UNIVERSITY OF NIGERIA, NSUKKA

Faculty of Engineering

Department of
Agricultural and Bioresources Engineering

Revised Five-Year Standard Undergraduate Academic Programme in Agricultural & Bioresources Engineering

2017

FOREWORD

A review, update and revision of the Departmental 5-year B.Eng Degree Programme in Agricultural and Bioresources Engineering, which came into operation in 2004 following a Departmental name-change, has been successfully effected and the programme received the approval of the Senate of the University of Nigeria on Monday the 3rd of July, 2017. The new curriculum provides for four options of minor specialization in the final year of study, namely: (1) Power Systems, Machinery and Mechatronics; (2) Soil, Water Resources and Aquacultural Engineering; (3) Food and Bioprocess Engineering, and; (4) Structures and Environmental Engineering.

Many new courses have been introduced to reflect current developments in the discipline and to prepare students for future careers and greater relevance in a changing environment. It is hoped that the new programme will further advance the goals of the Department, which are to train the personnel, conduct relevant research and engage in consultancy and community services for the development of national self-sufficiency in food, fibre and timbre products, and to ensure the sustainable management and utilizationof the natural resources in the production processes.

Engr. Prof. C. C. Mbajiorgu
Head of Department

Revised Five-Year Standard Undergraduate Academic Programme in Agricultural & Bioresources Engineering

Brief History of the Department

The Agricultural Engineering Department at UNN is the first to offer a regular degree programme in Nigeria. The Department produced its first set of agricultural engineering graduates literally on the eve of the Nigerian civil war in 1967. In 2004, the Department pioneered the name change to Agricultural and Bioresources Engineering in line with global developments, incorporating the relevant specialties of Aquacultural, Forest and Biomass Engineering into its curriculum. In adding Bioresources Engineering to its curriculum, the Department seeks to embrace the full range of its capability in providing much needed personnel for the development of national self-sufficiency in food, fibre and timber products. This development has since become a model to other Departments of Agricultural Engineering in Nigerian universities.

Philosophy

Engineering combines creativity and practicality on a scientific basis. When the scientific basis borders on living things, their by-products and/or their natural resource base, the resulting branch of engineering is variously called Agricultural, Biological, Biosystems, Bioresource, and/or Bio-environmental Engineering. The current world population ofover 7 billion is expected to grow to at least 8 billion by the year 2025, and most of this growth will take place in the developing world. It is therefore clear that expanding agricultural production in a sustainable manner will be crucial in responding to these challenges. Complex problems ranging from the development of sustainable systems for the production of food, fiber and renewable energy, to the scale-up of products of new discoveries in biology and biotechnology will require engineering solutions. These solutions must be developed in the context of globalization and the prevailing role of Information and Communications Technology (ICT), while at the same time ensuring local relevance and the protection of the environment. The curriculum described below is aimed at producing 21st–century engineers that are well equipped to tackle these challenges in the context of the philosophy, “think globally; act locally”.

Objectives

The primary objectives are to train engineers who will function in one or more of the following roles towards national self-sufficiency:

- To increase and sustain agricultural, aquacultural and/or forest production;
- To manage the natural resources such that a high level of production can be sustainable without damage to the environment;
- To maintain or change the natural characteristics of food and biomaterials for suitable purposes;
- To remove or reduce the physical drudgery in production operations, and;
- To provide desirable amenities for communities of producers, usually rural.

Scope

The Department offers a 5-year B.Eng degree programme designed to give students a firm foundation in the discipline. In the first two years of the programme, study concentrates on the engineering sciences common to all engineering disciplines. From the third year onwards, discipline specialization courses are introduced. This finally leads to students, in the final year of the programme, taking courses with emphasis on one of the following options:

(i) Power Systems, Machinery and Mechatronic Engineering
(ii) Soil, Water Resources and Aquacultural Engineering
(iii) Food and Bioprocess Engineering
(iv) Structures and Environmental Engineering

Job Opportunities

Graduates can find employment in the following institutions, companies and industries: Government - federal and state ministries/departments of Agriculture, Fisheries, Environment, Energy, Mines, Natural Resources (Land and Water), Rural Development, Science and Technology, town/LGA engineering divisions; Engineering consulting firms; Companies - food processing, irrigation and drainage design and component manufacturing, farm machinery engineering component sales, chemical/fertilizer/feed, tyre manufacturers; Educational - teaching/lecturing/research – universities, polytechnics,

colleges of science/technology/agriculture, research and training institutes and centers; Financial institutions – Banks and Agricultural credit institutions; Industries - fisheries, surface/subsurface survey, biotechnology firms, greenhouse and horticultural, solar energy technology and other renewable energy industries; goods manufacturing for waterpollution control, air pollution control, solid waste management, measuring and monitoring instrumentation, scientific/research/laboratory equipment and chemicals; Services provision sector - waste handling and environmental facility operation, environmental pollution/impact assessment, laboratory and related field services, facilities design for natural resources conservation and protection, and for aquacultural and forest production.

Entry Requirments

Candidates who have passed the W.A.S.C./NECO or General Certificate of Education G.C.E.(Ordinary Level) or Senior School Certificate Examinations in 5 credits including Mathematics, Physics, Chemistry and English Language in not more than two sittings may be admitted into the five-year programme through the U.M.E. entrance requirements. In addition, applicants who have passed the Higher School Certificate (H.S.C.) (Principal Level) or G.C.E. (Advanced Level) in Physics and Mathematics, with Chemistry (at Ordinary or Advanced Level) in addition to other University minimum entry requirements, may be admitted into the second year of the 5-year programme as direct entry students.

Stress Areas

Basic/Introductory and General	0
Power Systems, Machinery and Forest Engineering	1
Soil, Water Resources and Aquacultural Engineering	2
Food and Bioprocess Engineering	3
Structures and Environmental Engineering	4
Computers, ICT, Electrical and Renewable Energy	5
Seminar and Special Problems	8
Project	9

Five-Year Standard Undergraduate Academic Programme

First Year

First Semester

Course No		Title	Units
Major Courses			
EGR	101	Introduction to Engineering	2
Required Ancillary Courses			
MTH	111	Elementary Mathematics I	3
MTH	121	Elementary Mathematics II	3
PHY	121	Fundamentals of Physics I	3
PHY	195	Practical Physics I	2
CHM	101	Basic Principles of Inorganic Chemistry	2
CHM	171	Basic Practical Chemistry	2
General Studies Courses			
GSP	101	Study Skills and Basic Research Methods	2
			Total: 19

Second Semester

Course No		Title	Units
Major Courses			
EGR	102	Applied Mechanics	3
Required Ancillary Courses			
MTH	122	Elementary Mathematics III	3
PHY	116	General Physics for Physical Sciences II	2
PHY	124	Fundamentals of Physics III	3
CHM	112	Basic Principles of Physical Chemistry II	2
CHM	122	Basic Principles of Organic Chemistry	2
General Studies Courses			
GSP	102	Basic Grammar and Varieties of Writing	2
			Total: 17

Second Year

First Semester

Course No		Title	Units
Major Courses			
ABE	201	Introduction to Agricultural and Bioresources Engineering	1
EGR	201	Materials Science	2
EGR	202	Materials Science Laboratory	1
Required Ancillary Courses			
CVE	211	Strength of Materials I	2
CVE	212	Strength of Materials Laboratory	1
EEE	211	Basic Electrical Engineering I	3
MEC	211	Engineering Drawing	2
MEC	261	Thermodynamics and Heat Engines	2
MTH	207	Advanced Mathematics VII	2
General Studies Courses			
GSP	201	Peace Studies and Conflict Resolution I	2
GSP	207	Humanities I	2
			Total: 20

Second Semester

Course No		Title	Units
Major Courses			
ABE	252	Computer Applications in Engineering	3
ABE	254	The Internet and information Technology	2
Required Ancillary Courses			
CVE	221	Fluid Mechanics I	2
CVE	222	Fluid Mechanics Laboratory	1
EEE	251	Basic Electrical Engineering Laboratory/Practice	1
MEC	212	Workshop Technology	2
MTH	206	Advanced mathematics IV	2
MTH	208	Advanced Mathematics VIII	2
General Studies Courses			
GSP	202	Peace Studies and Conflict Resolution II	2
GSP	208	Humanities II	2
			Total: 19

Third Year

First Semester

Course No		Title	Units
Major Courses			
ABE	301	Introduction to Technical Writing and Presentation	1
ABE	321	Applied Hydraulics in ABE	2
ABE	323	Applied Soil Mechanics in ABE	2
ABE	331	Engineering Properties of Biomaterials	2
ABE	341	Environmental Control in Agricultural & Bioresources Structures	2
Required Ancillary Courses			
CED	341	Introduction to Entrepreneurship	2
CVE	351	Engineering Surveys I	3
MEC	341	Mechanics of Machines	2
STA	205	Statistics for Physical Sciences and Engineering I	2
SSC	211	Principles of Soil Science	2
			Total: 20

Second Semester

Course No		Title	Units
Major Courses			
ABE	302	Basic Agricultural and Bioresources Engineering	1
ABE	312	Mechanics of Soil-Machine Interaction	2
ABE	314	Engineering Drawing and Design	1
ABE	322	Water Quality, Epidemiology and Environmental Chemistry	2
ABE	324	Climatology and Meteorology in ABE	1
ABE	326	Environmental Hydrology	2
ABE	332	Introduction to Food Engineering	1
EGR	301	Engineering Analysis	4
Required Ancillary Courses			
CED	342	Business Development and Management	2
ANS	271	Principles of Animal Production	2
CSC	332	Introduction to Crop Science	2
			Total: 20

Elective Course

ABE	304	Introduction to Farm Machinery and Mechanization	2

Fourth Year

First Semester

Course No		Title	Units
Major Courses			
ABE	411	Agricultural and Bioresources Power and Machinery	2
ABE	413	Land Clearing and Development	2
ABE	421	Hydraulic Structures	2
ABE	423	Principles of Irrigation and Drainage Engineering	2
ABE	431	Principles of Plant and Animal Products Handling, Processing &Storage	2
ABE	441	Environmental Impact Assessment in ABE	2
ABE	451	Decision Support and Data Acquisition Systems	2
EGR	401	Computational Methods	3
Required Ancillary Courses			
AGE	301	Basic Farm Management and Production Economics	2
			Total: 20

Second Semester

Course No		Title	Units
Major Courses			
ABE	482	Special Problems in Agricultural and Bioresources Engineering	3
ABE	484	Seminar	2
EGR	402	SIWES	10
			Total: 15
Elective Course			
ABE	412	Agricultural Engineering Practicals	2

Fifth Year
(Four Options Available)

Option One: Power Systems, Machinery and Mechatronics

First Semester

Course No		Title	Units
Major Courses			
ABE	501	Climate Change Adaptation in ABE	1
ABE	511	Agricultural and Bioresources Mechanization	2
ABE	513	Power Sources for Agriculture and Forestry	2
ABE	515	Agricultural and Forest Machinery	3
ABE	517	Safety, Ergonomics and Health Issues in ABE	1
ABE	521	Soil and Water Conservation	2
ABE	531	Processing of Agricultural and Bioresources Products	2
ABE	551	Precision Agriculture and Information Technology	2
ABE	553	Mechatronics and Power Machinery Systems Automation	2
ABE	555	Electrification and Renewable Energy	2
			Total: 19

Second Semester

Course No		Title	Units
Major Courses			
ABE	512	Principles of Agro-Industrial Management	2
ABE	514	Agric & Bioresources Power and Machinery Syst Management	1
ABE	516	Design of Agricultural and Forest Machinery	3
ABE	518	Forest Engineering	2
ABE	532	Biomaterial Handling and Transportation Equipment	2
ABE	546	Agric and Bioresources Engineering Contracts and Specification	2
ABE	592	Final Year Project	6
			Total: 18

Option Two: Soil, Water Resources and Aquacultural Engineering

First Semester

Course No		Title	Units
Major Courses			
ABE	501	Climate Change Adaptation in ABE	1
ABE	511	Agricultural and Bioresources Mechanization	2
ABE	521	Soil and Water Conservation	2
ABE	523	Design of Irrigation Systems	3
ABE	525	Aquacultural Engineering I	2
ABE	527	Design of Drainage Systems	2
ABE	529	Integrated Water Resources Development and Management	2
ABE	543	Bio-Environmental Engineering	2
ABE	545	Agricultural and Bioresources Structures Design	3
			Total: 19

Second Semester

Course No		Title	Units
Major Courses			
ABE	522	Design of Soil and Water Conservation Structures	2
ABE	524	Rural Water Supply and Sanitation	2
ABE	526	Aquacultural Engineering II	2
ABE	528	Watershed Management	2
ABE	542	Environmental Systems Management in ABE	2
ABE	546	Agric and Bioresources Engineering Contracts and Specification	2
ABE	592	Final Year Project	6
			Total: 18

Option Three: Food and Bioprocess Engineering

First Semester

Course No		Title	Units
Major Courses			
ABE	501	Climate Change Adaptation in ABE	1
ABE	511	Agricultural and Bioresources Mechanization	2
ABE	521	Soil and Water Conservation	2
ABE	531	Processing of Agricultural and Bioresources Products	2
ABE	533	Storage of Agricultural and Bioresources Products	3
ABE	535	Solar Energy Application in Bioprocess Engineering	2
ABE	537	Food Engineering	3
ABE	539	Fermentation Engineering	2
ABE	555	Electrification and Renewable Energy	2
			Total: 19

Second Semester

Course No		Title	Units
Major Courses			
ABE	512	Principles of Agro-Industrial Management	2
ABE	532	Biomaterial Handling and Transportation Equipment	2
ABE	534	Biomass Engineering	2
ABE	536	Packaging and Containerization Engineering	2
ABE	538	Post Harvest Technology	2
ABE	546	Agric and Bioresources Engineering Contracts and Specification	2
ABE	592	Final Year Project	6
			Total: 18

Option Four: Structures and Environmental Engineering

First Semester

Course No		Title	Units
Major Courses			
ABE	501	Climate Change Adaptation in ABE	1
ABE	511	Agricultural and Bioresources Mechanization	2
ABE	521	Soil and Water Conservation	2
ABE	525	Aquacultural Engineering I	2
ABE	541	Farmstead Planning and Design	3
ABE	543	Bio-Environmental Engineering	2
ABE	545	Agricultural and Bioresources Structures Design	3
ABE	547	Agricultural Solid Waste Management	2
ABE	555	Electrification and Renewable Energy	2
			Total: 19

Second Semester

Course No		Title	Units
Major Courses			
ABE	524	Rural Water Supply and Sanitation	2
ABE	542	Environmental Systems Management in ABE	2
ABE	544	Applied Biotechnology in Agricultural Waste Utilization	3
ABE	546	Agric and Bioresources Engineering Contracts and Specification	2
ABE	548	Rural Roads and Farm Transportation	3
ABE	592	Final Year Project	6
			Total: 18

COURSES DESCRIPTION

ABE 201: Introduction to Agricultural and Bioresources Engineering (1 Unit)

The human need for food, fiber and timber and the role of engineering in their production, processing, storage/preservation and transportation. Concept of Agricultureas crops and livestock production and of Bioresources as including Aquaculture and Forestry, among others. Definition of Agricultural and Bioresources Engineering and its unique position in the engineering professions. The specialty areas of Agricultural and Bioresources Engineering; their general introduction.

ABE 252: Computer Applications in Engineering (3 Units)

Concept of structured programming. Procedures and functions in FORTRAN. Declarations, I/O and file operations. Using a Windows-based FORTRAN software in finding solutions to equations, interpolations/extrapolations, calculus, numerical derivatives and integrals, matrix operations, differential equations, least square approximations, and sorting of data. Introduction to CSharp (C#) programming language. C# syntax: loops, conditions, arrays and strings. Object oriented programming. Object oriented concepts. Sample projects.

ABE 254: The Internet and Information Technology (2 Units)

Introduction to the PC and the internet including a brief history; Formatting and partitioning of hard drives of the PC; Installing operating systems and basic software like Windows, Microsoft Office, Drivers, Antivirus, etc; Managing the computer and removable devices against virus attacks; Using soft and hard back-ups for works being done inside the PC as a precursor to crashing and other possible problems with computers while working; Introduction to cloud computing; Data and word processing with Microsoft Excel and Word; Introduction to Computer Aided Design (CAD); Accessing the internet and navigating the web; E-mailing operations; Use of the internet for information searching and research; Downloading documents on the internet

ABE 301: Introduction to Technical Writing and Presentation (1 Unit)

Principles of effective communication, professional use of the English language. Principles of technical writing. Oral presentation of technical ideas. Using Reference software such as EndNote and Mendeley for managing bibliography; Using relevant software for plagiarism management such Ithenticate, CrossRef, etc.

ABE 302: Basic Agricultural and Bioresources Engineering (1 Unit)

Basics of Agricultural and Bioresources Engineering. Application of practical-problems solving skills. Identification of various tractors, implements, forestry machinery and

aquacultural equipment. Tractor driving and test. Introduction to field operations in agricultural and bioresources engineering.

ABE 304: Introduction to Farm Machinery and Mechanization (2 Units)
(A service course offered to Faculty of Agriculture)

Introductory treatment of topics in farm power and machinery, electric power and processing, farm buildings and storage structures, and soil and water engineering to provide an understanding of the role of agricultural engineering in the mechanization of the agricultural industry and familiarize the agricultural student with basic agricultural engineering principles and technology.

ABE 312: Mechanics of Soil -Machine Interaction (2 Unit)

Shearing resistance of soils. Active and passive resistance of cohesive and cohesionless soils. Stability of slopes and foundation. Consolidation and settlement. Application of classical soil, mechanics. Drainage of agricultural soils, Traction and trafficability curves. Soil compaction: causes, effects on soil structure. Control measures, Soil – Machine dynamics, Models for 2D and 3D analysis of soil- machine interaction.

ABE 314: Engineering Drawing and Design (1 Unit)

Parts and components assembly. Detailed drawing of machine, building and/or engineering system components. Sketching and use of design features, symbols, screws, fasteners, couplings, clutches, gears, etc. Building/Machine/Engineering-systemcomponent design. Presentation of design portfolio.

ABE 321- Applied Hydraulics in ABE (2 Units)

Review of fluid statics, kinematics and dynamics. Flow in closed conduits: continuity, momentum and energy equations and their applications for single pipelines. Head losses in transitions and fittings, and in non-circular pipes. Empirical friction-loss formulae. Pumps. Flow in open channels: continuity, momentum and energy equations and their applications. The Darcy-Weisbach and Manning equations. Energy grade line. Specific energy. Water-surface profiles. The hydraulic jump. Description and comparison of different types of hydraulic systems; hydraulic filters; Valves: direction and pressure control valves; electro hydraulics and electro-hydraulic control systems. Hydraulic pumps: displacement, open and closed center systems, vane, piston and gear pumpassemblies, pump failures, system contamination, filter operation. Types of cylinders: double and single acting cylinders, balanced and unbalanced cylinders, master slave cylinders and operations, vane type cylinders; Hydraulic motors: hydraulic pump and motor control operation; Hydraulic plumbing selection, hydraulic hose routing and

selections; Hydraulic test equipment: pressure gauge, flow meter, test port placement and usage. Hydraulic safety procedures accident management

ABE 322: Water Quality, Epidemiology and Environmental Chemistry (2 Units)

Overview of freshwater geochemistry. Primary production and nutrient cycles in rivers and lakes. Water pollutants and their sources. The health, environmental and socio- economic impacts of Water pollution. Epidemiological concept and definition. Water- borne diseases. Food-borne diseases. Air-borne diseases. Air pollution sources and effects. Origin and fate of air pollutants. Air pollution meteorology and atmospheric dispersion.

ABE 323: Applied Soil Mechanics in ABE (2 Units)

Soil physical properties, crop growth, crop yield, crop physical properties and land management; soil mechanics laboratory practicals and measurement of physical, permeability, compaction and shear strength properties of agricultural soils. Phase relationships, shear strength, consolidation, settlement and compaction. Site investigations.

ABE 324: Climatology and Meteorology in Agric. and Bioresources Engineering(1 Unit)

The tropics: Atmospheric circulation in the tropics. Sunshine, Radiation, Temperature and humidity. Clouds, condensation and rainfall. Climate and climate change. Crop yield and Weather. Weather forecasting. Seasonality of tropical hydro-meteorological phenomena. Meteorology and agricultural/ bioresources production in the tropics.

ABE 326: Environmental Hydrology (2 Units)

Definition of hydrology and applications to environmental problems. Watershed concepts. The hydrological cycle and its component processes. The hydrologic budget and water balance equation. Precipitation, Vegetative-canopy Interception, Evaporation, Evapo-transpiration, Infiltration, Unsaturated Flow, Rainfall Excess, Abstractions and Direct Runoff. Overland flow; Surface runoff; and Flow Routing. Runoff Hydrographs. Groundwater Flow. Measurement of Hydrologic variables and their common Units of Measurement. Hydrologic Data Sources. Rainfall intensity-duration-frequency analysis. Design storms. Design rainfall hyetographs. Empirical methods of estimating design runoff volume, peak flow, and design hydrograph - the Curve Number method, rational method, and Dimensionless Hydrograph method. Design flow simulation.

ABE 331: Engineering Properties of Biomaterials (2 Unit)

The importance, scope and application of biometry to the solution of engineering problems in agricultural and food industry. Physical characteristics; criteria for describingshape and size; determination of volume, density, porosity, surface area. Mechanical properties; texture and quality of food materials; mechanical damage of food materials. Biological systems and some basic concepts of rheology; time dependent andcharacterization of biomaterials. Newtonian and non-newtonian fluids and viscometry. Thermal properties. Aerodynamic properties. Physicochemical properties, electrical/dielectric properties, colorimetric properties of biomaterials.

ABE 332: Introduction to Food Engineering (1 Unit)

Definitions; Introduction to food preservation processes; fermentation, packaging concepts; food properties; chemical and physical changes food undergoes during processing; food safety and quality; Introduction to fluid flow in food processing, energy and controls.

ABE 341: Environmental Control in Agricultural and Bioresources Structures (2 Units)

Animal and crop thermal environment interaction and application of principles of heat and mass transfer in the control of temperature, humidity and radiant heat load in animal and crop production/storage buildings as well as family houses. Topics to be covered include psychrometry heat and vapour transmission, ventilation, evaporative cooling, homeothermic systems and homeothermic mechanism. Response of animal to changes in environmental temperatures. Animal heat production. Heat and mass transfer in animals. Comfort indices. Radiant heat load and production. Plant physiological processes. Environmental factors affecting plant growth. Greenhouses. Environmental control in crop storage structures.

ABE 411: Agricultural and Bioresources Power and Machinery (2 Units)

Power sources for agriculture and forestry. Selection and management of farm tractors and equipment. Force analysis and power measurement on tillage tools. Fieldperformance evaluation of food- and forest crop production equipment. Adjustment, maintenance and repair of tractors and equipment. Practical exposure to the adjustment, operation and maintenance of tractors, farm machinery, forest machinery, and aquacultural equipment and gadgets as applicable in Nigeria. Introduction to field and laboratory measurement devices and equipment

ABE 412: Agricultural Engineering Practicals (2 Units)
(A service Laboratory & Field course Offered to Faculty of Agriculture)

Practical exposure to the adjustment, operation and maintenance of tractors, farm machinery and other equipment and gadgets as applicable in Nigerian agriculture.

ABE 413: Land Clearing and Development (2 Units)

Land resources and Land use Act in relation to Nigerian agriculture and forestry. Vegetation types. Objectives, methods and equipment for land clearing and development. Machinery selection, mechanics of operation. Land reclamation. Earth moving machinery and earth moving mechanics. Economic analysis of land clearing operations.

ABE 421: Hydraulic Structures (2 Units)

Introduction to dams and artificial wetlands. Reservoir hydraulics, spillways and high pressure outlets. Discharge measurement structures. Weirs – sharp-crested, broad-crested. The Parshall Flume. Gates. Culverts. Water level and velocity control structures. Flow-dividing structures. Flow intake structures. Riprap protection and silt control devices.

ABE 423: Principles of Irrigation and Drainage Engineering (2 Units)

Crop water requirements in agriculture and forestry. Methods of irrigation. Principles of furrow, basin and sprinkler irrigation. Frequency and amount of irrigation. Irrigation water scheduling. Evaluating irrigation systems and practices. Principles and methods land drainage. Effect of crops, surface drainage, and sub-surface drainage.

ABE 431: Principles of Plant & Animal Products Handling, Processing & Storage (2 Units)
Properties and characteristics of plant/animal products and biomaterials, Heat transfer and heat exchangers Cleaning, sorting and grading. Handling methods and machines. Processing techniques. Crop storage. Crop drying. Psychrometry and psychometric charts. Postharvest losses.

ABE 441: Environmental Impact Assessment in Agricultural & Bioresources Engineering (2 Units)

Definition and concept of EIA. Socio-economic impacts definition. Scoping and baseline studies. Physical parameters for the soils, hydrological, water quality, and ecological components of an EIA. Impacts from direct manipulation or utilization. Impacts from projects not directly associated with manipulation and utilization. Hydrological impacts of construction projects - roads, land clearing/development/dams, etc. Impacts prediction, mitigation and monitoring. Mitigation measures relating to urban runoff and flood protection. International conventions on nature conservation. Evaluation of ecosystems. Restoration and compensation.

ABE 451: Decision Support and Data Acquisition Systems (2 Units)

Systems Concepts. Geographic information systems (GIS) applications. Global positioning systems (GPS) applications. Simulation modeling applications. Expert systems applications. Introductory Bioinformatics. Introduction to Geoinformatics. Introduction to Hydroinformatics. Data logging and Telemetry. Remote sensing applications. Digital elevation mapping (DEM) applications. Monitoring instrumentationand microcomputer controls.

ABE 482: Special Problems in Agricultural and Bioresources Engineering (3 Units)

Each student will select and undertake a detailed study of any problem in agricultural and bioresources engineering of relevance to Nigeria under the guidance of an academic staff. A term paper will be submitted at the end of the study, which may be part of the literature review and research proposal for the student's final-year project.

ABE 484: Seminar (2 Units)

Based on the student's thoroughly researched project proposal topic, the student is required to present a technically sound seminar which is preparatory to embarking on the final-year project, if approved.

ABE 501: Climate Change Adaptation in Agric. and Biores. Engineering (1 unit)

Definition of climate change; causes of climate change; indicators/evidence of climate change; General effects of climate change. Impacts on rainfall amounts, distribution and intensity; consequences of sea level rise; water logging of agricultural lands, flooding,etc. Impacts on agricultural and bioresources production systems. Impacts on engineering infrastructure; - transportation, energy, water, communications, waste management, etc. Definitions of and relationships between coping, vulnerability and adaptation. Methods of Vulnerability Assessment. Types of adaptation measures. Instruments for improved climate resilience: Technical Standards; Environmental Impact Assessment and Strategic Environment Assessment; Framework for the assessment and management of flood risks; Climate "proofing". Technical adaptation: Identifying technologies for adaptation already in use elsewhere; Identifying opportunities for dual-use infrastructure; Mitigation and adaptation interactions. Smart buildings; Smart grid and intelligent networks; Dual water delivery and waste systems. Regulatory and policy issues: Design codes and standards; Adapting regulation for probabilistic scenarios; Planning for adaptation at the systems level; Expectation management: what standards of service are reasonable? Planning for a resilient agricultural and bioresources production system.

ABE 511: Agricultural and Bioresources Mechanization (2 units)

Nature and objectives of agricultural and forest mechanization. Factors affecting mechanization in the tropics. Analysis of production systems. Agricultural/forest mechanization as a strategy for rural development. Impact on food, fibre and timber production and on infrastructural development. Linkages with rural industrialization. Mechanization of fishing and aquacultural operations. Selected case studies.

ABE 512: Principles of Agro-Industrial Management (2 Units)

Principles of management. Feasibility and establishment of Agro-industries. Management of cottage industries for agricultural products. Selected management case studies in plant and equipment. Industrial group and organisational behaviour, motivation, industrial law, legislation on wages, trade marks and patents. Law of contract and sale of goods. Industrial safety and liability for injuries. Industrial relations. Trade unions, employer associations and role of state.

ABE 513: Power Sources for Agriculture and Forestry (2 Units)

Human-powered tools and machines. Draft animal power. Engines. Tractors for Agriculture and forestry. Two-wheel tractors. Two-axle tractors.

ABE 514: Agricultural & Bioresources Power and Machinery Systems Management (2 Units)

Integrated approach to machinery usage and agricultural/bioresources production sequence. Equipment selection. Scheduling of operation, seasonally factor. Machinery management Model. Machinery ownership and financing. Gross margin-analysis. Optimization of machinery -input combinations. Management of farm/forestry enterprises. Cost analysis of agricultural/forest machinery, Maintenance and Replacement. Case studies.

ABE 515: Agricultural and Forest Machinery (3 Units)

Tillage Machinery. Seeders and planters. Fertilizer distributors. Pest control equipment. Harvesters and Threshers. Specialized machines and equipment for forage crops, root crops, fruits and vegetables, tropical crops and orchards. Greenhouse and forest cultivation equipment. Forest machines - portable chain saws, portable brush saws, winches, hitches, mobile and self-propelled machinery, portable brush-cutters and grass trimmers.

ABE 516: Design of Agricultural and Forest Machinery (3 Units)

Machine design processes and procedures. Materials of construction, strength properties, stress analysis, costing. Design of machine elements. Machine fabrication. Typical design of low cost agricultural/forest machinery development and commercial manufacture in Nigeria.

ABE 517: Safety, Ergonomics & Health Issues in Agricultural and Bioresources Engineering (1 Unit)

Care and protection against pesticide spills and poisoning. Safety issues in machinery operation. Work science and the human physiology. Physical training and professional skills requirements for safe and healthy operation of motorized machinery. Gender issues and considerations in design and operation of machinery.

ABE 518: Forest Engineering (2 Units)

Forest stand establishment. Site preparation. Planting. Forest stand maintenance. Clearing and thinning of young stands. Pruning. Fertilization. Fire protection. Soil restoration. Forest roads. Tree harvesting, processing techniques, handlings and maneuvers. Tree felling, felling process, felling tools. Mechanical tree fellers. De- limbing, topping, bucking. Debarking. Wood comminution. Timber transportation; log extraction, skidding, winch skidding, grapple skidding, forwarding, locomotion. Special logging systems.

ABE 521: Soil and Water Conservation (2 Units)

Types of erosion. Soil erosion by water. Universal soil loss equation. RUSLE. Control of soil erosion by water. Wind erosion and its control. Desertification and control measures. Earth dams and farm ponds.

ABE 522: Design of Soil and Water Conservation Structures (2 Units)

Review of relevant hydraulic theories. Design of vegetated waterways. Terracing: functions and classification. Terrace system planning and design. Conservation structures permanent and temporary structures, functional requirements and design features. Function, limitations and design features of drop spillways, chutes, formless flume, pipe spillways and culverts. Irrigation and drainage structures. Earth embankments and farm ponds. Floods: types and methods of control. Flood routing.

ABE 523: Design of Irrigation Systems (3 Units)

Distribution of water on the farm –surface ditches, underground pipes, portable pipes. Review of irrigation water application methods. Design of surface irrigation systems – graded border design, furrow irrigation design, evaluation of existing systems. Sprinkler irrigation systems and components. Sprinkler system design and layout for intermittent-

move systems and for center-pivot sysems. Special sprinkler applications. Microirrigation systems layout and components. Emitters; discharge capacity and water distribution. Microirrigation system design.

ABE 524: Rural Water Supply and Sanitation (2 Units)

Water requirements. Water quality standards. Water-borne diseases. Biochemical oxygen demand. Portable water impurities. Sources and treatment methods of water for rural homes. Water lifting devices. Transportation and distribution systems. Pipe sizes. Waste disposal in rural communities. Collection, septic tanks. Digestion ponds and familyprivies.

ABE 525: Aquacultural Engineering I (2 Units)

Aquacultural systems and their environmental requirements. System types. Ponds, raceways, net pens and cages, tanks and re-circulating systems. Primary constraints in aquacultural systems: properties of water, oxygen as a constraint. Environmental needs of aquatic organisms. Materials for aquacultural facilities: considerations in materials selection; weight of water, corrosion, bio-fouling, ozone as a constraint. Materials for system components; tanks, raceways, waterproof lining, screen mesh, nets, ozone unit. Advantages and disadvantages of masonry, metals, plastics, rubber compounds, and wood materials. Design of aquacultural facilities: pond types, pond photosynthesis, diurnial limits. Productive systems and polyculture, pH limits, Nitrogen control.

ABE 526: Aquacultural Engineering II (2 Units)

Raceways design densities and loadings. Raceway length. Fish growth. Design principles and considerations for raceways. Site selection for net pens. Net pen design and construction. Biomass loading of tanks. Labour requirements. Tank shapes and sizes. Water inlet and outlet. Equipment and controls in aquacultural systems: feeding equipment; hand feeding, automatic feeders, demand feeders. Harvest equipment types. Monitoring equipment, sensors, monitoring and control systems. Aquacultural wastes handling: effluent regulations; materials to remove. Methods to remove ammonia. Methods to remove solids. Methods to dispose of solids. Methods to remove dissolved and colloidal organic matter. Methods to remove carbon dioxide.

ABE 527: Design of Drainage Systems (2 Units)

The need and design considerations for land drainage. Surface drainage and land forming. Subsurface drainage design. Drainage accessories – pipes and envelope materials. Loads on conduits. Drainage pumping. Construction and installation of drains. Maintenance of drains. Drainage applications in land reclamation and improvement.

ABE 528: Watershed Management (2 Units)

Watershed rainfall-runoff processes. Derivation of the St. Venant equations and solutionof their kinematic approximation. Watershed hydrologic models, types and characterization. Watershed erosion and sediment yield models. Model application to planning and management of watershed changes and development. Watershed management for water harvesting, flood control, soil erosion and sediment yield control. Reservoir design, sedimentation and useful life.

ABE 529: Integrated Water Resources Development and Management (2 Units)

What is Integrated Water Resources Management? Why IWRM? Key issues in water management. Water management principles. Water use, impacts and benefits. Implementing IWRM. Basic functions for water resources management. Water management objectives as a way of performing the functions. Institutional arrangements for performing the functions. Stepwise approach to conduct the functions. Water management objectives in water allocation. Water resources system analysis. Water permits. Planning for pollution control. Monitoring of water resources. Monitoring of water use. Monitoring of pollution and water quality. Information management process. Information management tools. Information management outputs. Preparing for basin planning. Basin planning process. Implementation of the basin plan.

ABE 531: Processing of Agricultural and Bioresources Products (2 Units)

Unit operations in processing; cleaning, sorting, grading and separation: Principles, techniques and machines; comminution. Particle size analysis. Heat treatment. Evaporation, Dehydration and drying. Psychometry. Properties of air-water-vapor mixtures. Processing techniques for Nigerian food/fibre/forest crops and aquatic products. Process control in biomaterial processing size reduction equipment, mixing and emulsification

ABE 532: Biomaterials Handling and Transportation Equipment (2 Units)

Definitions; design of material handling machines; methods of reducing handling damages. Transportation equipment. Powered farm vehicles for field use. Mono- wheelers, tri-wheelers, four-wheel carriers, multi-wheel carriers, crawler-type carriers. Motor trucks, subcompact trucks, farm trucks. Trailers used with walking tractors; used with four-wheel tractors; used for transporting Combine Harvesters and heavy equipment.Trailers with hydraulic tippers. Grain trailers. Loaders and forklifts. Monorails.

ABE 533: Storage of Agricultural and Bioresources Products (3 Units)

Storage types and environment. Economics of produce storage, deterioration of produce in storage; behavior of fresh produce in storage, importance of asepsis; extrinsic parameters of produce deterioration and their control. Special storage techniques. Unique aspects and problems of food/fibre and biomaterials storage in the humid tropics. Rational design of grain storage structures. Environmental control in storage structures. Evaporative cooling. Psychrometric charts and its application in storage.

ABE 534: Biomass Engineering (2 Units)

Biomass resources and principles of utilization. Energy crops and their production. Biomass feed stocks and environmental considerations. Anaerobic digestion of biomass: feedstock, technology and products. Biomass pretreatment techniques: steam explosion technology, briquetting, torrefaction and other densification technologies. Treatment of Municipal solid wastes: principles and processes. Bioethanol: fermentation and distillation technologies. Octane number and octane number improvers. Transesterification of biomass: feedstocks, technology and products. Cetane number. Combustion technologies. Gasification technology. Gasification reactors. Pyrolysis. Charcoal production.

ABE 535: Solar Energy Application in Bioprocess Engineering (2 Units)

Fundamentals of solar radiation. Solar heating and cooling. Heat transfer. Solar energy conversion efficiency. Principles of solar collections. Solar heat storage and applications in drying, preservation and storage systems for tropical food/fibre/forest crops, and for aquatic products. Design of solar dryers.

ABE 536: Packaging and Containerization Engineering (2 Units)

Purposes of packaging food and biomaterials. Packaging types: boxes, cartons, bags, bins, prepacks, paper wrapping and padding, plastic film bags, bio-degradables etc.Packaging systems. Marketing requirements for packaging. Storage environmental requirements. Types of packing configuration. Protection against shock, vibration and static compression of packaged biomaterials. Apportionment, convenience and labeling of cartons. Palletization. Canning technology. Aseptic processing and packaging. Modified atmosphere packaging and applications. Maximum allowable load concepts and containerization design.

ABE 537: Food Engineering (3 Units)

Definitions. Heat and mass transfer. Insulation. Heat exchanger design and application. Heat and cold preservation of foods. Food packaging principles. Food safety, and quality control. Principles and design of food processing equipment. Food product development. Sensory evaluation. Food wastes management. Process control.

ABE 538: Post-harvest Technology (2 Units)

Definitions; biology of fresh produce; effect of postharvest factors on post-harvest life; maturation and maturity indices; harvesting; pre-cooling operations; packing and packaging of fresh produce; transport systems; postharvest losses; postharvest technology of seeds; postharvest handling of perishable crops; postharvest packaging systems

ABE 539: Fermentation Engineering (2 Units)

Fundamentals of fermentation processes, modes of fermentation, and the principle of upstream operation. Physical and chemical factors that affect fermentation processes. Different types of fermenters. Brewing, bioreactor design and control; microbial kinetics. Unitary operations for solid-liquid separation, concentration, and drying of fermented foods. Potential application of a biorefinery concept to add value to food industry wastes. Fermentation for biofuels and biobased chemicals.

ABE 541: Farmstead Planning and Design (3 Units)

Farm and Farmstead types. Planning factors. Planning considerations, Farmstead layout and the concept of zone planning. Orientation and spacing of farm buildings. Functional design of family, poultry, pig, dairy and beef cattle, goats and sheep and micro-livestock housing. Building material – timber, concrete, metals, organic materials.

ABE 542: Environmental Systems Management in Agricultural and Bioresources Engineering (2 Units)

Definition of ecosystems. Biological control of the environment. Concept ofproductivity. Production and decomposition in nature. Homeostasis of the ecosystem. Food chains, food webs and trophic levels. Ecosystem energetics. Biogeochemical cycles and recycle pathways. Nutrient cycling in the tropics. Primary goods and services provided by various ecosystems: Agro-ecosystem, Forest ecosystem, Freshwater ecosystem, Grassland ecosystem and Coastal ecosystem. Management trade-offs among various ecosystem goods and services. Taking stocks of ecosystem conditions and changing capacity. Ecosystem balancing.

ABE 543: Bio-Environmental Engineering (2 Units)

Sources and collection of agricultural and bioresources liquid wastes including animal waste, slaughter house and food processing waste. Liquid waste characteristics. Pollution potential of liquid waste. Unit operations for agricultural liquid waste treatment – screening, communition, sedimentation and floatation. Biological treatment processes – aerobic, anaerobic and facultative systems. Biological treatment of liquid waste. Suspended culture systems – CMR, activated sludge, UASB, waste stabilization ponds and lagoons, constructed wetlands. Attached film systems – trickling filter and RBC.

Waste stabilization system design. Disinfection. Sludge treatment. Bio and phyto-remediation. Sources and control of air pollution.

ABE 544: Applied Biotechnology and Agricultural and Bioresources Waste Utilization (3 Units)

Fermentation processes. Anaerobic fermentation of liquid waste. Bio-reactor operating parameters. Classification and types of anaerobic reactors. Reactor performance indices. Anaerobic reactor kinetics. Biogas collection and utilization. Microbial fuel cells. Re-use of agricultural waste – animal feed, single cell protein production, fish production, composting, land application, industrial uses.

ABE 545: Agricultural and Bioresources Structures Design (3 Credit Units)

Review of structural analysis. Design principles and design procedures. Design codes. Analyses of action (load estimation). Characteristic strength and characteristic action. Partial safety factor for materials and load. Design of concrete beams, columns, slabs, and footings. Design of steel and timber beams, columns and connections. Applications in agricultural buildings and structures. Design of storage structures (silos and cribs).

ABE 546: Agricultural and Bioresources Engineering Contracts and Specifications (2 Units)

Engineering economy (Review of interest and depreciation estimation). Legal and professional relations in Agricultural and Bioresources engineering contracts. Estimation of Investment cost – Bill of Engineering Measurement (BEM). Recurrent costs – interest, depreciation, repairs and maintenance, insurance and taxes, machinery/equipment operating costs. Economic comparison of alternative projects. Management organizational forms – personal management, partial or general/whole contract, turn-key projects. Public procurement procedure – bid types (force account, LCB and ICB), bill preparation and bidding requirements, advertising, tendering, bid opening, bid evaluation.Contracts, work schedule, Stores management. Causes and avoidance of cost overrun. Project supervision. Contract and labour laws.

ABE 547: Agricultural Solid Waste Management (2 Units)

Sources and types of solid waste – crop residues, municipal and agro-industrial solid waste. Physical and chemical composition of agricultural solid waste. Solid waste generation. Solid waste collection. Estimation of and factors affecting generating rate. On-site handling, storage and processing. Processing techniques – mechanical size alteration, mechanical component separation, magnetic and electro-mechanical separationdrying and de-watering. Land-filling with solid waste. Design, operation and maintenance of landfills. Material recovery systems for agricultural solid wastes. Recovery of Biological and thermal conversion products – composting (aerobic conversion), combustion, gasification and pyrolysis.

ABE 548: Rural Roads and Farm Transportation (3 Credit Units)

Rural roads selection. Review of surveying. Road design. Inventorization. Routine and recurrent maintenance. Farm transport systems – standards and specifications. Farm transportation equipment and design.

ABE 551: Precision Agriculture and Information Technology (2 Units)

Definition of precision agriculture. Electronic monitoring and control of field machines. Integrated control of tractors and their associated implements. Precision agriculture based on the NAVSTAR Global Positioning System. Sensors and automatic navigation offield machines. Machine vision concepts and cameras. Recognition of crop and soil features for applications to vehicle guidance and site-specific treatments.

ABE 553: Mechatronics and Power Machinery Systems Automation (2 Units)

Introducing mechatronics: philosophy, examples of mechatronic systems, embedded systems, traditional and mechatronics designs, modeling systems, connected systems, measurement systems, control systems, programmable logic controller; Sensors and actuators; Agricultural automation and control; Agricultural vehicle robots; Mechanization, sensing and control in crop and animal production

ABE 555: Electrification and Renewable Energy (2 Units)

Electrical codes, tariffs and regulations. Generation and transmission of electricity. Testing procedure. Power factor correction. Selection and use of electric motors. Transformers. Energy conversion. Applications and use of electricity in agricultural and bioresources engineering. Electrical load assessment. Electrical distribution systems in farmsteads. Natural energy sources and their characteristics. Wind energy. Types of wind machines. Water power. Water turbines, water wheels, mechanical and electrical components. Solar energy. Solar photovoltaics; solar cells and modules. Biomass energy.

ABE 592: Final - Year Project (6 Units)

Supervised individual student project undertaken in research, development, design and/or construction and testing, to deepen knowledge, strengthen practical experience and encourage creativity and independent work. The student submits a written report for grading in content, and also makes an oral presentation before a panel of examiners for assessment in technical presentation.