies in meeting the need in achieving sustainable development goals (SDGs) numbers 1 and 2 in the areas of reducing poverty and zero hunger respectively. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of the course are to:

1. solve some vectors in addition and multiplication
2. calculate force and momentum
3. explain types of vectors, a geometrical representation of vectors, and components of vectors
4. solve differentiation and integration of vectors
5. illustrate the linear dependence of vectors and its simple application
6. demonstrate dimensional coordinates systems
7. analyze the equation of a circle, tangent, and normal to a circle
8. describe the properties of parabola, ellipse, hyperbola, straight lines, and planes in space
9. describe force, momentum, laws of motion under gravity, projectiles, resisted vertical motion, angular momentum, and simple harmonic motion
10. describe elastic string, simple pendulum, and impulse
11. analyze the impact of two smooth spheres and of a sphere on a smooth surface

**Learning outcomes**

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

1. explain at least two (2) types of vectors, a geometrical representation of vectors, components of vectors
2. illustrate two kinds of linear dependence of vectors and their simple applications clearly
3. demonstrate any two types of dimensional coordinates systems
4. analyze any two equations of a circle, tangent, and normal to a circle.
5. describe the properties of parabola, ellipse, hyperbola, straight lines, and planes in space
6. describe two types each force, momentum, laws of motion under gravity, projectiles, resisted vertical motion, angular momentum, and simple harmonic motion
7. describe any two each elastic strings, a simple pendulum, and an impulse.
8. analyse two impacts of two smooth spheres and of a sphere on a smooth surface

**Course contents**

Types of vectors: points, lines, and relative vectors. Geometrical representation of vectors in 1-3 dimensions. Addition of vectors and multiplication by a scalar. Components of vectors in 1-3 dimensions. Direction cosines. Linear independence of vectors. Point of the division of a line. Scalar and vector products of two vectors. Simple applications. Two-dimensional coordinate geometry. Straight lines. The angle between two lines, distance between points. Equation of a circle, tangent and normal to a circle. Properties of parabola ellipse. Hyperbola straight lines and planes in space. Direction cosines. The angle between lines and between lines and planes. A distance of a point from a plane. Components of velocity and acceleration of a particle moving in a plane, force, momentum. Laws of motion under gravity, projectiles, and resisted vertical motion. Angular momentum. Simple harmonic motion. Elastic string. Simple pendulum, and impulse. The impact of two smooth spheres and of a sphere on a smooth surface.

**Minimum Academic Standards**

Agricultural and biosystems engineering programme’s NUC-MAS requirement facilities.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B. Eng. Agricultural and Biosystems Engineering

**BUK–ABE 102 Basic Statistics (3 Units; Core; LH = 45)**

**Senate-approved relevance**

Training of high-quality graduates that are well-skilled and knowledgeable in handling and analyzing statistical data is in line with BUK’s mission to address African developmental challenges in producing graduates in agricultural and biosystems engineering. Relevance is seen in agricultural and biosystems engineers from BUK because all agricultural activities use statistical principles to solve challenges during food production.

**Overview**

Statistics is a vital approach used in handling data obtained from different processes, operations, and experiments in agricultural and biosystems engineering. It is designed to introduce and expose students to various statistical tools required in computing and analyzing data.

The course is also designed to build the capacity of students in the area of data analysis formulating problem-solving approaches in the midst of an abundance of untapped raw materials. The importance of the course lies in meeting the need in achieving sustainable development goals (SDGs) numbers 1 and 2 in the areas of reducing poverty and zero hunger respectively. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of the course are to:

1. define statistics and identify various sources of data
2. explain the measurement of location and dispersion in grouped and un-grouped data
3. explain exponential, elements of a probability distribution; normal, binomial, Poisson, geometrics, and negative binomial distributions
4. describe estimate and tests the hypothesis concerning the parameters of distributions
5. analyze regression and correlation models
6. construct questionnaires and simple index numbers
7. apply statistical principles in agricultural and biosystems engineering

**Learning outcomes**

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

1. identify at least five (5) various sources of statistical data
2. measure at least one location and dispersion in grouped and un-grouped data
3. evaluate exponential, elements of a probability distribution; normal, binomial, Poisson, geometrics, and negative binomial distributions
4. evaluate two types of estimates and test hypotheses concerning the parameters of distributions
5. analyze at least a regression and a correlation model
6. construct at least a questionnaire and a simple index number
7. apply at least a statistical principle in agricultural and biosystems engineering

**Course contents**

Definition of statistics. Statistical data sources, collection, and analysis. Types of statistics. Descriptive statistics and inferential statistics. Measurement of location in grouped and un-grouped data. Skewness and Kurtosis.The measuree of central tendencies: mean, mode, median variance, and standard deviation for grouped and un-grouped data. Time series and demographic measures and index numbers. Construction of questionnaires and simple index numbers. Use of random numbers and statistical tables. Estimation and test of hypothesis. Analysis and presentation of statistical data. Curve fitting and goodness-of-fit tests. Analysis of regression and correlation models. A measure of dispersion in grouped and un-grouped data. Deterministic and statistical (Stochastic) Models. Elements of a probability distribution. Binomial Distribution, Normal Distribution. Geometric Distributions. Poisson distribution. Negative Binomial Distributions. Exponential Distribution. Reliability function. Estimation and tests of hypothesis concerning the parameters of the distributions. Generation of statistical events from set-theory and combinatorial methods. Elementary principles of probability. Types and distribution of random variables. The binomial, Poision, hypergeometric, and normal distributions. Expectations and moments, random variables. Probability sampling from table of random numbers. Applications of statistical principles in agricultural and biosystems engineering.

**Minimum Academic Standards**

Agricultural and biosystems engineering programme’s NUC-MAS requirement facilities.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B. Eng. Agricultural and Biosystems Engineering

BUK-ABE 202 Applied Mechanics (3 Units; Core; LH = 45)

**Senate-approved relevance**

Training of high-quality graduates who are highly skilled and knowledgeable in the applications of mechanics in respect of machine development. This is in agreement with BUK’s mission to address African developmental challenges in producing agricultural and biosystems engineering, graduates. Relevance is seen in agricultural and biosystems engineers from BUK because the programme requires knowledge of machinery and equipment development at higher levels.

**Overview**

Knowledge of applied mechanics is vital in the development of agricultural machinery. This highlights the importance of preparing students in agricultural and biosystems engineering with knowledge of the applications of mechanics in agricultural machinery development processes.

This course is planned to expose students to the application of mechanics in the areas of designs and fabrications of various agricultural power and machinery with a view to sustainable agricultural practices. This course includes a great variety of devices with a wide range of complexity from simple hand-held implements used to the complex machines of mechanized agriculture.

This will also enable them to select appropriate machinery development approaches. 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. The objectives of the course, learning outcomes, and contents are provided to address this need.

Objective

The objectives of the course are to:

1. resolve a force into its components and find the resultant of a system of forces acting on a structure
2. compute the moment of force or forces acting on a body in 2D and 3D
3. compute the moment of a couple and be able to replace a given force by an equivalent force couple system or vice versa
4. identify the conditions required for equilibrium and model the action of forces on rigid  
   bodies in equilibrium.
5. apply the principles of equilibrium to perform force analysis on simple trusses
6. identify the resultant and its location of forces distributed over lines, areas, and volume
7. identify the various types of friction and explain the mechanism of dry friction.
8. apply the principle of friction in the analysis of wedges, belt drives, and screws
9. explain the concept of virtual work, degrees of freedom, and potential energy
10. identify the principle of virtual work to determine the equilibrium for a body or a system of interconnected bodies

**Learning outcomes**

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

1. resolve four different forces into their components and obtain the results of the system
2. explain at least two of the fundamental principles of applied mechanics, particularly equilibrium analysis, friction, kinematics, and momentum
3. identify two types of formulate, and solve complex engineering problems by applying principles of engineering, science, mathematics, and applied mechanics
4. synthesize Newtonian Physics with static analysis to determine the complete load impact (net forces, shears, torques, and bending moments) on all components (members and joints) of a given structure with a load
5. apply at least engineering design principles to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

**Course Contents**

Definition of mechanics. Types of mechanics. Forces. Moments. Couples. Equilibrium of simple structures and machine parts. Combination, resolution, and resolution of system forces. Moments and Couples in 2D and 3D. Equilibrium of simple structures: Free-body diagrams and equilibrium conditions in 2D and 3D. Force analysis of pin-jointed frames: Method of joint and section. Friction and its applications. Types of friction. Machines-wedges. Belt drives and screws. First and second Moments of area. Centroids. Work equilibrium, Potential Energy, and stability. Centroids. Kinematics of particles and rigid bodies in plane motion. Newton's laws of motion. Kinetic energy and momentum analyse. Laws of statics. System of forces and their properties. Application and simple problem. Friction and its applications. Nature and types of friction. Application of friction in machines‑wedges. Belt drives. Screws and simple problems. Works principle of virtual work. Application and simple problems. Particle dynamics. Kinematics of plane motion. Kinetics of particles (equation of motion, momentum, and energy method). Kinematics of rigid bodies. Types of rigid bodies. Velocity and acceleration diagrams for simple mechanisms. Two-dimensional motion of rigid bodies. Energy and momentum. Moment of inertia and simple problems. Simple harmonic motions. Introductory concepts (Newton’s laws of motion, gravitation; dimensions and units; weight and mass). Particle (rigid body system). Statics of a particle. Stability. Centre of gravity. Vector Algebra. Bending moments.

**Minimum Academic Standards**

Agricultural and biosystems engineering progamme’s NUC-MAS requirement facilities.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B. Eng. Agricultural and Biosystems Engineering

BUK-ABE 202 Strength of Materials (3 Units; Elective; LH = 45)

**Senate-approved relevance**

Training of high-quality graduates who are highly skilled and knowledgeable in strength of material in respect of materials selection during agricultural power and machinery development. This is in agreement with BUK’s mission to address African developmental challenges in producing agricultural and biosystems engineering, graduates. Relevance is seen in agricultural and biosystems engineers from BUK since the programme involves the designs and fabrications of agricultural machinery.

**Overview**

Knowledge of strength of materials is vital in agricultural machinery development. Agricultural operations require machine as important input in food production. This highlights the importance of preparing students in agricultural and biosystems engineering with knowledge of the applications of strength of materials in machinery designs and fabrications for agricultural production.

This course is planned to expose students to the application of strength of materials and selections appropriately with a view to sustainable agricultural practices. This course includes identifications, uses and applications of various engineering materials. This will also enable them to select appropriate engineering materials for machinery development, repair, and maintain. 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. The objectives of the course, learning outcomes, and contents are provided to address this need.

Objective

The objectives of the course are to:

1. recognize a structural system that is stable and in equilibrium
2. determine the stress-strain relation for single and composite members based on Hooke's law
3. estimate the stresses and strains in single and composite members due to temperature  
   changes
4. evaluate the distribution of shear forces and bending moments in beams with  
   distributed and concentrated loads
5. determine bending stresses and their use in identifying slopes and deflections in beams
6. use Mohr's circle to evaluate the normal and shear stresses in a multi-dimensional stress system and transformation of these stresses into strains
7. evaluate the stresses and strains due to torsion on circular members
8. determine the buckling loads of columns under various fixity conditions at the ends

**Learning outcomes**

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

1. resolve two different forces into their components and to obtain the resultant of the system
2. explain at least one fundamental principles of applied mechanics, particularly equilibrium analysis, friction, kinematics and momentum
3. identify two types formulate, and solve complex engineering problems by applying principles of engineering, science, mathematics and applied mechanics
4. synthesize Newtonian Physics with static analysis to determine the complete load impact (net forces, shears, torques, and bending moments) on all components (members and joints) of a given structure with a load
5. apply at least one engineering design principles to produce solutions that meet specified needs with  
   consideration of public health, safety, and welfare, as well as global, cultural, social,  
   environmental, and economic factors

Course contents

Introduction to stress and strain. Simple states of stress and strain. Relationship between loading sheering forces and bending moment. Composite shaft and torsional strain energy. Deflection of beams. Maculay’s method. Area moment method. Maxwell’s reciprocal rule. Built-in and continuous beam in various loading situations. Complex stress and stream. Mohr’s stress circle. Principal stress and strain. Elastic constant and volumetric strain. St. Venant’s theory. Stress in composite materials. Bending of plates. Thermal stresses. Stresses in rivets and joints. Use of strain gauge and other measuring devices. Consideration of equilibrium. Composite members. Stress-strain relation. Generalized Hooke's law. Stresses and strains due to loading and temperature changes. Torsion of circular members. Shear force. Bending moments, and bending stresses in beams with symmetrical and combined loadings. Stress and strain transformation equations and Mohr’s circle. Elastic buckling of columns

**Minimum Academic Standards**

Agricultural and biosystems engineering programme’s NUC-MAS requirement facilities.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B Eng. Agricultural and Biosystems Engineering

**BUK-ABE 301 Agricultural Waste Management Systems (2 Units; Core; LH = 30)**

**Senate-approved relevance**

Training of high-quality graduates who are highly skilled and knowledgeable in the design, construction, and maintenance of appropriate waste management systems in the arid and semi-arid areas of Nigeria. This is in agreement with BUK’s mission to address African developmental challenges in producing agricultural and biosystems engineering, graduates. Relevance is seen in agricultural and biosystems engineers from BUK being able to develop waste management strategies to establish waste valorisation units, which will reduce a state's reliance on several products, open new perspectives for developing skills, employment opportunities for job-seeking youth in the respective state, and mitigate environmental pollution issues.

**Overview**

This course deals with agricultural waste management systems which is vital in agricultural activities in Northern Nigeria where agriculture is the major economic activity. Agriculture, while producing food, also generates waste. Agricultural waste management system is an important step toward ensuring that disposal does not endanger living things or the environment. This highlights the importance of preparing students in agricultural and biosystems engineering with knowledge of the agricultural waste management to generate wealth.

The course is developed to expose students to the practical application of agricultural waste management systems with a view to sustainable agriculture and environment. This course includes engineering properties of agricultural waste, design of agricultural waste management systems, agricultural wastes handling and disposal methods. The importance of the course lies in meeting the need in achieving sustainable development goals (SDGs) number 1, 7 and 11 in the areas of poverty reduction, affordable and clean energy, and sustainable cities and communities, respectively. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of the course are to:

1. explain different types of agricultural waste and their indicators
2. discuss engineering properties of agricultural wastes
3. design agricultural waste management systems
4. discuss the agricultural wastes handling and disposal methods
5. explain principles of agricultural waste to wealth

**Learning outcomes**

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

1. explain five (5) different types of agricultural waste and their indicators
2. discuss at least three (3) engineering properties of agricultural wastes
3. design at least one agricultural waste management systems from a given case study
4. discuss at least four (4) agricultural wastes handling and disposal methods
5. explain four (4) principles of agricultural waste to wealth

**Course contents**

Introduction to agricultural waste management and agricultural waste systems. Types of agricultural waste (crops residue, crop processing wastes, livestock wastes). Classification and role of soil and plants in waste management. Source of waste. Impact of waste on soil and plant quality. Harmful effects of agricultural waste. Importance of waste management. The six (6) basic functions of agricultural waste management system that include generation, collection, transportation, storage, treatment, and disposal. Reduce, reuse, and recycle hierarchy. Waste management options such as green manuring, composting, and incineration. Beneficial uses of livestock wastes; such as in soil amendments, fuel, biogas, feeding wastes to animals. Indicators of agricultural wastes: physical, chemical, and bacteriological indicators. Engineering properties of agricultural wastes: moisture content, relative humidity, density, angle of repose. Agricultural waste management systems: green manuring, composting, incineration. Design of biogas systems. Beneficial uses of livestock wastes: soil amendments, fuel, biogas, feeding wastes to animals. Agro-allied industrial wastes. Characterization of agro-allied wastes. Treatment systems for wastewater from agro-allied industries: slaughterhouse wastes, brewery wastes, food and beverage wastes, textile wastes, and intensive livestock farm wastes. Potential of recyclable crop residues and its management. Agricultural wastes handling and disposal methods. In-situ management of agricultural waste composting and vermicomposting for the bio conservation of biodegradable waste. Biogas technology, agricultural waste and water, air and animal resources. Redesign of composting, biogas and pyrolysis systems. Design of facultative, anaerobic and maturation ponds. The use of waste stabilization ponds: process design considerations, design of facultative, anaerobic, and maturation ponds. Design of waste treatment lagoons and holding facilities. Agricultural waste to wealth concepts and principles

**Minimum Academic Standards**

Environmental engineering laboratory with NUC-MAS requirement facilities.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B. Eng. Agricultural and Biosystems Engineering

**BUK-ABE 302 Agricultural Land Development (2 Units; Core; LH = 30)**

**Senate-approved relevance**

Training of high-quality graduates who are highly skilled and knowledgeable in the applications of the appropriate agricultural land development strategy in the dryland areas of Nigeria. This is in agreement with BUK’s mission to address African developmental challenges in producing agricultural and biosystem engineering graduates. The relevance is seen in BUK’s agricultural and biosystems engineers because all agricultural activities might not be possible without clearing and developing the land using modern machinery and equipment. The knowledge of the available land resources and the land use act related to Nigerian agriculture is important. The methods, objectives, and equipment for land clearing and development, modern earthmoving machinery and their selection, mechanics of operation and type of vegetation cover, land reclamation, and strategies, and knowledge of earthmoving machinery and mechanics in relation to soil are critical in grooming agricultural and biosystems engineers from BUK.

**Overview**

In the mechanization of agricultural activities, the knowledge of agricultural land development is paramount, particularly in the drylands of Nigeria where agriculture is the major economic activity. Modern agricultural machinery is necessary during the operations of land preparation in order to boost production. This highlights the importance of preparing students in agricultural and biosystems engineering with knowledge of the applications of land development prior to agricultural production activities.

This course is designed to expose students to the various land resources in developing agricultural land within the confines of the land use act related to Nigerian agriculture with a view to promoting agricultural mechanization. This course includes a great variety of devices with a wide range of complexity from simple hand-held implements used since prehistoric times to the sophisticated earthmoving pieces of machinery that employed Geographical Information System (GIS), sensor, and satellite technologies for mechanized agriculture. This will enable the students to make decisions on the selection of the appropriate equipment, and use, repair, and maintain them. The importance of the course lies in meeting the need in achieving sustainable development goals (SDGs) numbers 1 and 2 in the areas of poverty reduction and zero hunger, respectively. The objectives of the course, learning outcomes, and contents are presented in the subsequent section to address the need.

**Objectives**

The objectives of the course are to:

1. explain land resources and their economic uses in the drylands of Nigeria
2. understand and interpret the Land use act of Nigeria
3. discuss various earthmoving equipment and their applications in land clearing and development
4. explain how earthmoving machinery is selected, and utilize and the mechanics of operation in agricultural land preparation
5. explain the various techniques in land reclamation

**Learning outcomes**

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

1. discuss two types of agricultural land development
2. explain two (2) types of land resources and their uses in drylands
3. interpret at least one the land use act in relation to Nigerian agriculture
4. outline at least five (5) objectives, methods, and the equipment employed in land clearing for agricultural production
5. discuss at least five (5) pieces of equipment used in land forming
6. determine four earthmoving machinery selection criteria with respect to the appropriateness of application and mechanics of operation in relation to vegetation types
7. characterize the various vegetation zones in Nigeria
8. explain at least three (3) processes and unit operations in mechanized agricultural bush clearing and development.

**Course contents**

**Theory:** Land resources. Land Use Act in relation to Nigerian Agriculture. Objectives, methods, and equipment for land clearing and development. Earth-moving machinery and their selection, mechanics of operation, and vegetation types. Land reclamation. Earthmoving machinery and earthmoving mechanics.

**Minimum Academic Standards**

Agricultural and biosystem engineering laboratory and tractors and implements workshop having NUC-MAS requirement facilities.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B. Eng. Agricultural and Biosystems Engineering

**BUK-ABE 303 Emerging Technologies in Agriculture, (2 Units; Core; LH = 30)**

**Senate-approved relevance**

Training graduates who are highly skilled and knowledgeable for the use of emerging technologies in agricultural value chain in the dryland areas of Nigeria. This is in agreement with BUK’s mission to address African developmental challenges in producing quality agricultural and biosystems engineering graduates. Relevance is seen in agricultural and biosystems engineers from BUK and around, especially at the during food production and processing processes.

**Overview**

Emerging agricultural technologies are based on artificial intelligence, blockchain, analytics, connected sensors, drones, GPS, and robots. Agriculture's new generation of technologies enables businesses to be more profitable, efficient, safe, and environmentally friendly. Modern farms and agricultural operations work far differently than those a few decades ago, primarily because of advancements in technology, including sensors, devices, machines, and information technology. Adequate knowledge in the application and use of emerging technologies for agricultural value chain is vital in food production and processing, especially at the production level as in the dryland areas of Nigeria where agriculture is one of the major economic activities.

Emerging technologies knowledge entails the use and adaptation modern technologies. The knowledge on the use of emerging technologies can aid in scaling up sustainable agricultural intensification in order to boost production, safeguard the environment, and alleviate poverty. This course is planned to expose students on the use of emerging technologies in agricultural production. The course discusses on the concepts of emerging technologies and precision agriculture, agricultural robots/drones, vertical farming among others. The importance of the course lies in meeting the need in achieving some of the objectives of the ongoing sustainable development goals (SDGs) numbers 2 (zero hunger) and 6 (clean water and sanitation). The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of the course are to:

1. explain the concept of emerging technologies in agriculture
2. discuss the modern agricultural technology
3. explain the concepts precision agriculture
4. discussion the concept of vertical farming
5. explain types of agricultural robots/drones

**Learning outcomes**

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

1. explain one concept of emerging technologies in agriculture
2. discuss five (5) types of modern agricultural technology
3. explain one concepts precision agriculture
4. discussion two (2) types of vertical farming
5. explain four (4) types of agricultural robots/drones

**Course Content**

Concept of emerging technologies in agriculture. Importance of agricultural technology. Modern agricultural technology, adoption, role and usage for the improvement of agriculture. Analysis of production systems. Agricultural mechanization as a strategy for rural development. Impact on food production and on infrastructural development. Linkages with rural industrialization. Concept of precision agriculture. Agdrones (agricultural drones)/agricultural robots. Agricultural robots in crop-harvesting. Fresh fruit robotics. Agricultural robots in weeding. Agricultural robots in greenhouse. Aerial imagery drones and seed-planting drones. Temperature and moisture sensors. Types, working principle and practical applications. Aerial images. GPS technology. Closed ecological systems. Vertical farming. Floating farms. Harvest quality vision. Livestock biometrics. Animals tracking.

**Minimum Academic Standards**

Agricultural and biosystems engineering programme with NUC-MAS requirement facilities.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B. Eng. Agricultural and Biosystems Engineering

**BUK-ABE 304 Agricultural and Biosystems Engineering Practical I (2 Units; Core; PH = 90)**

**Senate-approved relevance**

Training of high-quality graduates who are highly skilled and knowledgeable in the practical and field trips in agricultural and biosystems engineering. This is in agreement with BUK’s mission to address African developmental challenges in producing agricultural and biosystems engineering, graduates. Relevance is seen in agricultural and biosystems engineers from BUK since all agricultural related challenges require practical skills.

**Overview**

The knowledge of practical skills is vital in the training of agricultural and biosystems engineering where agriculture is faced with divergent challenges. Agricultural operations require problem solving approach which would make students well-grounded in the fields practically. This highlights the importance of preparing students in agricultural and biosystems engineering with knowledge in practical approaches in addressing agricultural challenges.

This course is planned to expose students to the practical applications of various agricultural and biosystems engineering with a view to sustainable agricultural practices. This course includes a great variety of practical and field trips. This will also enable them to apply the practices of agricultural and biosystems engineering. 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. The objectives of the course, learning outcomes, and contents are provided to address this need.

Objective

The objectives of the course are to:

1. evaluate farm power and machinery as per test standards
2. identify various machine functions as they affect the economic operation of farm machinery for optimum productivity
3. conduct field demonstration of farm stead layout and planning
4. estimate of soil loss for a specific site and selection of best management practices to reduce soil loss
5. determine of drying characteristics of selected food material

**Learning outcomes**

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

1. evaluate two types of farm power and machinery as per test standards
2. identify four types of machine functions as they affect the economic operation of farm machinery for optimum productivity
3. conduct at least one field demonstration of farm stead layout and planning
4. estimate five types of soil loss for a specific site and select of best management practices to reduce soil loss
5. determine four types of drying characteristics of selected food material

**Course Contents**

Field demonstration of farm stead layout and planning. Visit livestock and poultry buildings for observations and measurements of environmental parameters. Structural requirements of farm housing and poultry buildings. Identification of equipment/facilities in the various laboratories. Linear measurement and mapping (survey). Determination of field capacity of soils. On-field determination/observation of different layers in a soil horizon (soil profile) Interpretations of animal and livestock shade designed. On-field determination of water source. Determination of physicochemical properties of soil (soil moisture content, Ph, Turbidity, Electrical conductivity, EC, Organic matter contents. Interpretations of animal and livestock shade designed. On- field determination of water source. Estimation of soil loss for a specific site and selection of best management practices to reduce soil loss. Visit to soil and water conservation project. Design/construction of a complete soil and water conservation system for two lots at a given site considering environmental and institutional constraints of the site. Hydrologic computations, design of surface drainage, subsurface drainage and erosion control systems with detailed specification and layout (profile of surface drains, the layout of pipe drains, laterals, mains, inlets and outlets etc.) of all major components. Thermal conductivity measurements. Psychrometry chart readings. Determination of drying characteristics of selected food material. Adsorption and desorption isotherms of agricultural products. Internal Combustion Engine parts and functions, working principles; Oil and Fuel - determination of physical properties, Visit to engine manufacturer/assembler/spare parts agency. Visit to implements shed and research hall; Field capacity and field efficiency measurement for at least two machines implements; Draft and fuel consumption measurement for different implements under different soil conditions, adjustments and working of Mould Board (MB) plough, disc plough and disc harrow and secondary tillage tools. Working of transplanters and operation. Weeding equipment’s and their use. Study of sprayers, dusters, measurement of nozzle discharge, field capacity.

**Minimum Academic Standards**

Agricultural and biosystems engineering laboratory with a NUC-MAS requirement facilities.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B. Eng. Agricultural and Biosystems Engineering

**BUK-ABE 305 Farm Structures and Environmental Control (2 Units; Core; LH = 30)**

**Senate-approved relevance**

Training of high-quality graduates who are highly skilled and knowledgeable in the design of farm structures and environmental control suitable for the dryland areas of Nigeria. This is in agreement with BUK’s mission to address African developmental challenges in producing agricultural and biosystems engineering, graduates. Relevance is seen in agricultural and biosystems engineers from BUK because optimum farm structures and environmental control is needed for effective and efficient agricultural production.

**Overview**

Farm structures and environmental control is vital in agricultural productions activities and practices in Northern Nigeria where agriculture is the major economic activity. This highlights the importance of preparing students in agricultural and biosystems engineering with knowledge of farm structures and environmental control.

This course is planned to expose students to the development of various farm structures with appropriate environmental control techniques with a view to sustainable agricultural practices. The course will focus on the design of farm structures such as storage facilities, irrigation facilities, animal houses, and farmsteads. The development and use of the farm structures with appropriate environmental control techniques for the optimum crops and animals production. The importance of the course lies in meeting the need in achieving sustainable development goals (SDGs) number 1, 2, and 3 in the areas of poverty reduction, zero hunger, and good health and well-being respectively. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of the course are to:

1. explain the proper planning of farmstead
2. discuss how to do a structural analysis of farm structures
3. design different storage structures in the farm
4. explain the elements of a building’s heat balance and the basic terminology related to the calculation of heating and cooling requirements
5. design proper ventilation systems for humans and livestock in a typical farmstead

**Learning outcomes**

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

1. explain two types of proper planning of farmstead
2. discuss at least one principle on how to do a structural analysis of farm structures
3. design three different storage structures in the farm
4. explain two (2) elements of a building’s heat balance and the basic terminology related to the calculation of heating and cooling requirements
5. design at least one proper ventilation system for humans and livestock in a typical farmstead
6. explain two (2) types of skills for selecting relevant and effective drying and ventilation equipment on the farm

**Course contents**

Farmstead and its planning. Introduction to farm structures. Structural analysis and basic mechanics. Classification of loads. Design of structural members (beams and columns). Structural analysis with an introduction to reinforced concrete design. Load on beans and trusses. Foundations. Walls, doors, and windows. Roofs. Building materials (Concrete, wood, steel, aluminum, burnt bricks, etc). Design of silos and timber shades. Design of poultry house, dairy, hog bankers, silos, fences. Design of grain storage structures. Review of structural components. Principles and examples in elementary structural analysis and design. Building material selection and use for specific building types. Design of sheep, pig, and poultry housing. Animal environment requirements. Animal heat and moisture production. Types and characteristics of construction materials concrete, masonry and wood. Specifications and selection of farm building material. Environmental control for plants and livestock. Use of psychometric charts. Farmstead and layout. Design of different storage structures for grains, perishable and non-perishable products. Fundamentals of heating and cooling. Calculation of heating and cooling requirements for buildings (Heat balance of livestock buildings, energy demand solar heat loads) Ventilation, and ventilation rates. Selection of drying and ventilation equipment. Farm roads and drainage structures Different types of on-farm structures. Planning of a farm structure: selection and preparation of site, layout and design. Building materials: selection, properties, wood, plywood, earth as a building material. Elements of construction, frames. Planning buildings for livestock production and biomaterials storage to provide optimum environmental control, animal houses, grain storage, waste storage, recovery, reuse, transport, climate, ventilation and disease control systems.

**Minimum Academic Standards**

Farm structures and environmental control laboratory with NUC-MAS requirement facilities.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B. Eng. Agricultural and Biosystems Engineering

**BUK-ABE 401 Irrigation Practices and Drainage Engineering (2 Units; Core; LH = 30)**

**Senate-approved relevance**

This course is packaged with modules that will prepare students for the 21st century’s food production issues through cutting-edge research and training of high-quality graduates which is in line with the University’s mission and vision of producing graduates who are skilled and knowledgeable in the design of irrigation and drainage systems, improving food production to ensure the food security of the country. The drainage knowledge will enable access to marginal land submerged by floods and more land for agricultural purposes. Relevance of agricultural and biosystems graduate engineers from BUK to being able to address irrigation and drainage issues to produce more food under irrigated farming to supplement rainfed agriculture and increased crop production through irrigation practices.

**Overview**

Irrigation and drainage are necessary for the adequate quantity and quality of water required in the root zone for plant growth. However, in actual conditions during the whole period of plant growth /partly there exists an inadequacy of water to meet the crop water requirements.

Irrigation is required when the seasonal rainfall is less than the minimum requirement for the satisfactory growth of crops when the rainfall is not evenly distributed during the crop period or throughout the cultivable area, some perennial crops such as sugarcane require water throughout the major parts of the year, but the rainfall fulfills the demand during the rainy season only. Therefore, for the remaining part of the year irrigation is necessary, in areas where the rainfall is very scanty, irrigation is required for the development of agriculture, irrigation may not be required during the normal rainfall condition and can be necessary during drought. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of the course are to:

1. explain the principles of soil water plant relationship, and effectively manage water resources through well-designed irrigation and drainage systems.
2. apply appropriate techniques and analyses to the effective design of both irrigation and drainage systems.
3. design, an agricultural irrigation and drainage systems and their components.
4. describe principles and processes necessary to effectively manage water resources through well-designed drainage and irrigation systems.
5. apply appropriate techniques and analyses for the selection of irrigation methods.
6. evaluate a water delivery system including the preparation of irrigation water schedules.
7. conduct preliminary designs for both irrigation and drainage systems in agricultural fields.
8. describe principles and processes necessary to effectively manage water resources through well-designed drainage and irrigation systems.

**Learning outcomes**

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

1. explain one (1) concept and analyses of the soil-water-plant relationship.
2. design at least two different irrigation methods for managing agricultural water.
3. describe two (2) principles and processes of well-designed effectively managing water resources through well-designed drainage and irrigation systems.
4. apply appropriate techniques and analyses for the selection of low-cost irrigation methods.
5. evaluate two (2) types of water delivery systems including the preparation of irrigation water schedules.
6. conduct at least one preliminary design for both irrigation and drainage systems in agricultural fields.
7. develop two appropriate experiments, analyze and interpret data, and use engineering judgment to draw conclusions; and
8. apply at least one new knowledge as needed, using appropriate learning and application strategies.

**Course contents**

Definitions and types of irrigation systems. Plant-water-Soil-Atmospheric relationship. Soil water retention; Infiltration and water uptake. Measurement of soil water content. concept and measurement of soil water potential. Metric potential. and Solute potential. Water exchange in plant cells and tissues. Water movement through the plant systems. Concept and measurement of transpiration and Evapotranspiration. Energy and Water Balance. Factors affecting plant-water status. Metabolic and other characteristics for efficient water use. Availability of soil water for plant growth. Response of plants to water deficit. Irrigation Design standards. Performance of irrigation Systems. Uniformity of water application. Irrigation Performance Indicators. Design criteria for Irrigation. Types of sprinkler systems. Sprinkler system components. Sprinkler system design. Micro irrigation benefits and Problems. Clogging control. Sub-irrigation systems. Design of seepage irrigation systems. Nature and extent of Drainage Problems. In-situ hydraulic conductivity measurement. Drainage design criteria under rainfed and irrigated conditions. Steady and transient–state drainage equations. Design, construction, and maintenance of surface and subsurface drainage systems. Guideline for the selection of envelope materials for the subsurface drain. Drainage machinery.

**Minimum Academic Standards**

Farm irrigation laboratory, drip, and sprinkler irrigation prototype/models

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B. Eng. Agricultural and Biosystems Engineering

**BUK-ABE 401 Soil and Water Conservation Engineering (2 Units; Core; LH = 30)**

**Senate-approved relevance**

Training of high-quality graduates who are highly skilled and knowledgeable in the studying, design, construction, and maintenance of soil and water conservation techniques in the arid and semi-arid regions of Nigeria are in agreement with BUK’s mission to address African developmental challenges in producing agricultural and biosystems engineering graduates. Relevance is noticed in agricultural and biosystems engineers from BUK being able to develop soil and water conservation techniques to mitigate flood and soil erosion as a result of climate change as well as increase crop production through irrigation best practices.

**Overview**

Soil and water conservation techniques are a vital approach used in mitigating climate change impact as a result of water and wind erosion, particularly in the arid and semi-arid areas of Nigeria where irrigation is practiced. This highlights the importance of preparing students in agricultural and biosystems engineering with the knowledge and skills on how to conserve the two most important resources (soil and water) used for not only crop production but also human consumption and environmental health.

This course is designed to expose students to various soil and water conservation engineering techniques for conserving soil and water resources and to educate them on how to revive degraded lands. Also, to build the capacity of students in the area of addressing climate change in the arid and semi-arid areas of Nigeria. The importance of the course lies in meeting the need in achieving sustainable development goals (SDGs) numbers 1, 2, 11, and 13 in the areas of poverty reduction, zero hunger, sustainable communities/cities, and climate action issues, respectively. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of the course are to:

1. describe principles, types, and control of soil erosion from water and air/wind
2. differentiate the concept of the universal soil loss equation and the revised one.
3. conduct analysis on the sediment transport and geographical distribution of soil erosion.
4. conduct practical exercises on the impacts of soil erosion on arid and semi-arid soils
5. state the theory and measurement of soil water content, movement, storage, and plant availability
6. describe two (2) types of operational principles and maintenance of soil erosion control techniques
7. describe flood control measures
8. explain primary causes and consequences of a wide range of soil degradation
9. identify soil and water management practices that can mitigate soil erosion
10. distinguish the relationship between soil erosion and climate change
11. discuss two (2) type of water resources conservation and development methods and techniques
12. explain the methods of reclamation of the degraded soils (saline/sodic, eroded, and waterlogged)

**Learning outcomes**

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

1. describe at least four (4) principles and control of soil erosion from water and air/wind

explain the methods of reclamation of the degraded soils (saline/sodic, eroded and, waterlogged)

1. conduct at least one analysis from the experimental result on the sediment transport and geographical distribution of soil erosion
2. conduct two practical exercises on the impacts of soil erosion on arid and semi-arid soils from laboratory practical data
3. state at least two (2) theories and measurements of soil water content, movement, storage, and plant availability
4. describe at least six (6) operational principles and maintenance of soil erosion control techniques
5. describe at least ten (10) flood control measures
6. explain two (2) types of primary causes and consequences of a wide range of soil degradation problems after conducting a field trip
7. identify at least five (5) soil and water management practices that can mitigate climate change
8. distinguish the relationship between soil erosion and climate change using a case study
9. explain at least eight (8) water conservation methods
10. explain two (2) methods of reclamation of the degraded soils (saline/sodic, eroded, and waterlogged)

**Course contents**

The principles and control of soil erosion from water and air/wind. Sediment transport and geographical distribution of soil erosion. Impacts of soil erosion in arid and semi-arid areas of Nigeria. Forms of soil degradation: soil salinity and sodicity, nutrient loss, loss of structure. Soil and water classifications for conservation. Operational principles and maintenance of soil erosion control techniques. Flood control measures. Water resources conservation and development. Water harvesting, principles, types, and challenges. Socio-economic aspects of soil and water conservation. Water quality and pollution. Watershed modeling Impacts of climate change on soil and water resources. Role of soil and water conservation practices in mitigating the impact of climate change. Introduction to Universal Soil Equation (USLE) and Modified Universal soil loss equation (MUSLE). Design of Soil Erosion Control Systems: Estimation of soil loss for a specific site and selection of best management practices to reduce soil loss. Development of a complete soil and water conservation system for two lots at a given site considering environmental and institutional constraints of the site. Development of surface drainage, subsurface drainage, and erosion control systems with detailed specifications and layout (profile of surface drains, the layout of pipe drains, laterals, mains, inlets, and outlets). Reclamation of the degraded soils (saline/sodic, eroded, and waterlogged)

**Minimum Academic Standards**

Soil and water engineering laboratory with a NUC-MAS requirement facilities.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B.Eng. Agricultural and Biosystems Engineering

**BUK-ABE 403 Agricultural and Biosystems Engineering Practical II (2 Units; Core; PH = 90)**

**Senate-approved relevance**

Training of high-quality graduates who are highly skilled and knowledgeable in the practical and field trips in agricultural and biosystems engineering. This is in agreement with BUK’s mission to address African developmental challenges in producing agricultural and biosystems engineering, graduates. Relevance is seen in agricultural and biosystems engineers from BUK since all agricultural-related challenges require practical skills.

**Overview**

The knowledge of practical skills is vital in the training of agricultural and biosystems engineering where agriculture is faced with divergent challenges. Agricultural operations require problem solving approach which would make students well-grounded in the fields practically. This highlights the importance of preparing students in agricultural and biosystems engineering with knowledge in practical approaches in addressing agricultural challenges.

This course is planned to expose students to the practical applications of various agricultural and biosystems engineering with a view to sustainable agricultural practices. This course includes a great variety of practical and field trips. This will also enable them to apply the practices of agricultural and biosystems engineering. 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. The objectives of the course, learning outcomes, and contents are provided to address this need.

Objective

The objectives of the course are to:

1. determine various properties that affect processing and handling of agricultural products
2. determine oil and fuel physical properties
3. determine soil hydraulic conductivity and infiltration rate on agricultural soils
4. determine evaporation and evapotranspiration
5. determine performance evaluation of selected agricultural machinery
6. conduct a geophysical survey for selected fields in the Kano metropolitan
7. Visit to irrigation project to understand the canal system, the water distribution system, and the irrigation project management
8. Visit food processing equipment sales and services company
9. Determination of food physicochemical properties in relation to the processing technique employed

**Learning outcomes**

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

1. determine three (3) properties that affect the processing and handling of agricultural products
2. determine three (3) physical properties of oil and fuel
3. determine four soil hydraulic conductivity and infiltration rates on agricultural soils
4. determine at least one evaporation and evapotranspiration
5. determine two types of performance evaluations of selected agricultural machinery
6. conduct two geophysical surveys for selected fields in the Kano metropolitan

**Course Contents**

Determination of physicochemical properties of soil (soil moisture content, Ph, Turbidity, Electrical conductivity, EC, Organic matter contents. Laboratory determination of some properties of selected agricultural materials. Solving problems related to various capacities, pattern efficiency, system limitation, power requirement and other operational parameters; Solving problems related to cost analysis and inflation; Solving problem-related to a selection of equipment, replacement, break-even analysis, and time value of money. Presentation of the seminar on the topic assigned related to farm machinery management; Design of farm mechanization plan for different farm size and cropping pattern. Some unit operations such as blanching, extraction, pressing, and refrigeration. Determination of food physicochemical properties in relation to processing technique employed. Visitation to food processing industries including soybean oil extraction and refining, rice processing, and food packaging industries around Kano. Visitation to food processing equipment sales and services company. Psychrometric (air-water vapor mixture properties. Performance evaluation of some processing machines in terms of: Capacity or Rate of work. Theoretical field capacity Effective field capacity. Throughput capacity. Field efficiency. Theoretical field capacity: Effective field capacity. Throughput capacity. Cleaning efficiency. Oil extraction and characterization: solvent method. Oil extraction from seeds (solvent method). Internal Combustion Engine parts and functions, working principles; Oil and Fuel - determination of physical properties. Visit to engine manufacturer/assembler/spare parts agency. Visit to implements shed and research hall. Study of sprayers, dusters, measurement of nozzle discharge, and field capacity. Determination of soil hydraulic conductivity. Determination of infiltration rate on agricultural soils. Evapotranspiration and its determination using Pan method. Determination of evaporation and evapotranspiration on farmlands. Determination of soil bulk density. Provide information on source of good irrigation water as a solution to food scarcity. Provide solutions to drainage problem on agricultural soils. Flow measurement using various methods (e.g., floating, current meters). Visit to irrigation project to understand canal system, water distribution system and irrigation project management. Sieve analysis of granular materials e.g., milled grains and poultry feeds. Performance evaluation of selected agricultural processing machines. Slug test. Study of groundwater artificial recharge in laboratory. Geophysical survey (groundwater exploration) for a selected field in Kano metropolitan. Groundwater dynamics and contamination study in Kano Industrial Estate

**Minimum Academic Standards**

Agricultural and biosystems engineering laboratory with a NUC-MAS requirement facilities.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B. Eng. Agricultural and Biosystems Engineering

**BUK-ABE 404 Agricultural Power and Machinery (3 Units; Core; LH = 45)**

**Senate-approved relevance**

Training of high-quality graduates who are highly skilled and knowledgeable in the selection and applications of the appropriate agricultural power and machinery in northern Nigeria. This is in agreement with BUK’s mission to address African developmental challenges in producing agricultural and biosystems engineering, graduates. Relevance is seen in agricultural and biosystems engineers from BUK because all agricultural activities use energy directly to operate machinery and equipment, to heat or cool buildings, and for lighting on the farm, and indirectly in the fertilizers and chemicals produced off the farm.

**Overview**

Knowledge of agricultural power and machinery is vital in agricultural mechanization practice, in Northern Nigeria where agriculture is the major economic activity. Agricultural operations require energy as important to production. This highlights the importance of preparing students in agricultural and biosystems engineering with knowledge of the applications of power and machinery in agricultural production processes.

This course is planned to expose students to the application of various agricultural power and machinery appropriately with a view to sustainable agricultural practices. This course includes a great variety of devices with a wide range of complexity from simple hand-held implements used to the complex machines of mechanized agriculture. This will also enable them to select appropriate machinery, use, repair, and maintain the same. 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. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of the course are to:

1. define agricultural power and machinery for farm operations
2. explain the working principles of an internal combustion engine (ICE) system of a farm tractor
3. discuss functions of various farm machinery and their basic mechanism as they affect agricultural productivity
4. determine machinery selection criteria with respect to appropriate application and timeliness factors
5. explain farm machinery operation practices for optimum machinery performance

**Learning outcomes**

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

1. define agricultural power and machinery for farm operations correctly
2. explain two working principles of an ICE system of a farm tractor from different types of scenarios
3. discuss at least five (5) functions of various farm machinery and their basic mechanism as they affect agricultural productivity
4. determine five methods of machinery selection criteria with respect to the appropriateness of application and timeliness factors from different case studies
5. explain at least two (2) farm machinery operation practices for optimum machinery performance

**Course contents**

Definition and sources of conventional and non-conventional agricultural power (human, animal, mechanical, electrical, wind, solar and biomass, biofuels). Internal combustion engines and their application to agricultural operations. Internal combustion engine systems: intake, exhaust systems, fuel systems; cooling systems; lubricating systems. Transmission system: clutch, gearbox, propeller shaft, differential, and final drives. Steering system. Brake system. Hydraulic system. Agricultural power measurement. Historical development of agricultural tractors, use, and maintenance. Classification/types of agricultural tractors, size, and utilization. Introduction to hitches and hitching systems. Classification of farm machines. Tillage: primary, secondary, and minimum tillage. Tillage implement: ploughs, tillers, sub-soilers, harrows, and cultivators. Planting equipment: planters, drills and broadcasters and hill droppers, Fertilizer distributors, spinning discs, side dressers, and manure spreaders. Plant protection equipment: manually operated sprayer, power operated boom sprayer, mist blower and dusters, controlled droplet atomiser (CDA) sprayers, and granule applicators. Introduction to harvesting equipment: hay and forage harvesters, mowers, conditioners, balers, combine harvesters, cotton picking and stripping, and root crop diggers. Principles of operation and selection of machines used for the production and processing of crops. Agricultural field machinery performance evaluation. Criteria for agricultural machinery selection, replacement, and cost analysis.Safe agricultural tractor operations. Agricultural tractor testing and test codes. Visit to engine manufacturer/assembler/spare parts agency. Visit farm centers.

**Minimum Academic Standards**

Agricultural power and machinery laboratory with NUC-MAS requirement facilities.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B. Eng. Agricultural and Biosystems Engineering

**BUK-ABE 405 Hydrology and Hydraulics Engineering (3 Units; Core; LH = 30)**

**Senate-approved relevance**

Training of high-quality graduates who are highly equipped with skills and educated in hydrology studies engineering, and hydraulics. This will involve the design, construction, and maintenance of water conveyance distribution and application systems. The Bayero University Kano is situated in the semi-arid area of Nigeria; thus, this course is in agreement with BUK’s mission to address African developmental challenges in producing agricultural and biosystems engineering, graduates. Relevance is seen in agricultural and biosystems engineers from BUK being able to develop hydrology and hydraulics engineering to mitigate flood and soil erosion as a result of climate change as well as increase crop production through irrigation best practices.

**Overview**

Engineering Hydrology and Hydraulics techniques are a vital approach used in improving availability of water resources and mitigating climate change with is more devastating in arid and semi-arid areas of Nigeria. Especially in the regions where irrigation is practiced with limited water resources.

Therefore, this highlights the importance of preparing students in agricultural and biosystems engineering with the knowledge and skills on how to explore and understand the concept of hydrology and hydraulics. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of the course are to:

1. define hydrologic cycle, hydraulics and components involved of water cycle, hydrograph, and reservoir routing.
2. explain the concept of water flow through soil profile, Solar and earth radiation, heat balance of earth’s surface and atmosphere.
3. discuss the occurrence, movement and distribution of global water and their basic mechanism affecting the change of states (solid, liquid, and vapor).
4. design hydraulics systems, pipe networks and pressure drop in close and open pipes networks.
5. determine the fundamentals of hydrodynamics, explain the flow regimes, steady flow of incompressible fluids, unsteady flow, turbulent flows.
6. explain the precipitation, infiltration, watershed, runoff, stream order, time of concentration, and factors affecting infiltration in developed and undeveloped surfaces.

**Learning outcomes**

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

1. define one concept of hydrology, water cycle, and hydrodynamics.
2. explain two (2) principles of water flow through open and close conduits, hydraulic pressure and general piping networks.
3. discuss four (4) major components of hydrologic cycle and the basic mechanism affecting water during change of states (solid, liquid, and vapor)
4. determine three appropriate equipment and instruments for water pumping, conveyance and application in appropriate quantities.
5. design at least two (2) simple pipe network and flood control structures.
6. explain three (3) procedures for measuring hydrological events, flood forecast, and open channel flow. Critical velocity. Flow measurement

**Course contents**

Definition of Hydrologic cycle. Components of the hydrological cycle. Measurements and evaluation. Solar and earth radiation. Precipitation. Evapotranspiration. Infiltration. Rainfall-runoff over agricultural land. Stream gauging. Hydrographs. Stream flow routing. Groundwater and surface hydrology. Watershed management. Flood control. Groundwater hydraulics. Fluid properties. Fluid statics. Fluid motion: continuity, Bernoulli, energy, momentum equations, Reynolds number. Laminar and turbulent flows. Pipe flow. Open channel flow. Weirs. Flumes. Pumps. Turbines. Outlets. Gates. Valves. Pipe flow. Fundamentals of fluid flow. Flow through pipes in parallel and in series, branched pipes, simple pipe network. Water hammer, open channel flow, critical velocity, flow measurement. Weirs, flumes, outlets, gates, valves, and forces developed by moving fluids. Simple pipe network. Water hammer. Hardy cross method of water distribution open channel flow. Channel transition and hydraulics jump. Backwater curves. Dimensional analysis and similitude. Reservoir hydraulics and planning. High-pressure outlets, gates, valves. Classes and types of hydraulic machinery: pumps, turbines. Reservoir hydraulics and planning.

**Minimum Academic Standards**

Agricultural and biosystems engineering programme with NUC-MAS requirement facilities.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B. Eng. Agricultural and Biosystems Engineering

**BUK-ABE 406 Properties and Handling of Agricultural Products (3 Units; Core; LH =45)**

**Senate-approved relevance**

The content of this course is tailored towards teaching and learning to produce quality graduates who are skilful and innovative in the applications of the engineering properties to the handling, processing and storage of agricultural products in the dryland areas of Nigeria. This is in accord with the BUK’s mission to address African developmental challenges in producing agricultural and biosystems engineering graduates that are well-versed in the application of properties materials to handling and processing of the products. Significance of the course is in its applications in the field of agricultural and biosystems engineering during transportation of agricultural products; design, construction/fabrication of agricultural machine elements; and the development of storage structure for the agricultural products

**Overview**

Agricultural products are usually biological materials and have certain unique characteristics. These products undergo various unit operations from pre-harvest to post-harvest processing, formulation, preservation, storage distribution, domestic storage and finally consumption. Properties of biological (food and agricultural) materials change from time to time (desirable or sometimes not desirable changes in nutrient profile, texture, colour, taste, aroma and other quality attributes). Hence, understanding of engineering properties of biological material are important in order to solve problems while designing and selecting the mode of preservation, packaging, processing, storage, marketing and consumption.

Knowledge of an engineering properties of biological/food material is necessary because they are vital in defining and quantifying a description of the biological/food materials, for optimum design of food equipment and processes to ensure food quality and safety, proving basic data for food processing and unit operation and predicting behaviour of new food materials. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of the course are to:

1. define properties and handling of agricultural materials
2. explain the procedures for determining various properties of agricultural materials
3. describe methods of selecting materials handling equipment
4. explain the principles of design of appropriate material handling equipment products.
5. determine the power requirement for the operation of conveyors

**Learning outcomes**

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

1. define properties and handling of agricultural materials;
2. explain at least two step-by-step procedure for determining various properties of agricultural materials
3. describe two (2) criteria of selecting materials handling equipment
4. explain three (3) principles of design of appropriate material handling equipment for tropical products
5. determine two (2) types of power requirement for the operation of conveyors

**Course contents**

**Theory:** Properties and characteristics of Agricultural materials, determination of physical, mechanical and rheological properties, newtonian and non-newtonian fluids, Thermal properties. Cleaning, sorting and grading. Handling methods: principles, description and selection of materials handling systems; pneumatic, screw, bucket and belt conveyors. Design and construction of appropriate material handling equipment for tropical products. **Practicum:** Moisture content determination: wet basis and dry basis. moisture content variation. Determination of: Volume (ml). True density (Particle density, g/ml). Bulk density (g/ml). Specific gravity. Surface area. Sphericity. Porosity (packing factor). Coefficient of friction. Angle of repose

**Minimum Academic Standards**

Properties and handling of agricultural products laboratory with NUC-MAS requirement facilities.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B. Eng. Agricultural and Biosystems Engineering

**BUK-ABE 501 Application of GIS and Sensor Technologies to Agriculture (2 Units; Core; LH = 30)**

**Senate-approved relevance**

The modules are prepared to equip students for addressing technological innovations in agriculture, particularly the application of GIS sensor technologies to agriculture. The graduates from this course will be equipped with problem-solving technical, technological and modern digital skills and their application in agriculture, in addition to analytical and innovative skills, emotional and behavioural skills including communication, and interpersonal through cutting-edge research and training of high-quality graduates which is in line with the University’s mission and vision of producing graduates who are skilled and knowledgeable in Precision agriculture, improving food production through precision agriculture to ensure the food security of the country. The knowledge of GIS and Sensor technologies will enable the Relevance of agricultural and biosystems to graduate engineers from BUK to be able to address issues related to precision farming approach through the application of GIS and Sensors technology.

**Overview**

The application of GIS in agriculture is important because is very helpful in mapping the current and future variations in the sleet, crop output and temperature of the soils. The mapping of the current features of a farm enables scientists and farmers to work together towards the same goal of creating more diverse, effective, and efficient farming techniques. In addition to that, this helps in increasing food production in a country and can eliminate the problems of food shortages. Precision Farming, also called Precision Agriculture (PA) or site-specific crop management (SSCM), is the application of technologies and principles to manage spatial and temporal variability associated with all aspects of agricultural production. The system that integrates information with crop production is designed to increase long-term, site-specific as well as whole-farm production efficiency, productivity, and profitability while minimizing unintended impacts on wildlife and the environment. The operational goals of precision farming include better management of inputs such as seeds, fertilizers, pesticides, herbicides, and water using the right amounts of inputs at the right place, and at the right time. Several crucial tools and systems such as GPS, GIS, and RS are required for the collection of timely geospatial information. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of the course are to:

1. explain a broad spectrum of theories and methodology in geographic information systems (GIS).
2. analyse the basic concepts of digital remote sensing and develop skills in image interpretation.
3. discuss GIS and remote sensing technologies can be used for natural resources assessment and management.
4. demonstrate hands-on practice in operating GIS software and geospatial data authoring software.
5. develop the ability to integrate and present geo-information with geo-web services.
6. compute soil moisture and nutrient variability and monitor water supplies and forecast droughts.
7. estimate and predict yields, combine, and analyze agriculture data from several sources.
8. create an online information system through webGIS.

**Learning outcomes**

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

1. recall four broad spectrums of theories and methodology in geographic information systems (GIS).
2. demonstrate at least one use of these technologies and how GIS and remote sensing technologies can be used for natural resources assessment and management
3. apply four technologies to agriculture to monitor soil moisture and nutrient variability, water supplies, and forecast droughts.
4. analyze two techniques of mapping, estimating, and predicting yields, and agriculture data from several sources.
5. create four tools for map modeling an online information system through a web map application.

**Course contents**

Introduction to geographic information system (GIS). GIS data structures. Introduction to GIS package’s (ArcGIS). Global positioning system (GPS). Remote sensing (RS). Principles and applications of GIS technology. Identification and delineation of locations and areas; collection, analysis, storage and retrieval of site and time specific data for agricultural and natural resource management and monitoring. Land suitability assessment and land use planning. Water resource management. Soil health and fertility management. Biotic and abiotic damage assessment and intervention. Crop monitoring and yield prediction. Precision farming. Biomass assessment. Improving supply chain management process. Supply chain management. Decision support systems. Locating power plants and developing supply chains.

**Minimum Academic Standards**

GIS and Remote Sensing Laboratory, Farm laboratory. Precision farming Laboratory.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B.Eng. Agricultural and Biosystems Engineering

**BUK-ABE 502 Processing and Storage of Agricultural Products (2 Units; Core; LH = 30)**

**Senate-approved relevance**

The coursework is to educate students and produce high-class graduates of agricultural and biosystems engineering who are well trained in the applications of suitable technologies needed for the processing and storage of agricultural products in Nigeria with particular emphasis to the arid and semi-arid agricultural products. This is in compliance with the BUK’s mission to address African developmental challenges in producing agricultural and biosystems engineering graduates with relevant knowledge in the areas of agricultural products value chain.

**Overview**

Agricultural crop production in the arid and semi-arid region of Nigeria is seasonal with the gluts and lean periods. There are also less agricultural processing plants to cater for the excess produce during surplus time through processing and storage of products to a more stable and non-perishable forms to balance the market forces. These made farmers to incur losses and sell crop at giveaway prices during the glut periods.

Processing and storage of agricultural products is a taught course in agricultural and biosystems engineering which imparts on the graduates the various techniques and unit operations of the transformation of raw agricultural materials into more useful products and train how to extends shelf life of products thereby improving the net economic value through raising quality and yield of products. The knowledge of storage of agricultural products made food available all year round. All these value additions to agricultural products increase the gross domestic product (GDP)/capita in the dryland areas of Nigeria where agriculture is the major economic activity and the nation at large. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of the course are to:

1. discuss products processing techniques and equipment
2. describe the theory and methods of crop drying
3. explain the features on the psychrometry chart
4. explain the procedure for designing grain storage structures
5. discuss the factors causing the deterioration of produce in storage.
6. describe the principle of refrigeration and evaporative cooling systems

**Learning outcomes**

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

1. explain five (5) different product processing techniques and the required equipment for them.
2. state five theories and methods of crop drying
3. describe four properties of air and water vapour
4. discuss four (4) procedures in designing grain storage structures
5. explain two factors causing the deterioration of products in storage
6. explain three operations of refrigeration and evaporative cooling systems

**Course contents**

**Theory:** Products processing techniques and equipment. Theory and methods of crop drying. Heat treatments. Psychrometry. Storage types and environment. Pressure distribution in storage structures. Design of grain storage structures. Factors causing deterioration of produce in storage. Environmental control in storage of: grains, fresh fruits and vegetables, livestock products (meat, milk, fish etc.). Evaporative cooling. Refrigeration and basic principles of cold storage of perishable produce. Influence of temperature on chemical reactions and growth of micro-organisms. Thawing and its effects on quality. Cold rooms and cold stores. Psychrometric (air-water vapor mixture properties. Performance evaluation of some processing machines in terms of: Capacity or Rate of work. Theoretical field capacity Effective field capacity. Throughput capacity. Field efficiency. Theoretical field capacity: Effective field capacity. Throughput capacity. Cleaning efficiency. Oil extraction and characterization: solvent method. Oil extraction from seeds (solvent method).

**Minimum Academic Standards**

Processing and storage of agricultural products laboratory with NUC-MAS requirement facilities.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B. Eng. Agricultural and Biosystems Engineering

**BUK-ABE 503 Food Processing Engineering (2 Units; Core; LH = 45)**

**Senate-approved relevance**

Training of high-quality graduates who are highly skilled and knowledgeable in the applications of food processing engineering in Nigeria. This conforms to BUK’s mission to address African developmental challenges in producing agricultural and biosystem engineering graduates with the requisite expertise. The relevance of this course in agricultural and biosystems engineers in BUK is all food processing engineering activities nowadays utilize start-of-art equipment for food manufacturing and operations that include processing, production, handling, storage, conservation, control, packaging, and distribution of food products.

**Overview**

Knowledge of food processing engineering is vital in agricultural food products handling and processing, especially in Nigeria where agriculture is the major economic activity. This shows the importance of grooming students in agricultural and biosystems engineering with skills and knowledge of the applications of food processing engineering in agricultural products handling and processing.

This course is conceptualized to subject students to the various application of food processing engineering techniques with a view to providing sustainable and healthy food to the populace. This course comprises a number of devices and equipment of divergent complexity from simple hand-held devices to advance sophisticated equipment and types of machinery for the processing and analysis of food and food products. This will also enable the students to select the appropriate tool/equipment for handling, processing, and analysis. The importance of the course lies in meeting the need in achieving sustainable development goals (SDGs) numbers 1, 2, and 3 in the areas of poverty reduction, zero hunger, and good health and well-being, respectively. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of the course are to:

1. define food process engineering
2. explain the principles of food processing engineering for agricultural food products handling
3. discuss the advantages of various unit operations and their basic mechanism as they affect agricultural food products
4. discuss the flow of liquid food products during processing and how it is affected by the technique
5. explain the basic principle of refrigeration, freezing, and evaporation as related to food quality.
6. explain thermal and nonthermal technologies for the inactivation of food-modifying agents
7. discuss the principles and functions of packaging technology
8. explain food safety in relation to human health
9. explain the principles and design of food processing equipment

**Learning outcomes**

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

1. appropriately define food processing engineering
2. explain the four (4) unit operations and their basic mechanism as they affect agricultural food products with clear case studies
3. discuss at least five (5) advantages of unit operations as they affect agricultural products’ quality and shelf life
4. explain two different heat transfer phenomena related to food processing
5. design heat exchangers and state their applications
6. predict at least one decision on the type of technology to process particular food products of high economic importance
7. identify five different packing materials and their characteristics
8. explain four quality changes in food products as affected by a particular processing technique
9. explain five (5) importance of food safety in the processing of agricultural food products

**Course contents**

**Theory:** Introduction to food processing engineering: blanching, frying, steaming, fermenting, canning, mixing, baking, extracting, pressing, liquefying, homogenizing, immobilizing. Transport phenomena – the basis of unit operations: transfer processes in conduction, heat transfers: Fourier’s law, mass transfer: Fick’s law, momentum transfer, convective transfer processes. Heat exchangers design and applications. Refrigeration and freezing for inhibition of food modifying agents: Definitions and basic principles, ice formation, and freezing process. Concentration by evaporation: single-stage evaporation, reduction in energy consumption, dehydration, roller drying, spray drying, and freeze-drying. Thermal and nonthermal technologies for inactivation of food modifying agents: ohmic heating, irradiation, ultrasound, ultraviolet light emitting diode, cold plasma hurdle technologies. Food quality control. Principles and technology of packaging: functions of packaging, properties of packaging material, packaging materials, and packaging technologies. Food safety and human health. Principles and design of food equipment. Unit operations such as blanching, extraction, pressing, and refrigeration. Determination of food physicochemical properties in relation to processing technique employed. Visitation to food processing industries including soybean oil extraction and refining, rice processing, and food packaging industries around Kano. Visitation to food processing equipment sales and services company.

**Minimum Academic Standards**

Food processing engineering laboratory equipped with facilities as per NUC-MAS requirements.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B. Eng. Agricultural and Biosystems Engineering

**BUK-ABE 504 Design of Agricultural Machinery (3 Units; Core; LH = 45)**

**Senate-approved relevance**

Training of high-quality graduates who are highly skilled and knowledgeable in the development of agricultural machinery suitable for the dryland areas of Nigeria. This is in agreement with BUK’s mission to address African developmental challenges in producing agricultural and biosystems engineering, graduates. Relevance is seen in agricultural and biosystems engineers from BUK because all agricultural activities are laborious and energy-intensive which require machine systems for effective and efficient agricultural production.

**Overview**

Design agricultural power and machinery is vital in agricultural mechanization practice, in Northern Nigeria where agriculture is the major economic activity. Agricultural operations require energy as important to production. This highlights the importance of preparing students in agricultural and biosystems engineering with knowledge of agricultural machinery development.

This course is planned to expose students on the development of various agricultural machinery appropriately with a view to sustainable agricultural practices. The course will focus on the design of agricultural machine elements/components as well as designing for fatigue and impact loading, design of selected power transmission elements (chain, belt, gears) and linkages, and the cost-benefit analysis in the design of agricultural machinery. The development and use of the appropriate machine in agricultural production reduce drudgery and time consumption. The importance of the course lies in meeting the need in achieving sustainable development goals (SDGs) number 1, 2, and 3 in the areas of poverty reduction, zero hunger, and good health and well-being respectively. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of the course are to:

1. explain various classifications of machine design
2. discuss machine design procedures
3. determine agricultural machinery materials for construction selection criteria
4. determine signs of failure in a design
5. design an agricultural machine using standard procedure

**Learning outcomes**

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

1. explain five (5) classifications of machine design
2. discuss at least five (5) machine design procedures
3. determine four agricultural machinery materials for construction selection criteria for a given a case study
4. determine five (5) signs of failure in a design for a given case study
5. design at least one agricultural machine using the standard procedure for a given case study

**Course contents**

Definition and classifications of machine design. Philosophy of design. Machine design processes and procedures. Machine design factors and procedures. Engineering materials of construction: selection, strength properties, stress and strain analysis, and costing. Theories of failure and failure analysis. Design against failure. The factor of safety. Stress concentration. Mechanics of farm machinery: stress and deflection analysis. Modern trends, principles, procedures, fundamentals, and economic considerations for the design and development of farm power and machinery systems. Design considerations, procedure, and their applications in agricultural power and machinery. Reliability criteria in design and its application. Analytical design considerations of linkages/components in farm machinery and its application. Design of selected farm equipment: – tillage, seeding, planting, plant protection, harvesting, and threshing. Design of rotary, vibrating, and oscillating machines. Design and selection of matching power unit. Computer-aided design (CAD) software, its uses, and applications in the design of farm machinery. Design procedures using CAD.

**Minimum Academic Standards**

Agricultural power and machinery laboratory with NUC-MAS requirement facilities.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B. Eng. Agricultural and Biosystems Engineering

**BUK-ABE 505 Design of Irrigation and Drainage Systems (3 Units; Elective; LH = 45)**

**Senate-approved relevance**

Training of high-quality graduates who are highly skilled and knowledgeable in the applications of engineering knowledge to design irrigation and drainage systems particularly, in the dryland areas of Nigeria. This is in agreement with BUK’s mission to address African developmental challenges in producing quality agricultural and biosystems engineering graduates. Relevance is seen in agricultural and biosystems engineers from BUK and around, especially at the integrated farm located in the Centre for Dryland Agriculture (CDA).

**Overview**

Adequate knowledge of irrigation and drainage is vital in the agricultural value chain, especially at the production level as in the dryland areas of Nigeria where agriculture is one of the major economic activities. The knowledge of linking soil, water and infrastructure (irrigation scheme) is very essential in agricultural production. This highlights the importance of preparing students in agricultural and biosystems engineering with knowledge of the applications of engineering principles and theories to design irrigation and drainage systems.

This course is planned to expose students to the concept, theories models and software related to flow measurement, soil infiltration concept, design of open channels, design of irrigation systems (surface and micro) the concept of seepage and its implications and soil salinity/sodicity and reclamation. The importance of the course lies in meeting the need in achieving some of the objectives of the ongoing sustainable development goals (SDGs) numbers 2 (zero hunger) and 6 (clean water and sanitation). The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of the course are to:

1. discuss the concept and practice of water flow measurement and design of open channels
2. define and discuss pump and pumping power requirements.
3. design of irrigation systems; border, basin, sprinkler and drip.
4. discuss irrigation water quality; salinity, sodicity, and reclamation of saline soils.
5. explain the concept of seepage from canals and canal lining.
6. design an irrigation project and discuss irrigation water sources and management.
7. explain the theory of rainfall, runoff, land drainage and drainage requirement of crops.
8. design of drainage systems; surface and subsurface drainages (envelope materials and their design, loads on conduits, and drainage pumping)
9. construction, installation, and maintenance of drains

**Learning outcomes**

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

1. explain two concepts of water flow measurement and design of open channels
2. discuss three types of pump and pumping power requirements
3. design at least one irrigation system; border, basin, sprinkler, and drip
4. explain two types of irrigation water quality; salinity, sodicity and reclamation of saline soils
5. discuss three concepts of seepage from canals and canal lining
6. design at least one irrigation project and discuss irrigation water sources and management
7. explain two (2) theories of rainfall, runoff, land drainage and drainage requirement of crops
8. design four types of drainage systems; surface and subsurface drainages (envelope materials and their design, loads on conduits, and drainage pumping)
9. analyse two methods on how to construct, install and maintain drains

**Course contents**

Water flow measurement. Design of open channels. Pump and pumping power requirements. Design of irrigation systems (border, basin, sprinkler and drip). Salinity, sodicity and quality of irrigation water. Reclamation of saline soils. Seepage from canals and canal lining. Design of an irrigation project. Irrigation water sources and management. Review of rainfall, runoff and drainage. Theory of land drainage and drainage requirement of crops. Design of drainage systems; surface and subsurface drainages. Envelope materials and their design, loads on conduits and drainage pumping. Construction, installation and maintenance of drains.

**Minimum Academic Standards**

Agricultural power and machinery laboratory with NUC-MAS requirement facilities.

Bayero University, Kano (BUK)

Engineering

Agricultural and Environmental Engineering

B. Eng. Agricultural and Biosystems Engineering

**BUK-ABE 506 Indigenous Technologies for Agricultural Value Chain (3 Units; Elective; LH = 45)**

**Senate-approved relevance**

Training graduates who are highly skilled and knowledgeable in the applications of indigenous technologies particularly, for agricultural value chain in the dryland areas of Nigeria. This is in agreement with BUK’s mission to address African developmental challenges in producing quality agricultural and biosystems engineering graduates. Relevance is seen in agricultural and biosystems engineers from BUK and around, especially at the during food production and processing processes.

**Overview**

Adequate knowledge in the application and use of indigenous technologies for agricultural value chain is vital in food production and processing, especially at the production level as in the dryland areas of Nigeria where agriculture is one of the major economic activities. Indigenous technologies knowledge entails adaptation to native and appropriate technologies. The use of indigenous technologies knowledge can aid in scaling up sustainable agriculture in order to boost production, safeguard the environment, and alleviate poverty.

This course is planned to expose students to the applications and use of indigenous technologies for agricultural value chain. The course discusses on the agricultural productivity, digital innovations, digital technologies among others. The importance of the course lies in meeting the need in achieving some of the objectives of the ongoing sustainable development goals (SDGs) numbers 2 (zero hunger) and 6 (clean water and sanitation). The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of the course are to:

1. define indigenous technologies in agriculture
2. discuss the roles of indigenous technologies in agriculture
3. define agricultural productivity
4. explain methods of enhancing agricultural productivity
5. define digital innovation

**Learning outcomes**

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

1. define at least one indigenous technology in agriculture
2. discuss three (3) roles of indigenous technologies in agriculture
3. define at least one type of agricultural productivity
4. explain at least two (2) methods of enhancing agricultural productivity
5. define one types digital innovations

**Course Content**

Definition of indigenous technologies in agriculture. Roles/roles of indigenous technologies knowledge systems. Indigenous technologies for agroforestry, crop rotations and mixed-/inter-cropping. Definition of agricultural productivity. Methods of enhancing agricultural productivity. Agricultural productivity and innovations. Measuring productivity in agriculture. Measuring technical efficiency in agriculture. Definition of digital innovation. Types of digital innovation. Benefits of digital innovation. Definition of traceability systems. Food traceability systems. Definition of digital technology. Importance/benefits of digital technology. Barriers that hinder the use of digital technology. Definition of polyculture farming. Common practices of polyculture farming. Functions, and effectiveness of polyculture farming. Benefits/advantages of polyculture farming. Concepts of rainwater harvesting. Rainwater harvesting diagram. Reasons for the rainwater harvest. Merits and de-merits of rainwater harvesting. Technological progress, diffusion, and opportunities. Industrial wastes general considerations. Specific industries including dairy industry, abattoirs, oil pollution. Biodegradability and treatability of the industrial effluents. Specific physical-chemical treatment methods and pollution control measures.

**Minimum Academic Standards**

Agricultural and biosystems engineering programmes with NUC-MAS requirement facilities.