UNIVERSITY OF ILORIN, NIGERIA

FACULTY OF ENGINEERING AND TECHNOLOGY

B.Eng. Agricultural and Biosystems Engineering

The Core Curriculum and Minimum Academic Standards for the Nigerian University System (CCMAS)

STUDENTS' HANDBOOK (UNDERGRADUATE)

2024

UNIVERSITY OF ILORIN, ILORIN, NIGERIA

BRIEF HISTORY

The University of Ilorin is one of the second-generation universities established by a Decree of the Federal Military Government in August 1975. It was initially an affiliated College of the University of Ibadan, known as the University College, Ilorin and attained full autonomous status as University in October, 1977. The University, which started with three (3) Faculties has grown in leaps and bounds to attain its present expansion to sixteen (16) Faculties. Starting with 200 students, the University presently has a total number of 50,833 students. The University runs and awards certificates in the following programmes: Diploma, Undergraduate Degree, Postgraduate Diploma, and Postgraduate Degree. In addition, the University currently has a total number of 3,652 staff members (both academic and non-teaching). The University, as part of its prowess as a citadel of learning, has won to its credit, several medals and awards in both academic and extra-curricular activities, nationally and internationally. The University of Ilorin emerged as the overall best institution at the Fourth Edition (2021/2022 – 2022/2023) of the Joint Admissions and Matriculation Board (JAMB) **NATIONAL TERTIARY ADMISSION PERFORMANCE-MERIT AWARD (NATAP-M)**.

MISSION STATEMENT

To provide a world-class environment for learning, research, and community service.

VISION STATEMENT

To be an International Centre of Excellence in learning, research, probity, and service to humanity.

MOTTO: Probitas Doctrina (Probity and Scholarship)

COLOURS: Deep Blue, Green, Golden, and White

MASCOT: Eagle Wide Span

PRINCIPAL OFFICERS OF THE UNIVERSITY

The Vice-Chancellor
Professor Wahab Olasupo Egbewole, *SAN*
LL.B (Hons) (Ile-Ife); B.L. (Lagos); LL.M (Ile-Ife); Ph.D. (Ilorin); *FCArb, Fspsp, fciml (USA), fnipr*

The Deputy Vice-Chancellor (Academic)
Professor Olubunmi Abayomi Omotesho
B.Sc., M.Sc., Ph.D. (Ibadan), *FNAE, FNAAE, fciml (USA)*

The Deputy Vice-Chancellor (Management Services)
Professor Sulaiman Folorunsho Ambali
DVM, M.Sc., Ph.D. (Zaria), *FSASS, FSEAN, fciml (USA)*

The Deputy Vice-Chancellor (Research, Technology & Innovation)
Professor Adegboyega Adisa Fawole
MB;BS (Ilorin), *FWACS, fciml* (USA)

The Registrar
Mr. Mansur Adeleke Alfanla
B.A. Comb. Hons. (Kano), LL.B. (Ilorin), B.L. (Abuja), LL.M. (Ilorin), *fciml (USA)*

The Ag. Bursar
Mr. Oba Abdulbarki
B.Sc. (ABU, Zaria), ACA

The University Librarian
Professor Kamal Tunde Omopupa
B.A. (LS) (Kano), MILR (Ilorin), MLIS (Ibadan), Ph.D. (SA), *fciml (USA)*

FACULTY OF ENGINEERING AND TECHNOLOGY

Historical background

The Faculty of Engineering and Technology at the University of Ilorin was established in September 1978, with the primary objective of providing a robust institutional framework for training engineers capable of driving the technological development of Nigeria and the world. From its inception, the faculty has fostered a conducive environment for the education of undergraduate engineering students and has facilitated cutting-edge research activities among its academic staff. Over the years, the faculty has expanded its programs to include postgraduate training, offering master's and doctoral degrees in various engineering disciplines.

VISION STATEMENT

To be a world-class Engineering and Technological centre for innovations in learning, research, probity and service to humanity.

MISSION STATEMENT

To provide Engineering and Technological environment for learning, research and community service.

Departments and Growth

At its founding, the faculty started with three departments: Civil Engineering, Electrical Engineering, and Mechanical Engineering, alongside a Central Engineering Workshop, which was established in 1979 to provide hands-on training and practical experience to all engineering students. The faculty's academic and research programmes were designed to attract students with strong backgrounds in mathematics and physical sciences, with an emphasis on logical, imaginative, and creative problem-solving skills.

The faculty's commitment to academic excellence and research has led to the expansion of its programmes over the years. In 1982, the Department of Agricultural Engineering was established as the faculty's fourth department. Subsequent additions include:

- Department of Chemical Engineering (2008/2009)
- Department of Materials and Metallurgical Engineering (2010)
- Department of Water Resources and Environmental Engineering (2013)
- Department of Computer Engineering (2014)
- Department of Biomedical Engineering (2015)
- Department of Food Engineering (2014/2015)

As of the 2020/2021 academic session, the Faculty of Engineering and Technology had grown to host 3,351 undergraduate students across its ten departments. The faculty has been led by a series of distinguished Deans since its inception. Below is a list of the past and present Deans:

1. **Prof. V.O.S. Olunloyo** (Mechanical Engineering, 1978-1980)
2. **Prof. I.E. Owolabi** (Electrical and Electronics Engineering, 1980-1984)

3. **Prof. B.J. Olufeagba** (Electrical and Electronics Engineering, 1984-1988)
4. **Prof. S.O. Adeyemi** (Civil Engineering, 1988-1990)
5. **Prof. J.S.O. Adeniyi** (Mechanical Engineering, 1990-1994)
6. **Prof. F.L. Bello-Ochende** (Mechanical Engineering, 1994-1998)
7. **Prof. K.C. Oni** (Agricultural and Biosystems Engineering, 1998-2001)
8. **Prof. O.A. Adetifa** (Civil Engineering, 2001-2005)
9. **Prof. B.F. Sule** (Civil Engineering, 2005-2009)
10. **Prof. J.O. Olorunmaiye** (Mechanical Engineering, 2009-2013)
11. **Prof. Y.A. Jimoh** (Civil Engineering, 2013-2017)
12. **Prof. D.S. Ogunniyi** (Chemical Engineering, 2017-2021)
13. **Prof. O.A. Lasode** (Mechanical Engineering, 2021-2023)
14. **Prof. J.K. Odusote** (Materials and Metallurgical Engineering, 2023-present)

The faculty has also benefited from the support of dedicated administrative staff, including several Senior Registry staff who have served as Faculty Officers. These officers play a crucial role in facilitating the activities of students from admission to graduation and supporting staff from recruitment to retirement. Notable present Faculty Officers include Mrs. Docars D. Adu, M. L. Abiodun, A. B. Shuaib, O. Jolayemi, A. J. Anate, A. Bello, Hassana Adegbite, Dr. A. S. Alawaye, A. O. Shuaib, Grace A. Abajo, Mrs. Florence B. Adeniyi, Adetola Oluwakemi, J. K. Omotosho, Mrs. Nimotallahi Ismail, Lamidi Helen and A. M. Adisa who currently serves in the role. The Faculty of Engineering and Technology hosts an annual international conference known as the Faculty of Engineering and Technology International Conference (FETiCON). Additionally, the Faculty publishes the Nigerian Journal of Technological Development, a Q4 journal indexed in Scopus and Scimago, which highlights research and innovations in engineering and technology.

The Faculty of Engineering and Technology continues to strive towards improving the quality of education and research offered to its students. Through regular curriculum reviews and a focus on innovative research, the faculty aims to remain at the forefront of engineering education in Nigeria and beyond, contributing to both national development and the global engineering community.

DEPARTMENT OF AGRICULTURAL AND BIOSYSTEMS ENGINEERING

Historical background

The Department of Agricultural and Biosystems Engineering was established during the 1982/83 Session as the fourth department in the Faculty of Engineering and Technology (after Civil, Electrical and Mechanical Engineering Departments). The name was changed from Agricultural Engineering to Department of Agricultural and Biosystems Engineering in June 28, 2008 to accommodate current universal trends in the field of Agricultural Engineering. The department emphasizes the major areas of Agricultural Engineering: Power and Machinery Engineering, Soil and Water Engineering, Processing and Storage Engineering. The Structures and Environmental Engineering, Food and Bioprocess Engineering, and Aquacultural Engineering options are also being developed. The Department has continued to make progress in teaching and research. This is manifested in the quality of teaching and publications of the academic members of staff and notable contributions from the technologists and other members of staff.

MISSION STATEMENT

To produce globally competitive graduates equipped with skills and knowledge, fostering innovation and creativity in Agricultural and Biosystems Engineering.

VISION STATEMENT

To create an excellent learning environment where creative and innovative skills are nurtured to drive food security for national development.

Staff List of the Department

S/No.	Name	Rank	Qualifications	Area of Specialization
1	T. D. Akpenpuun	Reader	B.Sc., M.Sc., Ph.D. (Ibadan), R. Engr. (Nigeria)	Farm Structures Environmental Control and Environmental Engineering
2	A. O. Ogunlela	Professor	B.Sc (Ibadan), M.Sc (Iowa State), Ph.D (Oklahoma State), R.Engr. (Nigeria)	Soil and Water Engineering
3	C. J. Ejieji	Professor	B.Eng, M.Eng (UNN), Ph.D (New Castle), R.Engr. (Nigeria)	Soil and Water Engineering
4	J. O. Olaoye	Professor	B.Eng, M.Eng, Ph.D (Ilorin), R.Engr. (Nigeria)	Farm Power and Machinery
5	K. A. Adeniran	Professor	B.Sc, M.Sc, Ph.D (Ibadan), R.Engr. (Nigeria)	Soil and Water Engineering
6	K. O. Yusuf	Professor	BEng (Minna); MEng (Ilorin), Ph.D. (Ilorin), R.Engr. (Nigeria)	Soil and Water Engineering
7	Y. L. Shuaib Babata	Professor	BEng, MSc, (Ilorin); Ph.D. (MINNA), R.Engr. (Nigeria)	Casting technology, Corrosion, Materials Characterization, and Manufacturing

8	T. A. Ishola	Reader	B.Eng, M.Eng, Ph.D (Malaysia), R.Engr. (Nigeria)	Food Machine Design and Automation
9	E.O. Ajala	Reader	BTech, (Ogbomoso), MSc. (Ife), Ph.D. (Minna), R.Engr. (Nigeria)	Biochemical Engineering
10	J. A. Adeniran	Reader	BTech (Ogbomoso); MSc (Lagos); Ph.D. (Ogbomoso), R.Engr. (Nigeria)	Environmental Engineering, Climate Change
11	G. Adeniyi	Reader	BTech, MTech, Ph.D. (Ogbomoso), R.Engr. (Nigeria)	Process System Engineering, Process and Product Development
12	A. I. Abdullateef	Reader	BEng, (OSUA); MEng. (BENIN); Ph.D. (IIUM, Malaysia), R.Engr. (Nigeria)	Power Engineering
13	M. O. Iyanda	Senior Lecturer	B.Eng, M.Eng, Ph.D. (Ilorin), R. Engr. (Nigeria)	Farm Power and Machinery
14	M.S. Sanusi	Senior Lecturer	BTech (Ogbomoso), MSc, Ph.D. (Ibadan) R.Engr. (Nigeria)	Food Engineering and Product Development
15	O. S. Zakariyya	Senior Lecturer	BEng (Zaira); MSc (EMU, Famagusta, Cyprus); PhD (Zaira) R.Engr. (Nigeria)	Digital Image Processing
16	H. U. Hambali	Senior Lecturer	BEng (Maiduguri); MSc (Zaria); Ph.D. (UTM, Johor Bahru) R.Engr. (Nigeria)	Catalysis of Petrochemicals production and Wastewater treatment
17	Mary A. Ajala	Senior Lecturer	BTech; MTech; (Ogbomoso); Ph.D. (Minna) R.Engr. (Nigeria)	Environmental Engineering
18	B. Rabiu	Senior Lecturer	B.Eng (Kano), MEng, Ph.D. (Ilorin), R.Engr. (Nigeria)	Thermo-fluids Engineering
19	O. T. Popoola	Senior Lecturer	B.Eng (Kano), MEng, Ph.D. (Ilorin), R.Engr. (Nigeria)	Thermo-fluids Engineering and Computational Fluid Dynamics
20	B. Adelodun	Lecturer I	B.Eng, M.Eng (Ilorin), Ph.D (Daegu), R. Engr. (Nigeria)	Soil and Water Engineering
21	Zainab T. Yaqub	Lecturer I	BSc, (Lagos); MTech, (Johannesburg); Ph.D. (Johannesburg), R.Engr. (Nigeria)	Biochemical Engineering
22	M. A. Amoloye	Lecturer I	B. Eng (Bauchi); MTech (Ogbomoso); Ph.D. (Ilorin), R.Engr. (Nigeria)	Process System Engineering, Process and Product Development

23	I. N. Aremu	Lecturer I	MSc, (Ukraine), R.Engr. (Nigeria)	Iron and Steel Making, Materials Characterization
24	Y. O. Babatunde	Lecturer I	BEng, MEng. (Ilorin), Ph.D. (PAUSTI, Kenya), R.Engr. (Nigeria)	Structures
25	H. O. Sanusi	Lecturer II	B.Sc (OAU), M.Sc. (Ibadan), R. Engr. (Nigeria)	Crop Processing and Storage
LIST OF NON-ACADEMIC STAFF IN THE DEPARTMENT				
26	Victoria O. Adeyinka-Ajiboye	Principal Technologist	PGD (Akure) Agric Engineering -HND (Agric Engineering), R.Engr. (Nigeria)	Crop Processing and Storage
27	E. O. Dada	Workshop superintendent	GTC, First Leaving School Certificate, Trade Test I, Test II, Test III	Fabrication
28	Shuaib, Jimoh	Senior Driver Mechanic I	GTC, First Leaving School Certificate, Trade Test I, Test II, Test III	Shuaib, Jimoh
29	A. A. Ibraheem	Laboratory Assistant	B.Sc (Ilorin)	A. Ibraheem
30	S. O. Salami	ND	Executive Officer	S. O. Salami
31	J. Abdullahi	First School Leaving Certificate	Caretaker	J. Abdullahi

B. Eng. Agricultural and Biosystems Engineering

Overview

This new Agricultural and Biosystems engineering curriculum contain courses that will produce Agricultural and Biosystems Engineers that will be globally competitive in a world that is nowdictated by a knowledge-based economy. The desired and required competences in biologicalsystems, process instrumentation and control, application of robots and drones to agriculture,irrigation and drainage, machine development, renewable energy and food process systemsare supported by this new curriculum. The curriculum emphasises courses such as artificial intelligence, machine learning, renewable energy technologies, drone and robot technologies,project management, software engineering and design of machines and structural elements. Other courses include livestock production, aquaculture and, agroponic, instrumentation and measurement, greenhouse technology, biosystems engineering, solid modelling and environmental and social impact analysis. Agricultural and Biosystems Engineers will now have the skills to be gainfully employed as Design Engineers, Test Engineers, Product Engineers,Quality Control Engineers, Energy Engineers and Advisors, Machinery Maintenance Engineers, Waste Management Engineers, Diary Engineers, and Irrigation and Drainage Engineers. Thenew curriculum compares well with those of top global agricultural and biosystems engineering institutions. The synopsis of each of these courses have been made elaborate with indicatedlearning outcomes. In all, the new features of agricultural engineering and its transition to biosystems engineering are captured in this curriculum.

The major areas of Agricultural and Biosystems Engineering are:

1. farm power and machinery engineering;
2. soil and water resources engineering;
3. crop processing, storage and agro-industrial engineering;
4. farm structures, rural electrification and environmental control engineering;
5. forestry and wood products engineering; and
6. food process engineering.

It is pertinent to make a clarification. Global development in recent years have seen the adoption of various nomenclatures, world-wide, to define and describe the old Agricultural Engineering Programme. These include Agricultural and Biosystems, Agricultural and Environmental, Agricultural and Bioresources, Agricultural and Biological, Bioresources and Biological Engineering. The revised curriculum here applies to all these variants and is precisely adopting the name 'Agricultural and Biosystems Engineering (ABE)". This new Core Curriculum and Minimum Academic Standards (CCMAS) is a product of wide consultation with the agricultural engineering community (academic and field Agricultural Engineers) through theNigerian Institution of Agricultural Engineers (NIAE), comparison with top universities of the world, alignment with the Council for the Regulation of Engineering (COREN) curriculum and the National Universities Commission (NUC) guidelines

Philosophy

Agricultural and Biosystems engineering encompasses the application of all engineering knowledge to solving problems encountered in agricultural production, handling and processing of biological materials for food, feed, fibre and fuel. The programme is designedto prepare students for careers in machine systems: design and provision of power for agricultural machines including renewable energies and design of machines for crop and livestock production; processing systems for food, biofuels and other by-products: crop processing and storage and post-harvest handling; natural resources system: irrigation and drainage, erosion control and water conservation; environmental system: farm structures, waste remediation and farm electrification; biological system: sensors, controls and computer models to monitor biological processes and conversion of bio-based resources to food, fuel and others. It is thus very wide and all encompassing.

Objectives

The objectives of the programme are to train engineers that are equipped with appropriate knowledge and skills to play the following roles:

1. increase and sustain agricultural (crop and livestock), aquacultural and forest production;
2. maintain a high level of agricultural production without damage or distortion to theenvironment;
3. minimise the drudgery associated with agricultural production by use of appropriatemachinery;
4. improve rural infrastructures by providing desirable amenities for communities;
5. convert bio-based resources to food, fuel and other renewable products;
6. design new generation of devices or processes for agricultural and biological systems;
7. control agricultural and biological systems for natural resource protection, waste remediation and eco-system restoration;
8. develop sensors, control systems and computer models to monitor and control biologicalprocesses in industries or the environment; and
9. develop innovative green products and industries.

Employability Skills

This curriculum emphasises skills that can gainfully employ Agricultural and Biosystems Engineers in all agricultural, biosystems, environmental, rural and industrial environments asDesign Engineers, Test Engineers, Product Engineers, Plant Engineers, Quality Control Engineers, Process Engineers, Energy Engineers and Advisers, Consulting Engineers and Environmental Engineers. They can also be employed as Irrigation and Drainage Engineers, Waste Management Engineers, Machinery Maintenance Engineers and Dairy Engineers among others.

In addition to competence and savviness in problem-solving technical, technological and modern digital skills, the programme equips the students with appropriate cognitive, critical analytical and innovative skills, emotional and behavioural skills including communication, interpersonal, continuous and life-long learning capabilities that will make them to be conscious of their importance, and the need for sustainability in relation to the consequences of their professional activities on the human environment and ecosystem.

21st Century Skills

A graduate of the Agricultural and Biosystems Engineering programme is expected to have ability to:

1. Collaboration (teamwork and ethics);
2. Citizenship (local and global);
3. Learning to learn/metacognition;
4. integrate knowledge of areas of mechanical, electrical, environmental and civil engineering, construction technology, hydraulics and soil mechanics in a variety of agricultural and biological applications;
5. problem solving/decision making/computational thinking;
6. proffer sustainable solutions for addressing society's challenges in agriculture, food, energy, water and other natural resources by applying acquired technical, creativity andinnovative thinking and modern digital skills, which they are able to communicate lucidly;and
7. create, select and apply appropriate techniques, resources and convergent technologies,including ICT tools, artificial intelligence, machine learning, robotics, modelling, cognitivescience, biotechnology, genetic engineering, nanotechnology, GIS and optimisation to agricultural, food, energy and water problems.
8. manage resources well.

Unique Features of the Programme

1. This programme compared to that of the North Dakota State University, USA, McGill University, Canada and Auburn University, Alabama, USA showed close similarity; mostof the courses in the new curriculum are also offered in at least one of the world's top universities, and in some cases in three of these universities.
2. This new programme has courses that support emerging engineering practices in agriculture such as the use of drones and robots, the overriding intervention of renewable energy in agriculture, the engineering of livestock and fisheries, need to deepen the design thinking and creative skills of students and the gradual shift from agricultural engineering to biosystems engineering as well as reflecting the impact of climate change on agricultural technology applications. Some of these courses are:

   ABE 102: Introduction to Agricultural and Biosystems Engineering (2) units

   GET 102: Engineering Graphics and Solid Modelling (2) units

   GET 306: Renewable Energy Systems and Technology (3) units

   GET 307: Introduction to Artificial Intelligence, Machine Learning and ConvergentTechnologies (3) units

   ABE 307: Biosystems Engineering (2) units

   ABE 401: Instrumentation and Measurement in Agricultural and Biosystems EngineeringABE 501: Environmental and Social Impact Analyses (2) units

   ABE 502: Aquaculture and Agroponics Engineering (2) units

   ABE 503: Livestock Production Engineering (2) units

   ABE 504: Greenhouse Technology (2) units

   ABE 505: Drone and Robot Technology in Agriculture (2) units

3. The synopsis of most of the courses have been enriched to reflect the current practices of agricultural engineering.
4. The synopsis of the programme-based courses indicates the relevant excursion, laboratory and field practical to be undertaken by students.
5. The learning outcomes of each course is contained in this curriculum.

Admission and Graduation Requirements
Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree programme, in addition to acceptable passes in the Unified TertiaryMatriculation Examination (UTME), the minimum admission requirement is credit level passesin Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes which must include English Language, Mathematics, Physics and Chemistry, candidates with at least two passes in relevant subjects (Mathematics, Physics and Chemistry) at the GCE Advanced Level or IJMB or JUPEB may be considered for admission. Candidates who have good National Diploma (ND) result in relevant Engineering Technology programmes may alsobe considered for admission into 200 level. Holders of upper credit pass and above at HigherNational Diploma (HND) level, are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5-year engineering degree programme.Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode at 200 level, shall register for a minimum of 120 and a maximum of 150 units of courses during a 4-year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters.
3. Candidates admitted through the Direct Entry mode at 300 Level shall have registered

for a minimum of 90 and a maximum of 120 units of courses during a 3-year engineering degree programme. Such candidates shall have spent a minimum of 6 academicsemesters.

4. HND holders who enter as Direct Entry candidates at 300 level shall register for a minimum of 90 units of courses and a maximum of 120 units of courses.
5. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
6. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
7. A student shall also have earned the 11 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and 4 credit units ofEntrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered,whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing itor substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students who entered at 200 Level and 11 semesters in the case of students who entered at 300 Level.

Global Course Structure

Level	GST	ENT	Basic Sciences	Faculty (GET)	Programme (ABE)	SIWES & Engineering Valuation	Total
100	4	0	25	3	2	0	34
200	2	2	0	35	0	3	42
300	2	2	0	18	18	4	44
400	-	0	0	4	2	6	12
500	-	0	0	5	14	0	19
Total	**8**	**4**	**25**	**65**	**36**	**13**	**151**

*9 Credit units of GST 111 (2), GST 112 (2), GET 101 (1), GET 102 (2) and ABE 102 (2) will be used for final year result computation out of 34 credit units.

100 level

Course Code	Course title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian People and Culture	2	C	30	-
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 103	General Physics III	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
GET 101	Engineer in Society	1	C	15	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
ABE 102	Introduction to Agricultural and BiosystemEngineering	2	C	30	-

PHY 102	General Physics II	2	C	30	
PHY 104	General Physics IV	2	C	30	
MTH 103	Elementary Mathematics III	2	C	30	
STA 112	Probability I	3	C	45	
Total		**34**			

200 Level

Course Code	**Course title**	**Units**	**Status**	**L H**	**PH**
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 202	Engineering Materials	3	C	45	-
GET 204	Students Workshop Practice	2	C	15	45
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	45	-

*GET 299	SIWES I	3	C	9 Weeks	
GET 203	Engineering Graphics and Solid Modelling	3	E	15	90
EEE 202	Applied Electricity II	3	E	45	-
GET 207	Applied Mechanics	3	E	45	-
GET 208	Strength of Materials	3	R	45	-
Total		**42**			

300 Level

Course Code	**Course title**	**Units**	**Status**	**LH**	**PH**
ABE 301	Design of Machine and Structural Elements	2	C	15	45
ABE 302	Animal Production	2	C	30	-
ABE 303	Crop Production	2	C	30	-
ABE 304	Farm Management, Rural Sociology andAgricultural Extension	2	C	30	-
ABE 305	Soil Science	2	C	30	-
ABE 306	Land Surveying and Geographic Information System	2	C	15	45
ABE 307	Biosystems Engineering	2	C	30	-
ABE 308	Rural Infrastructural Engineering	2	E	30	-

GET 304	Technical Writing and Communication	3	C	45	-
GET 305	Engineering Statistics and Data Analysis	3	C	45	-
GET 306	Renewable Energy Systems and Technologies	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
*GET 399	SIWES II	4	C	12 weeks	
GST 312	Peace and Conflict Resolution	2	C	30	
ENT 312	Venture Creation	2	C	15	
GET 311	Engineering Economics	3	C	30	-
GET 302	Engineering Mathematic IV	3	E	45	-
Course code	**Course title**	**Units**	**Status**	**LH**	**PH**
UIL-ABE 314	Agricultural Power and Machinery	2	C	30	-
Total		**44**			

400 Level

Course Code	**Course title**	**Units**	**Status**	**LH**	**PH**
ABE 401	Instrumentation and Measurement in Agricultural and Biosystems Engineering	2	C	15	45

GET 402	Engineering Project I	2	C		90
GET 404	Engineering Valuation and Costing	2	C	30	
*GET 499	SIWES III	4	C	-	12 weeks
CEE 305	Soil Mechanics I	2	E	30	45
Course code	**Course title**	**Units**	**Status**	**LH**	**PH**
UIL-ABE 409	Agricultural Mechanization	2	C	30	-
UIL-ABE 413	Design of Agricultural Machinery	3	C	45	-
UIL-ABE 415	Operation and Management of Agricultural Power and Machinery Systems	2	C	30	-
UIL-ABE 417	Agricultural Structures and Environmental Control	3	C	45	-
UIL-ABE 421	Irrigation and Drainage	3	C	45	-
UIL-ABE 423	Agricultural and Biosystems Hydrology	3	C	45	-
Total		**28**			

SIWES courses and Engineering valuation*

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 299	SIWES I	3	C	9 weeks	
GET 399	SIWES II	4	C	12 weeks	

GET 499	SIWES III	4	C	12 weeks	
GET 404	Engineering Valuation	2	C	6 weeks	
	Total	**13***			

* All credited in the 2nd Semester of 400-Level

500 Level

Course Code	**Course title**	**Units**	**Status**	**LH**	**PH**
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
ABE 501	Environmental and Social ImpactAnalysis	2	C	30	-
ABE 502	Aquaculture and Agroponics Engineering	2	C	30	-
ABE 503	Livestock Production Engineering	2	C	30	-
ABE 504	Greenhouse Technology	2	C	30	-
ABE 505	Drone and Robot Technology inAgriculture	2	C	15	45
ABE 599	Final Year Project	4	C	-	180

Course code	**Course title**	**Units**	**Status**	**LH**	**PH**
UIL-ABE 506	Agricultural Land Clearing	2	C	30	-

UIL-ABE 507	Application of Electricity to Agricultural and Biological Systems	2	C	30	-
UIL-ABE 509	Food and Agricultural Biotechnology	2	C	30	-
UIL-ABE 511	Transportation System for Agricultural and Rural Development	2	C	30	-
UIL-ABE 528	Soil and Water Conservation	3	C	45	-
UIL-ABE 533	Engineering Properties of Agricultural and Biological Materials	2	C	30	-
UIL-ABE 534	Application of Solar Energy to Agricultural and Biological Systems	2	C	30	-
UIL-ABE 598	Final Year Project II	4	C	225	-
Total		**38**			

Specialization Courses					
Farm Power and Machinery Engineering Option					
UIL-ABE 513	Automation of Agricultural & Biosystems	2	E	45	-
UIL-ABE 514	Agricultural Power	2	E	45	-
UIL-ABE 516	Agricultural Machinery	2	E	30	-
UIL-ABE 535	Handling of Agricultural and Biological Materials	2	E	30	-
	Total	**8**			
Soil and Water Engineering Option					
UIL-ABE 522	Agricultural Land Drainage	2	E	45	-
UIL-ABE 523	Rural Water Supply and Sanitation	2	E	45	
UIL-ABE 524	Advanced Irrigation Engineering	2	E	30	-
UIL-ABE 527	Advanced Hydraulic Engineering	2	E	30	-
	Total	**8**			
Processing and Storage Engineering Option					
UIL-ABE 535	Handling of Agricultural and Biological Materials	2	E	30	-

UIL-ABE 536	Processing of Agricultural and Biological Materials	2	E	30	-
UIL-ABE 537	Bioprocess Engineering	2	E	30	-
UIL-ABE 538	Storage of Agricultural and Biological Materials	2	E	30	-
	Total	**8**			
Structures and Environmental Engineering Option					
UIL-ABE 537	Bioprocess Engineering	2	E	30	-
UIL-ABE 541	Renewable Energy Engineering	2	E	30	-
UIL-ABE 542	Waste Management Engineering	2	E	30	-
UIL-ABE 544	Bioenvironmental Engineering	2	E	30	-
	Total	**8**			
Food and Bioprocess Engineering Option					
UIL-ABE 535	Handling of Agricultural and Biological Materials	2	E	30	-
UIL-ABE 537	Bioprocess Engineering	2	E	30	-
UIL-ABE 552	Fundamental of Food Engineering I	2	E	30	-
UIL-ABE 554	Fundamental of Food Engineering II	2	E	30	-

	Total	**8**			
Aquacultural Engineering Option					
UIL-ABE 537	Bioprocess Engineering	2	E	30	-
UIL-ABE 541	Renewable Energy Engineering	2	E	30	-
UIL-ABE 562	Basic Aquacultural Technology	2	E	30	
UIL-ABE 564	Aquacultural and Animal Production Engineering	2	E	30	
	Total	**8**			

Summary of the credit units required per option

S/No.	Options	Levels					
		100	**200**	**300**	**400**	**500**	**Total**
1	Farm Power and Machinery	-	-	2	16	27	45
2	Soil and Water Engineering	-	-	2	16	27	45
3	Processing and Storage Engineering	-	-	2	16	27	45
4	Structures and Environmental Engineering	-	-	2	16	27	45
5	Food and Bioprocess Engineering	-	-	2	16	27	45
6	Aquacultural Engineering	-	-	2	16	27	45

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)
Learning Outcomes
At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents
Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining), writing (paragraphing, punctuation and expression), post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)
Learning Outcomes
At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation tonational development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents
Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a

politicalunit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (militaryintervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self- reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related socialvices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes

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

1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements,based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using Le Chatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II (2 Units C: LH 30)

Learning Outcomes

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

1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory inorganic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry ofgroup IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I (1 Unit C: PH 45)

Learning Outcomes

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

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetricanalysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes

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

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;

4. identify and carry out preliminary tests which include ignition, boiling point, melting point,test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds whichcould be acidic/basic/ neutral organic compounds.

Course Contents
Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry)
(2 Units C: LH 30)

Learning Outcomes
At the end of the course students should be able to:
1. define and explain set, subset, union, intersection, complements, and demonstrate theuse of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents
Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)
Learning Outcomes
At the end of the course, students should be able to:
1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits andcontinuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents
Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve

sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

MTH 103: Elementary Mathematics III (Vectors, Geometry and Dynamics) (2 Units C: LH 30)

Learning Outcomes

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

1. solve some vectors in addition and multiplication;
2. calculate force and momentum; and
3. solve differentiation and integration of vectors.

Course Contents

(Pre-requisite –MTH 101)

Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional co-ordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws ofmechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving orrotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects movingunder gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames,impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservationof angular momentum; circular motion; moments of inertia, gyroscopes and

precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

2. explain the concepts of heat and temperature and relate the temperature scales;
3. define, derive and apply the fundamental thermodynamic relations to thermal systems;
4. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
5. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
6. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
7. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 103: General Physics III (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept ofentropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopicbehaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermalequilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecularcollisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 104: General Physics IV (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. describe and quantitatively analyse the behaviour of vibrating systems and wave energy;
2. explain the propagation and properties of waves in sound and light;
3. identify and apply the wave equations;
4. explain geometrical optics and principles of optical instruments.

Course Contents

Simple harmonic motion (SHM): energy in a vibrating system, Damped SHM, Q values and power response curves, forced SHM, resonance and transients, coupled SHM. Normal modes. Waves: types and properties of waves as applied to sound; Transverse and Longitudinal waves; Superposition, interference, diffraction, dispersion, polarisation. Waves at interfaces, Energy and power of waves, the 1-D wave equation, 2-D and 3-D wave equations, wave energy and power, phase and group velocities, echo, beats, the doppler effect, propagation of sound in gases, solids and liquids and their properties. Optics: Nature and propagation of light; reflection, refraction, and internal reflection, dispersion, scattering of light, reflection and refraction at plane and spherical surfaces, thin lenses and optical instruments, wave nature of light; Huygens's principle, interference and diffraction.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies ofmeters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasisshould be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes

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

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists,technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineeringprofession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineeringliteracy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I

(2 Units C: LH 15; PH 45)

Learning Outcomes

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

1. have a good grasp of design thinking and be obsessed with the determination to applysuch to solving simple every day and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, andput such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive andsubtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical andother parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents
Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation andsolid modelling in design, prototyping and product-making. User interfaces in concrete terms.Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering.This course will use latest professional design tools such as fusion 360, solid works, solid edgeor equivalent.

ABE 102: Introduction to Agricultural and Biosystems Engineering
(2 Units C: LH 30)

Learning Outcomes
The course exposes fresh students to:
1. the contents of agricultural and biosystems engineering;
2. the diverse role and relevance of the agricultural engineering profession;
3. the career opportunities; and
4. appreciate the strategic importance of agricultural engineering in supporting andsustaining agricultural production.

Course Contents
Philosophy and evolution of agricultural and biosystems engineering. The role of Agricultural and Biosystems Engineers in the society and human development. The relationship betweenagricultural and biosystems engineering and the other engineering disciplines. Significance ofagricultural and biosystems engineering. Introduction to agricultural and biosystems engineering: farm power and machinery engineering; soil and water engineering; crop processing and storage engineering; farm structures and environment engineering; biosystems engineering. ABE and sustainable development. The global development goals (SDGs). Climate change impacts on agriculture, adaptation and mitigation measures; Climatesmart agriculture. Career opportunities in agricultural and biosystems engineering.

STA 112: Probability I (3 Units C: LH 45)
Learning Outcomes
At the end of the course students should be able to
1. explain the differences between permutation and combination;
2. explain the concept of random variables and relate it to probability and distribution functions;
3. describe the basic distribution functions; and
4. explain the concept of exploratory data analysis.

Course Contents
Permutation and combination. Concepts and principles of probability. Random variables. Probability and distribution functions. Basic distributions: Binomial, geometric, Poisson, normal and sampling distributions; exploratory data analysis.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

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

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophicaldiscourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existentialconditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas ofknowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy andlogic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as anindispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules ofinference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creativeand critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

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

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunityseeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employmentgeneration and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, includingbusiness planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world;and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and

creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, naturaland nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge andinnovation). Enterprise formation, partnership and networking (basics of business plan, formsof business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I (3 Units C: LH 30; PH 45)

Learning Outcomes

Students will be able to:

1. discuss the fundamental concepts of electricity and electrical direct current (dc) circuits;
2. state, explain and apply the basic dc circuit theorems;
3. explain the basic alternating current (ac) circuit theory and
4. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex *j* - notation, AC circuits, impedance, admittance, susceptance.

GET 202: Engineering Materials (3 Units C: LH 45)

Learning Outcomes

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

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbersand how the electrons are arranged in different atomic elements, and explain the role ofelectronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer,mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramicsin mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials,demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;

6. define properties, types and application of composite materials and fibres (synthetic andnatural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising,galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineeringmaterials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples,phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wetchemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography andfractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test, impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

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

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;

5. connect electric circuits, understand different wiring schemes, and check ratings ofcommon household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energyconservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-onexperience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice. Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes (welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines. Supervised identification, use and care of various electrical and electronic components suchas resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservationprinciples.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes

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

1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various pipe fittings (valves, orifices, bends and elbows) on fluidflow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs, etc;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications

Course Contents

Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 206: Fundamentals of Engineering Thermodynamics

3 Units C: LH 45)

Learning Outcomes

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

1. describe basic concepts of thermodynamics, i.e., quantitative relations of Zeroth, first, second and third laws;

2. define and explain system, surrounding, closed and open system, control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour usingproperty diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change inenergy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flowopen system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigeratorsand heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and thirdlaws of thermodynamics). Properties of pure substances: the two-property rule (P-V-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. Thesteady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 209: Engineering Mathematics I (3 Units C: LH 45)

Learning Outcomes

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

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and

volumeof engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;

5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as Fourier series, initial conditions and itsapplications to different engineering processes

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vectorcalculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes

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

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types; 3. numerically solve differential equations using MATLAB and other emerging applications;
3. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
4. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
5. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
6. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)
Learning Outcomes
At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with aspecific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and designsimulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevantto engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employableby means of short Internet courses in specific areas.

Course Contents
Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representationof non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators' precedence; componentsof computer programs; introduction to object oriented, structured and visual programming;use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)
Learning Outcomes
SIWES I should provide opportunity for the students to:

1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter- personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) oftheir practical experiences.

Course Contents
Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment,

productionof simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

GET 203: Engineering Graphics and Solid Modeling II (3 Units C: LH 30; PH 45)
Learning Outcomes
Students should be able to:
1. apply mastery of the use of projections to prepare detailed working drawing of objects and designs;
2. identify skills in parametric design to aid their ability to see design in the optimal specification of materials and systems to meet needs;
3. be able to analyze and optimize designs on the basis of strength and material minimization;
4. get their appetites wetted in seeing the need for the theoretical perspectives that create the basis for the analysis that are possible in design and optimization, and recognize/understand the practical link to excite their creativity and ability to innovate; and
5. be able to translate their thoughts and excitements to produce shop drawings for multi-physical, multidisciplinary design.

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

EEE 202: Applied Electricity II (3 Units C: LH 45)
Learning outcomes
Students will be able to:
1. differentiate between various d.c. and a.c. machines;
2. explain the principles of operation of machines;
3. explain the operation of basic semiconductor devices and their basic applications; and
4. explain the principle of operation of communication systems with examples.

Course contents
Basic machines – DC, synchronous alternators, transformers, equivalent circuits. Three-phase balanced circuits, PN junction diode, BJTs, FETs, thyristors, communications fundamentals, introduction of TV, Radio, Telephone systems.

GET 207: Applied Mechanics (3 Units C: LH 45)

Learning Outcomes

Students will acquire the ability to:

1. explain the fundamental principles of applied mechanics, particularly equilibrium analysis, friction, kinematics and momentum;
2. identify, formulate, and solve complex engineering problems by applying principles of engineering, science, mathematics and applied mechanics;
3. 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; and
4. apply 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

Forces, moments, couples. Equilibrium of simple structures and machine parts. Friction. First and second moments of area; centroids. Kinematics of particles and rigid bodies in plane motion. Newton's laws of motion. Kinetic energy and momentum analyse.

GET 208: Strength of Materials (3 Units C: LH 45)

Learning Outcomes

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

1. recognise 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; and
8. determine the buckling loads of columns under various fixity conditions at the ends.

Course Contents

Consideration of equilibrium; composite members, stress-strain relation. Generalised 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.

300 level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes

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

1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;

4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peacebuilding.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realisttheory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes,ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and landdisputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents ofconflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue, arbitration, negotiation, collaboration). The roles of international organizations in conflict resolution (a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post- conflict situations/crises: Refugees. Internally Displaced Persons (IDPs); the role of NGOs inpost-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographicallocation;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture

capital, equity finance, micro-finance, personal savings, small business investment organizations andbusiness plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI),virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

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

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language inengineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles,referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active andpassive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracyof technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writingskills (steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles ofcorrespondences – business report and proposal, business letter, memorandum, e-mails, etc.Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports (competency, major steps, components and formats of research reports andpublishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids andpracticing of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation ofreports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

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

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps themto see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements ofconventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays indata analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme- relevant industrial engineering systems, and evaluate the accuracy of the measurementsundertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, Poisson hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family.Statistical modelling and inference in R.

GET 306: Renewable Energy Systems and Technologies (3 Units C: LH 30; PH 45)

Learning Outcomes

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

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such ascoal, petroleum and natural gas, and discuss the sources, technology and contribution tofuture energy demands of renewable energy.

Course Contents
Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regionaland global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Content: Simple measurement of solar radiation, bomb calorimeter determinationof calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oilinto biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes
At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergenttechnologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervisedlearning;
4. demonstrate proficiency in machine learning workflow and how to implement the stepseffectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise witha data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents
Concepts of human and artificial intelligence; artificial/computational intelligence paradigms;search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems;

understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logicfoundations of AI; expert systems, automated reasoning and pattern recognition; distributedsystems; data and information security; intelligent web technologies; convergent technologies– definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 311: Engineering Economics (3 Units; C; LH = 45)

Learning Outcomes

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

Course Contents

This course introduces students to the fundamental principles and basic concepts of engineering economics as they relate to potential investment opportunities and their profitability by considering the time value of money. The peculiarity of the engineering economy with respect to various economic concepts are highlighted in the course. Engineering economics as a course will equip students with overview knowledge of the relevant principles and basic concepts of engineering economics, engineering economic decisions, interest formulae and economic equivalence, and standard cash flows; among others. Also, it will equip students with the ability to apply the fundamentals and principles of economic evaluation and comparison of alternatives.

GET 302: Engineering Mathematics IV (3 Units C: LH 45)

Learning Outcomes

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

1. solve second order differential equations;
2. solve partial differential equations;
3. solve linear integral equations;
4. relate integral transforms to solution of differential and integral equations;
5. explain and apply interpolation formulas; and
6. apply Runge-Kutta and other similar methods in solving ODE and PDEs.

Course Contents

Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturn-Louville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. RungeKutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

ABE 301: Design of Machine and Structural Elements
(2 Units C: LH 15; PH 45)

Learning Outcomes

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

1. Explain the theories of failure of machine components;
2. Analyse the loads on machine and structural elements;
3. Apply shear force, bending moment, torsion, bending stresses in designing machineand structural elements;
4. Design machine components such as belt drives, shafts, chain drives, gears;
5. Design beams and columns;
6. Select fasteners such as nut and bolts, studs, bearings, etc. in designing machines; and
7. Use computer software and empirical methods in designing machine and structuralelement

Course Contents

Design of machine elements: Theories of failure. Design of shafts, belt and pulley drives, gears, sprockets, bolts and nuts, keys and keyways; selection of bearings. Practical session: Use of computer software in machine design. Design of structural elements: Definitions. Hooke's law. Stress and strain due to loading. Torsion of circular members. Shear force. Bending moment and bending stresses in beamswith symmetrical and combined loadings. Stress and strain transformation equations. Mohrcycle. Elastic buckling of columns. Design of beams using empirical methods and computersoftware. Design of columns using empirical methods and computer software. Group designassignment of machine or structural elements or complete system.

ABE 302: Animal Production (2 Units C: LH 30)

Learning Outcomes

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

1. appreciate the basic science of animal production;
2. apply various engineering interventions in livestock housing, waste management, diaryproduction; and
3. implement mechanization strategies in livestock production

Course Contents

Types of livestock (for eggs, milk, meat, wool, etc). distribution of livestock in Nigeria.Livestock housing. Livestock processing equipment.

ABE 303: Crop Production (2 Units C: LH 15; PH 45)

Learning Outcomes

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

1. Appreciate the various farming systems in agriculture with emphasis on Nigerian smallfarm holding including the impact of climate change;
2. Describe the various farm machinery used in crop production;
3. Implement mechanical operations in crop production;
4. Establish small, medium and large-scale mechanize farms;
5. Undertake the application of fertilizer types for different crops;
6. Plan and implement irrigated agriculture; and
7. Undertake some post-harvest crop processing activities.

Course Contents
Classification and ecology of crops in Nigeria. Nutrient requirements and mineral nutrition of plants. Manures and fertilizers. Plant growth and development. Growth stages. Tillage and weed control. Other cultural practices. Cropping sequences and rotation. Farming systems. Production practices for specified crops. Conservation agriculture and sustainability in tropical agriculture.

ABE 304: Farm Management, Rural Sociology and Agricultural Extension
(2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. Apply extension strategies to adopt technologies on Nigerian small rural farms from theunderstanding of rural sociology;
2. Apply appropriate financial system to account for farm activities with a view to practicingprofitable agriculture; and
3. Take decisions appropriate to a farm establishment on staffing and machinery inputs.

Course Contents
Management decision making. Functions of management planning, organisation, staffing,directing and controlling. Financial management. Principles of extension: diffusion, adoption and rejection of innovations. Communication and leadership in agricultural extension.

ABE 305: Soil Science (2 Units C: LH 30)
Learning Outcomes
After taking this course, this course, the students should be able to:
1. apply the knowledge acquired in soil pedagogy, nutrient and nutrient exchange tomanaging soil fertility;
2. apply the different fertilizer types (organic and inorganic) appropriately to different soiltypes;
3. explain and describe the paedology, mineralogy and classification of soils;
4. undertake soil survey and mapping; and
5. manage soils for agricultural production.

Course Contents
Origin and formation of soils. Physical properties of soils. Basic concept of soil paedology.Soil colloids; soil reaction; soil mineralogy. Soil organic matter. Soil survey and mapping. Soil classification. Soil fertility and fertilizers. Particle size distribution analysis/sieve analysis. Properties and management of Nigerian soils.

ABE 306: Land Surveying and Geographical Information System
(2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. Undertake cadastral, levelling and topographic surveys essential for anti-soil erosionintervention;

2. Conduct levelling survey for road construction and farmstead planning; and
3. Use GIS to do contour mapping for contour farming and reclamation of gullies.

Course Contents
Definitions. Measurement of distances. Ise of minor instruments. Random errors. Chain surveying. Bearing of lines. Levelling. Topographic surveys. Traversing. Theodolite traversing. Plane table surveying. Triangulation. Land shaping and earthwork. Map reading.Photogrammetry. Aerial photography. Geographical Information System.

ABE 307: Biosystems Engineering (2 Units C: LH 30)
Learning Outcomes
Upon completing this course, students will be able to:
1. appreciate biological engineering processes;
2. analyse biosystems such as waste treatment systems;
3. design the various gadgets involved in unit operations in biological processes such asbio-reactors;
4. develop biosystems for energy production, municipal waste treatment; and
5. apply computer to biological systems.

Course Contents
Definitions. Modelling and design of fermentation systems. Microbial growth kinetics. Design of bio-reactors. Heat and mass transfer. Bioremediation of wastes. design of anaerobic andaerobic systems. Energy from biological systems. Monitoring and control of biological systems. Application of computer to biological processes.

ABE 308: Rural Infrastructural Engineering (2 Units C: LH 30)
Learning Outcomes
After taking this course, students should be able to:
1. Identify the various engineering infrastructures for a rural community;
2. Plan and design rural infrastructures such as roads, earth dams, electricity projects andirrigation projects; and
3. Develop and implement a rural water scheme.

Course Contents
Concept of integrated rural development (planning and implementation). Overview of theproblems of rural infrastructures. Review of agricultural construction survey. Rural road network. Rural road design, construction and maintenance; erosion of earth roads; minorroad crossing. Small scale irrigation; rural electricity; rural water supplies; rural sanitation. Practical contents: A levelling survey exercise for road construction. Excursion: Visit to anearth dam site and an irrigation project.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)
Learning Outcomes
At the end of the SIWES, students should be able to:
1. demonstrate proficiency in at least any three software in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on

YouTube)in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosencareers;
4. demonstrate proficiency in generating data from laboratory analysis and develop empiricalmodels;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers;
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarilylimited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engagedin the more advanced workshops, indoor software design training similar to what they will usein the industry and outdoor construction activities to sharpen their skills. The use of relevantanimation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, and wooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solid works: software capabilities, design methodologies and applications. Basics part modelling: sketching with Solid Works, building 3D components, using extrudedBose base · Basic assembly modelling, and solid Works drawing drafting. Top-down assemblytechnique exploded view, exploded line sketch. Introduction to PDMS 3D design software; auto CAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. Design of machine components;
b. Product design and innovation;
c. Part modelling and drafting in Solid Works; and
d. Technical report writing.

UIL-ABE 314: Agricultural Power and Machinery (2 Units C: LH =30)

Senate-approved relevance

Situated in the North-central region of Nigeria, the University of Ilorin benefits from a tranquil setting, providing an ideal environment for education and the training of students in agricultural

and biosystems engineering. The focus is on producing top-tier graduates with extensive knowledge in the design, construction, operation, and maintenance of irrigation systems, aiming to enhance agricultural productivity in the country. Aligned with the university's vision as a center of excellence in learning, research, and service, the course aims to cultivate highly skilled graduates in Agricultural and Biosystems Engineering. These professionals will be adept in the design, installation, operation, and maintenance of agricultural equipment, contributing significantly to the improvement of agricultural productivity across Nigeria.

Overview

Agricultural Power and Machinery is a course that exposes students to the principles, mechanics, and advanced technologies shaping modern agricultural systems. Covering the gamut from the selection and utilization of machinery to troubleshooting and innovation. Precision farming principles are integrated, emphasizing the synergy of cutting-edge machinery with efficient farming practices. Students acquire practical skills in safety protocols, risk management, and sustainable practices for machinery operations. The course also delves into economic analyses of machinery utilization, exploring the implications for the agricultural industry.

Objectives

The objectives of this course are to:

1. analyze the principles and mechanics of agricultural power systems and machinery;
2. evaluate the selection and utilization of machinery for diverse farming operations;
3. assess the impact of technological advancements on modern agricultural power systems;
4. examine the principles of precision farming and its integration with advanced machinery;
5. analyze and troubleshoot common issues in agricultural power systems;
6. evaluate the economic implications of machinery selection and utilization in agriculture;
7. analyze safety protocols and risk management strategies associated with agricultural machinery;
8. explore sustainable practices in agricultural machinery operations and maintenance;
9. investigate the role of data analytics and automation in optimizing agricultural machine performance;
10. assess the environmental impact of agricultural machinery usage and explore mitigation strategies.

Learning outcomes

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

1. demonstrate a comprehensive understanding of the principles and mechanics of agricultural power and machinery systems;
2. quantify and assess the selection and utilization of machinery for various farming operations by comparing the performance metrics of at least three (3) different types of machinery used in diverse agricultural tasks;
3. analyze the impact of technological advancements on the efficiency and effectiveness of modern agricultural power systems by quantifying the improvements in productivity and resource utilization achieved;
4. optimized farming practices by quantifying the increase in yield or reduction in resource usage achieved through the integration of precision farming techniques;
5. identify at least two (2) common issues in agricultural power;

6. evaluate the cost-benefit ratio of using two (2) different types of machinery for specific agricultural tasks;
7. implement safety protocols and apply risk management strategies associated with the operation of agricultural machinery;
8. quantify the reduction in resource consumption or environmental impact achieved through the adoption of sustainable agricultural practices;
9. utilize data analytics and automation technologies to optimize the performance of agricultural machines; and
10. assess the efficiency and environmental impact of three (3) different fuel sources used in agricultural machinery operations.

Course Contents
Principles and mechanics of agricultural power systems. Machinery selection and utilization in farming operations. Farm power sources. Farm tractor development and types. Crop production equipment: objectives, classifications, field performance evaluation. Selection and management of farm tractors and equipment. Adjustment, maintenance and repair of farm tractors and equipment. Precision farming and machinery integration. Troubleshooting in agricultural power systems. Economic implications of machinery selection. Safety protocols and risk management. Sustainable practices in machinery operations. Data analytics and automation in agricultural machinery. Design and improvement of agricultural machinery.

Minimum Academic Standards
As stated in 70% developed NUC CCMAS

400 level
GET 402 ENGINEERING Project I (2 Units: C: PH 90)
Learning Outcomes
At the end of this course, the students should be able to:

1. Complete the design phase of a complex engineering problem sourced from industry or community during the SIWES III programme.
2. Demonstrate the connection between engineering product-making and the theoreticalcourses they have learned following the applicable industry best practices.

Course Contents
In the second semester of the 400-level students, preferably in groups, work from the university on the identified industry or organization to tackle industry complex engineering problems. Theoretical issues may be provided by the department faculty or industry experts. During the vacation, students will now work full time with the organisation/industry on the project as part of the SIWES III. The students can also go beyond the department and engage in multidisciplinary undertakings. Literature survey, review of existing systems etc. must beachieved to a satisfactory extent.

GET 404 Engineering Valuation and Appraisal (2 Units: C; LH 30)
Learning Outcomes
At the end of this course, the students should be able to:

1. Identify at least three (3) objectives of engineering valuation work, valuer's primary dutyand responsibility and valuation terminologies.
2. Describe at least four (4) Valuer's obligation to his or her client, to other valuers, and to the society.
3. Demonstrate with example the engineering valuation methods, valuation standards, andpractices.
4. Prepare engineering valuation and appraisal reports and review
5. Discuss expert witnessing and ethics in valuation.
6. Determine price, cost, value, depreciation and obsolescence in real property, personalproperty, personal property, machinery and equipment, oil, gas, mines, and quarries valuation.

Course Content

Objectives of valuation work/ valuer's primary duty and responsibility. Valuer's obligation tohis or her client, to other valuers, and to the society. Valuation methods and practices. Valuation reports. Expert witnessing. Ethics in valuation. Valuation standards. Price, cost andvalue. Depreciation and obsolescence. Valuation terminology. Real asset valuation; personal asset valuation. Machinery and equipment valuation. Oil and gas facilities valuation. Mines and quarries valuation. Appraisal reporting and review.

ABE 401: Instrumentation and Measurement in Agricultural and Biosystems Engineering (2 Units C: LH 15; PH 45)

Learning Outcomes

This course will help students to:

1. identify the appropriate instruments for measuring parametres relevant to agricultural activities;
2. manage the acquisition, transmission, recording, analysing and computing of data; and
3. apply these instruments, particularly for research in agricultural and biosystemsengineering.

Course Contents

Motion, force, torque and shaft power, pressure and sound flux; humidity measurement; application of primary sensing element; data manipulation, computing and compensating devices; data transmission and recording.

GET 499: Students Industrial Work Experience III
(4 Units C: 12 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure toreal-life situations, including machines and equipment handling, professional workmethods and ethics, human relations, key performance assessment methods, and waysof safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work

and the environment seamlessly, and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their placeof engagement and the larger society and creatively device impactful solutions to them;and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (12 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Departmentfor overall assessment.

CEE 305: Soil Mechanics I (3 Units C: LH 30; PH 45)

Learning Outcomes

Upon the completion of the course, students should be capable of:

1. measuring soil properties in the laboratory;
2. interpreting and summarising the data;
3. classifying soils;
4. determining the optimum conditions for the compaction of soils and the ultimate amount achievable; and
5. estimating the settlement of soils due to compaction and consolidation.

Course Contents

Mineralogy of soils and soil structures. Formation of soils, soil classification, engineering properties of soils. Soil in water relationships - void ratio, porosity, specific gravity, permeability and other factors. Atterberg limits, particle size distribution, Shear strength of soils and Mohr's stress circle. Compaction and soil stabilisation, settlement, theory of consolidation. Laboratory work.

UIL-ABE 409: Agricultural Mechanization (2 Units; C; LH = 30)

Senate-approved relevance

Located in the north-central region of Nigeria, the University of Ilorin benefits from a serene environment, offering an ideal setting for education and the training of students in agricultural engineering. The focus is on producing top-tier graduates equipped with an in-depth knowledge of agricultural mechanization, including its principles and applications. Aligned with the university's vision as a center of excellence in learning, research, and service, the course aims to cultivate

highly skilled professionals in Agricultural Mechanization. Graduates will excel in the design, operation, and maintenance of agricultural machinery, contributing significantly to the advancement of mechanized agricultural practices and productivity in Nigeria.

Overview

Agricultural Mechanization is a course that explores the integration of machinery and technology in modern agricultural practices. Students will be exposed to the fundamental principles and applications of agricultural machinery, ranging from tractors to precision farming technologies. The course covers the entire spectrum of mechanized farming, emphasizing the role of machinery in enhancing efficiency, productivity, and sustainability in agriculture. Topics such as the selection, operation, and maintenance of agricultural machinery, as well as the integration of advanced technologies such as GPS and robotics will be taught.

Objectives

The objectives of this course are to:

1. analyze the fundamental principles and theories of agricultural mechanization,
2. evaluate the role of mechanized systems in increasing agricultural productivity,
3. describe power transmission drives such as belt drives, pulley, chain dives, universal joints, gears, bearings, clutches and Tractor power-take-off;
4. derive engine and tractor power estimation;
5. estimate cost of tractor and machine hourly use;
6. identify all types of maintenance repair works, maintenance manual, lubrication and safety measures;
7. calculate machine performance (efficiencies), field and material capacity and field efficiency;
8. assess the environmental implications of adopting mechanised farming practices;
9. develop skills in selecting, operating, and maintaining modern agricultural machinery; and
10. Evaluate the cost-benefit analysis of agricultural mechanisation.

Learning Outcomes

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

1. assess agricultural yield increase through at least two (2) mechanization techniques;
2. calculate at least five (5) economic benefits of mechanized farming practices;
3. identify at least four (4) methods through which agricultural machinery can on the environmental mitigated;
4. demonstrate safe operation of at least two (2) agricultural machinery;
5. utilize at least two (2) precision agriculture devices and techniques each for improved mechanized farming efficiency;
6. implement at least five (5) risk management protocols in mechanized agricultural settings;
7. analyze at least four (4) socio-cultural factors affecting the adoption mechanization;
8. optimize resource allocation in mechanized agricultural systems;
9. apply at least five (5) sustainable principles to enhance mechanized farming; and
10. enumerate at least five (5) gains from mechanized farming.

Course Contents

Introduction to agricultural mechanization (significance, evolution). Principles of agricultural machinery operation and design. Economic impact analysis of mechanization (cost-benefit, ROI,

financial planning). Environmental considerations in mechanized farming (ecological footprint, soil health). Sustainable practices in mechanized agriculture. Operation and maintenance procedures for agricultural machinery. Integration of precision agriculture technologies (GPS, sensors, data analytics). Safety protocols for mechanized farming operations. Risk management strategies in agricultural mechanization. Socio-cultural dimensions influencing mechanization adoption. Advances in agricultural robotics and automation. Irrigation systems and water management in mechanized agriculture. Mechanized crop planting and harvesting techniques. Soil preparation and cultivation methods in mechanized farming. Post-harvest handling and processing technologies. Energy sources and efficiency in agricultural mechanization. Government policies and regulations impacting mechanized farming practices.

Minimum Academic Standards
As stated in 70% developed NUC CCMAS

UIL-ABE 413: Design of Agricultural Machinery (3 Units C: LH = 45)
Senate-approved relevance
The university's focus is to nurture graduates equipped with profound knowledge in the principles and applications of agricultural machinery design. In harmony with the university's vision as a center of excellence in learning, research, and service, the design of agricultural machinery course aims to foster highly skilled professionals in Agricultural Machinery Design. Graduates will excel in conceptualizing, developing, and maintaining innovative equipment, significantly contributing to advancements in agricultural technology and productivity across Nigeria.

Overview
This course will expose students to manufacturing processes and ergonomic factors, fostering the development of efficient, sustainable, and safe agricultural machinery designs. Students will acquire skills to optimize machinery performance and analyze the cost-benefit of agricultural machine design and deployment.

Objectives
The objectives of this course are to:
1. analyse the procedure of machine design and develop an ability to apply it for simple component design by using design data handbook;
2. differentiate between the various theories of failure applicable to the development and design of mechanical components;
3. estimate forces on transmission shaft and design transmission shafts;
4. evaluate the endurance strength and design components subjected to fluctuating loads;
5. calculate the forces in welds and riveted joints and formulate design solutions for weld and rivet sizing;
6. investigate forces on power screw and bolted joints and formulate design solutions for power screw and bolt sizing;
7. evaluate the static and dynamic forces for mechanical systems;
8. estimate the balancing of masses of rotating and reciprocating machine elements;
9. ability to select bearing types and sizes, and gear types and sizes; and
10. analyze and interpret design requirements for agricultural machinery components.

Learning Outcomes

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

1. apply engineering graphics and design procedures in agricultural machinery and processing industries;
2. apply knowledge of stress and strain to at least three (3) mechanical component analysis;
3. develop logical and analytical skills for applying failure theories in at least two (2) mechanical component design;
4. estimate endurance strength for ductile and brittle materials and apply fatigue theories;
5. analyze strength of welded and riveted joints under three (3) loading conditions;
6. design screw jacks and bolted joints considering two (2) stress scenarios;
7. perform accurate analysis and sizing of shafts in at least two (2) design processes;
8. select and analyze rolling element bearings for optimal performance;
9. enumerate at least three (3) gear types and size;
10. analyze and select at least three (3) materials for gear systems; and
11. perform analysis, selection, sizing, and design of at least two (2) mechanical components.

Course Contents

Introduction to agricultural machinery design principles. Factors influencing the design process (materials for construction, selection, strength, properties, stress analysis, and costing). Advanced design of machine elements. Practical application of machine fabrication techniques. Compliance with safety standards and protocols in design and operation. Techniques for optimizing machinery performance. Economic implications of machinery design. Assessment of environmental impacts. Exploration of innovative materials and manufacturing processes. Ergonomic factors in design. Proposal writing and project development in agricultural machinery design. Problems and prospects in agricultural machinery development. Evaluation of commercial manufacturing prospects in Nigeria. Practical training in digital design tools. IoT technologies in agricultural machinery design. Application of artificial intelligence in agricultural machinery design and operation.

Minimum Academic Standards
As stated in 70% developed NUC CCMAS

UIL-ABE 415: Operation and Management of Agricultural Power and Machinery Systems
(2 Units C: LH = 30)

Senate-approved relevance

This course is designed to provide students with a deep understanding of the fundamental principles, technologies, and practices involved in operating and managing modern agricultural machinery systems. Aligned with the university's commitment to excellence in learning, research, and service, the operation and management of agricultural power and machinery course encompasses a broad spectrum, including safety protocols, risk management, troubleshooting, economic analyses, precision farming principles, data analytics and sustainable practices. This course aims to equip graduates with the necessary skills to optimize machinery performance and contribute to the advancement of sustainable and efficient agricultural practices and capable of addressing contemporary challenges in the agricultural sector within the locality of the university and the country at large.

Overview

This course aims to expose students to the foundational principles in the realm of agricultural power systems and machinery. Covering aspects from selection and maintenance to the integration of technological advancements, with emphasis on safety protocols and risk management. Students will develop practical skills in troubleshooting common issues, optimize machinery performance, precision farming principles, data analytics and conducting economic analyses.

Objectives

The objectives of this course are to:

1. analyze the fundamental principles underlying the operation of agricultural power systems and machinery;
2. evaluate the selection, operation, and maintenance of diverse machinery for efficient farming practices.
3. assess the impact of technological advancements on modern agricultural power and machinery systems;
4. examine safety protocols and risk management strategies associated with the operation of agricultural machinery;
5. develop skills in analyzing and troubleshooting common issues in agricultural power systems and machinery;
6. evaluate the economic implications of machinery operation and management, considering cost-effectiveness and market trends;
7. analyze data analytics and automation technologies for optimizing the performance of agricultural machines;
8. explore sustainable practices in the operation and management of agricultural power systems and machinery;
9. investigate the role of precision farming principles in enhancing machinery efficiency and productivity; and
10. simulate the agricultural power systems and machinery using available software.

Learning Outcomes

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

1. enumerate at least four (4) fundamental principles in the operation of agricultural power systems and machinery;
2. identify at least five (5) machinery for diverse farming operations and also be able to select, operate, and maintain;
3. apply at least two (2) new technologies into agricultural power and machinery systems for enhanced functionality;
4. implement at least five (5) safety protocols and employ at least four (4) risk management strategies in the operation of agricultural machinery;
5. apply analytical skills to troubleshoot and resolve at least three (3) common issues in agricultural power systems and machinery;
6. analyses the cost-effectiveness and market trends to make informed decisions on machinery operation and management;
7. utilize data analytics and automation technologies to optimize the performance of at least three (3) agricultural machines;

8. implement at least three (3) sustainable practices of the operation and management of agricultural power systems and machinery;
9. incorporate precision farming principles to enhance machinery efficiency and productivity; and
10. enumerate at least five (5) the advantages and disadvantages of agricultural mechanisation.

Course Contents
Fundamental principles in agricultural power systems and machinery operation. Equipment selection, scheduling of operation, seasonality factor, machinery management for various farming operations. Safety protocols and risk management in machinery operation. Environmental considerations in agricultural machinery operation. Machinery ownership and financing. Gross margin analysis. Economic implications of machinery operation and management. Troubleshooting common issues in agricultural machinery. Data analytics and automation for optimizing agricultural machinery performance. Sustainable practices in operation and management. Human resource management in machinery systems. Optimization of machinery input combinations. Management of farm enterprise. Evaluation of the socio-economic impacts of agricultural power and machinery systems on rural communities.

Minimum Academic Standards
As stated in 70% developed NUC CCMAS

UIL-ABE 417: Agricultural Structures and Environmental Control
(3 Unit C: LH = 45)

Senate-approved relevance
This course is designed to provide students with a deep understanding of the principles and applications involved in designing and managing agricultural structures, with a specific focus on environmental control measures. Aligned with the university's commitment to excellence in learning, research, and service, the course encompasses a broad spectrum, including structural design, environmental monitoring, climate control, and sustainable practices in agricultural settings. The Senate believes that this course aligns with the university's mission to produce well-rounded professionals capable of addressing the evolving needs of the agricultural and environmental sectors, especially in the North-Central region of the country.

Overview
The course is designed to expose students to various types of agricultural structures and learn about the principles of design, ventilation, heating and cooling systems, and environmental monitoring. Emphasis is placed on understanding how environmental factors impact agricultural productivity and animal welfare, and students develop skills to optimize these factors through technological interventions. Through theoretical study and practical exercises, students gain proficiency in designing and managing structures for optimal environmental control and productivity.

Objectives
The objectives of this course are to:
1. analyze the principles and design considerations of agricultural structures;
2. evaluate environmental control systems in agriculture for optimal crop and livestock management;
3. evaluate the environmental impact of different agricultural structures and control systems;

4. examine strategies for optimizing climate control within agricultural environments;
5. examine the integration of technology in environmental control for precision farming;
6. analyze the economic aspects of agricultural structures and environmental control practices;
7. explore sustainable and energy-efficient practices in agricultural building design;
8. evaluate the role of biological control in pest management within controlled environments;
9. assess the effectiveness of irrigation systems in agricultural environments for water conservation and crop productivity improvement;
10. investigate the utilization of renewable energy sources in agricultural operations to reduce environmental impact and operational costs;
11. assess the design and functionality of agricultural storage structures for preserving and protecting crops and commodities;
12. evaluate storage systems and techniques for maintaining product quality and reducing post-harvest losses.

Learning Outcomes

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

1. identify at least three (3) aspects influencing structural design and functionality of agricultural structures; note;
2. assess at least two (2) environmental control systems for optimal crop and livestock management per system in agriculture;
3. evaluate the environmental impact of agricultural structures and control systems; note three specific environmental factors affected by these systems;
4. identify three (3) strategies for optimizing climate control within agricultural structures environments;
5. enumerate and apply at least one (1) technological application (TRNSYS, Python, computational fluid dynamics (CFD), etc.) for environmental control for precision farming;
6. analyze energy-efficient practices in agricultural structures and environmental management.
7. conduct economic analyses of agricultural structures and environmental control practices;
8. list at least three (3) sustainable design features and their benefits;
9. evaluate the role of biological control in pest management within controlled environments; note at least two biological control methods and their effectiveness;
10. assess the effectiveness of irrigation systems in agricultural environments and mention two factors impacting irrigation efficiency and crop productivity;
11. simulate and validate agricultural structures environment for optimisation; and
12. simulate and validate the utilization of renewable energy sources in agricultural operations.

Course Contents

Principles and design considerations for agricultural structures. Environmental control systems in agriculture. Environmental impact assessment (ecological footprint). Climate control strategies (implementation of ventilation, heating, and cooling systems in controlled environments). Integration of technology in environmental control (utilization of sensors, automation, and data analytics in environmental control systems). Economic analysis of agricultural structures. Energy-efficient practices in agricultural structures. Sustainable building design (eco-friendly practices and energy-efficient technologies). Pest management in agricultural structures. Structural materials and construction techniques for durability and resilience. Water management systems for irrigation and drainage in agricultural structures. Lighting systems for optimized plant growth

and productivity. Automation and robotics for improved efficiency in agricultural operations. Regulatory compliance and safety standards for agricultural structures. Indoor farming techniques and hydroponic systems for intensive crop production. Waste management solutions for sustainable agricultural practices. Maintenance and upkeep of agricultural structures for long-term functionality and performance.

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

UIL-ABE 421: Irrigation and Drainage (3 Units; C: LH = 45)

Senate-approved relevance

The location of the university in the north central of Nigeria provides a peaceful atmosphere and good conducive environment for learning, training of students in agricultural engineering and the training of high-quality graduates that have good knowledge in the design, construction, operation and maintenance of irrigation systems to improve agricultural productivity in the country. This is in agreement vision of the University as a centre of excellence in learning, research and service to humanity. The relevance of the course is to produce graduates of Agricultural and Biosystems Engineering that are highly skilled in the design, installation of irrigation, operation and maintenance of irrigation systems to improve agricultural productivity in Nigeria.

Overview

The course is designed to equip students with the knowledge of the theories and skills for the planning, design, operation, performance evaluation and of surface, sub-surface and overhead irrigation systems. Importance of environmental impact of irrigation project, reclamation of arable land from soil-salinity and erosion. This course will improve knowledge of the graduates of Agricultural and Biosystems Engineering on irrigation systems as alternative to rainfed agriculture to boost annual food crops production in Nigeria for food sufficiency.

Objectives

The objectives of this course are to:

1. define irrigation;
2. state at least five (5) importance of irrigation;
3. explain the purpose or objectives of irrigation;
4. explain water requirement of crop during irrigation;
5. explain evapotranspiration and different methods for determining evapotranspiration;
6. estimate irrigation scheduling, full irrigation, deficit irrigation and their benefits;
7. determine water quality for irrigation: sodium adsorption ration;
8. enumerate three (3) methods of irrigation;
9. evaluate two (2) types of irrigation efficiency and computation of irrigation efficiencies;
10. describe agricultural land drainage and effects of poor drainage on plant and soil; and
11. explain types of agricultural land drainage and drainage requirement of crop.

Learning outcomes

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

1. analyze at least five (5) objectives of irrigation and outline the course contents.
2. examine the forms of water and soil water constants.
3. calculate water requirements for irrigation and crop evapotranspiration.

4. investigate irrigation scheduling principles.
5. assess the suitability of water for irrigation.
6. explore at least two (2) methods of irrigation.
7. evaluate irrigation efficiencies.
8. formulate designs for irrigation methods, including border, furrow, check basin, sprinkler, and drip irrigation.
9. enumerate at least four (4) implications of poor drainage on plant and soil health.
10. differentiate between surface drainage from sub-surface drainage.
11. estimate the drainage requirement of crops.

Course Contents
Water requirements of irrigation systems. Methods of irrigation. Measurement of water. Frequency and amount of irrigation. Irrigation water scheduling. Water quality for irrigation. Evaluation of irrigation systems and practices. Design of furrow, basin, and sprinkler irrigation. Effect of poor drainage on plants and soil. Drainage requirement of crop. Surface and subsurface drainage. Integration of precision agriculture in irrigation practices. Environmental and socio-economic implications of irrigation projects. Soil-water-plant relationships for effective water management. Design criteria for efficient water distribution. Irrigation system maintenance and troubleshooting for optimal performance. Modernization and automation of irrigation systems for efficiency and precision.

Minimum Academic Standards
As stated in 70% developed NUC CCMAS

UIL-ABE 423: Agricultural and Biosystems Hydrology (3 Units C: LH 45)
Senate-approved relevance
Training of high-quality graduates who are to be highly skilled and knowledgeable in hydrology, understand the components of hydrologic cycle, vast in watershed characteristics, rainfall-runoff relationship in watershed, stream flow, underground flow and prediction of flood to prevent flooding and protect the land from erosion. This aligns with the vision of the University as a centre of excellence in learning, research, probity and service to humanity. The relevance of the course is in the ability of Agricultural and Biosystems Engineering graduates of the University that hydrology, sources of water that could be used for agricultural purposes such as irrigation and domestic uses that can encourage crop production all the year round through irrigation.

Overview
The course is designed to equip students with the knowledge of the theories and skills for understanding of hydrologic cycle, evapotranspiration, evaluation of amount of rainfall annually over a given period of time and knowing the preventive and control methods for flooding.
The course will acquaint the graduates of Agricultural and Biosystems Engineering the knowledge of underground water, stream flow, aquifer, strategies and simple methods of getting underground water and prevention of flooding in society.

Objectives
The objectives of this course are to:
1. define hydrology and its importance in society;

2. explain the hydrologic cycle and its components;
3. describe precipitation and its types;
4. compute the average depth of precipitation using different methods (arithmetic mean, Thiessen polygon, isohyetal, and triangulation methods);
5. define evapotranspiration and determine it using various methods;
6. discuss infiltration, factors affecting it, and methods for measuring infiltration rate;
7. explain the rainfall-runoff relation and calculate the runoff coefficient;
8. define stream flow and describe methods for stream gauging;
9. describe hydrographs and develop them;
10. enumerate flood control measures;
11. calculate the discharge of a river;
12. explain confined and unconfined aquifers;
13. calculate the discharge of water from boreholes and springs;
14. discuss water quality and assess its qualities;
15. describe watersheds and their characteristics; and
16. determine runoff discharge from watersheds using the Rational formula and the US SCS method.

Learning outcomes

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

1. explain the term hydrology and give at least three (3) importance of hydrology;
2. describe hydrologic cycle and enumerate at list two (2) components of hydrology;
3. calculate the average depth of precipitation using arithmetic mean method, Thiessen polygon, isohyetal method and triangulation method;
4. explain evapotranspiration and compute evapotranspiration using at least two (2) different methods;
5. differentiate infiltration from at least two (2) other forms of water flow through the soil;
6. identify the relationship between rainfall and runoff;
7. interpret stream flow and identify at least two (2) methods for stream gauging;
8. define hydrograph and generate hydrographs;
9. enumerate at least five (5) flood control measures;
10. identify at least five (5) differences between confined and unconfined aquifers;
11. calculate the discharge of water from boreholes and springs;
12. Determine at least three (3) water physico-chemical properties;
13. describe watersheds and list at least three (3) attributes of watersheds; and
14. calculate runoff discharge from watersheds.

Course Contents

Definition of hydrology. Importance of hydrology. Hydrologic cycle. Components of the hydrologic cycle. Solar and earth radiation. Precipitation. Evapotranspiration. Infiltration. Rainfall-runoff relationship. Stream gauging. Hydrograph. Flood control. Ground water hydraulics. Confined and unconfined aquifers. Water discharge from the aquifer. Quality of water from the borehole and surface water. Boreholes and shallow well. Watershed management.

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning outcomes

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

1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness; decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case- financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques.Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting,planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courtsand legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and

practically present technical reports for use in varying judicial/quasi-judicial settings including as anexpert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Formsof contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety andrisk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

ABE 501: Environmental and Social Impact Analysis (2 Units C: LH 30)

Learning outcomes

After taking this course, students should be able to:

1. determine the impact and consequences of agricultural projects on the environment andmeasure them;
2. explain the environmental policies and regulations of their locality;
3. analysis projects and take decisions as to whether it will have a positive or negativeimpact on the environment; and
4. design the remediation of projects with negative impact.

Course Contents

Concept of environmental and social consequences/dimensions of development projects. Methods of impact analysis. Physical, sociological, legal, economic, environmental and public health implications of human activities. Effects of changed environments on man. Examplesof impact assessment with particular reference to developing countries. Role of environmental engineering in preventing or reducing environmental stress. Environmentaland social management plans (ESMP); Planning and policy, administration and organisationof natural resources development and public health. Land use planning and landscape design. Monitoring and evaluation of projects for ESIA compliance. Practical content: Students are expected to undertake an environmental and social impact analysis of an on-going project on campus.

ABE 502: Aquaculture and Agroponic Engineering (2 Units C: LH 30)

Learning outcomes

Students will after be taking this course have the capacity to:

1. appreciate fish farming, the machinery involved and integration of fish farming aspectto the other crop and livestock enterprises on a farm;
2. design mechanized fish ponds, conserve water, manage the wastes from the ponds;
3. design and construct efficient fish drying kilns; and
4. explain the benefits, practice and management of agroponic agriculture.

Course Contents

Aquaculture: Types of fish ponds. Design and construction of fish ponds. Integrated fish farming. Water quality for fish farming. Water conservation. Machinery for fish farms. Pollution control. Ecological re-use and disposal of water. Product harvesting, sorting andprocessing. Design of fish kilns. Agroponics: Agroponic farming systems. Prospects of agroponic agriculture in Nigeria. Soil and water management in agroponic systems. Economics of agroponic systems. Modern aquaponics and hydroponics systems design anduse. Practical content: Each student is expected to plant a yam seedling in a bag of sand and monitor its growth until harvest during the semester. Excursion: Visit to a commercialfish farm site or the university fish farm.

ABE 503: Livestock Production Engineering (2 Units C: LH 30)Learning outcomes

After taking this course, the students will be able to:

1. Explain the various rearing systems including the transhumance system of rearing;
2. Describe the production systems in the livestock enterprise;
3. Design livestock housing types;
4. Identify the various engineering interventions in the livestock enterprise, which includethe machinery for feeding, sanitation of the livestock housing, milking, irrigation of thepastures in a ranch;
5. Plan, design and implement a ranch;
6. Select appropriate machinery for various operations; and
7. Manage livestock wastes for energy production.

Course Contents

Production systems: rearing, fattening and milk production systems. Rearing systems: objectives; nomadic, transhumant, sedentary, scavenging and industrial (ranching) – organisation, personnel and infrastructures. Design, construction and equipment for housing for pigs, sheep, goats, domestic fowls, cattle and dairy cattle. Fattening production systems: Grass and intensive fattening. Milk production systems: factors limiting tropical milk production; milking bail; milking parlour: selection, design and types. Environmental requirements for animals. Environmental impact on animal growth and reproduction on their general physiology. Assessment of thermal comfort. Parametres affecting thermal comfort of animals. ASHRAE comfort charts. Ventilation systems: natural and automated. Aerodynamics of animal buildings. Building design methodology. Integrating animals with their environment through building designs. Disease control: Causes, factors favouring transmission. Design of buildings to control diseases. Animal waste management: Characteristics of animal wastes. Objectives of waste treatment; aerobic and anaerobic treatment of waste; manure disposal equipment.
Excursion: Visit to a functional biogas plant.

ABE 504: Greenhouse Technology (2 Units C: LH 30)
Learning Outcomes

Students are expected to be able to:

1. Define greenhouse and associated technologies;
2. Describe the types of greenhouses;

3. Analyse the thermal profile of greenhouses;
4. Determine the influence of the climate on the control and implementation of theenvironment in greenhouses;
5. Undertake climate control and cultivate plants in greenhouses; and
6. Design and construct low cost and effective greenhouses for crop cultivation.

Course Contents

Definition of greenhouse. Meaning of greenhouse technology and controlled environmentagriculture (CEA). History and present scenario of greenhouse cultivation. Importance of greenhouse crop cultivation. Types of greenhouses. Types of covering materials and thermal screens for greenhouses. Planning of greenhouses. Importance of different climatic and non-climatic factors in selecting proper greenhouse technology. Measuring systems required for greenhouse. Design, construction and cost estimate of a greenhouse. The bamboo greenhouse technology. Control mechanisms for different climatic conditions: light, temperature, humidity, precipitation and carbon dioxide. Special methods of crop husbandry in greenhouse cultivation.
Excursion: Visit to a commercial farm with greenhouse facility.

ABE 505: Drone and Robot Technology in Agriculture (2 Units C: LH 30)

Learning Outcomes

This course will enable students know control, tools, programming languages, sensors andactuators involved in automation; design and use of robots and drones in agriculture.

Students are expected to be able to:

1. Identify and explain the forms of automation and its control systems, automation toolsand various computer programming languages;
2. Explain the types and application of sensors;
3. Design and select sensors and actuators;
4. Describe and explain the types, classification and architecture of drones;
5. Explain the types, characteristics and advantages of agricultural robots;
6. Apply drones and robots in agriculture; and
7. Evaluate the performance, accuracy and repeatability of robots.

Course Contents

Automation: Introduction to automation. Control systems: open-loop and closed-loop, feedback control, logic control, on-off control and linear control systems. Control actions: discrete control (on/off); PID controller; sequential control and logical sequence or system state control; computer control. Automation tools: artificial neural network (ANN); distributed control system (DCS); human machine interface (HMI); robotic process automation (RPA); supervisory control and data acquisition (SCADA); programmable logiccontroller (PLC); instrumentation; motion control; robotics. Programming languages: introduction to programming language; Matlab programming, R programming, C, C# and C++ programming, Java and Java Script programming and Python programming. Sensors and actuators: introduction to sensors, types and applications. Design and selection of sensors. Introduction to actuators, types and applications. Design and selection of actuators. Drones or Unmanned Aerial Vehicles (UAVs): Introduction, types and classification of

drones. Architecture (components) of a drone: flight controller; electronic speed controller (ESC); battery; radio transmitter/receiver; antenna; propellers; electric motor; camera and its accessories.; ground station; intelligent sensors; intelligent battery; GNSS and RTK module. Advantages and disadvantages of drones. Design and selection of drones. Working principles of a drone. Performance considerations criteria of a drone. Application of drones in agriculture. Robots: Introduction, types and characteristics of agricultural robots (Agribot). Primary areas of robotics: operator interface; mobility or locomotion; manipulators and effectors; programming; sensing and perception. Advantages and disadvantages of robots. Robot design process. Design of components of agricultural robots: end effectors; grippers; manipulators. Operating principles of an agricultural robot. Performance evaluation of robots: productive time, overhead time and working efficiency index. Accuracy and repeatability of a robot. Application of robot to agriculture.

ABE 599: Final Year Project (3 Units C: 15 LH; PH 90)

Learning Outcomes

The project will enable students to:

1. Synthesis all that was learnt in the programme to develop a technology or obtain datathat can be deployed to solving a major agricultural and biosystems engineering problem.

Course Contents

Individual student project to deepen knowledge, strengthen practical experience and encourage creativity and independent work. The project ends in a comprehensive written report.

UIL-ABE 506: Agricultural Land Clearing and Development (2 Units C: LH =30)

Senate-approved relevance

Situated in the dynamic North Central region of the country, our university is uniquely positioned to address the specific agricultural challenges prevalent in this geographical area. This course aligns seamlessly with our institution's vision to be a center of excellence in learning, research, and service. By providing students with knowledge and skills in agricultural land clearing and development, we aim to contribute significantly to sustainable agricultural practices, economic development, and environmental stewardship in our region. This course embodies our commitment to fostering expertise that resonates with the agricultural needs of the North Central region and aligns perfectly with our mission to produce graduates who can actively contribute to the advancement of their communities and beyond.

Overview

This course offers students a thorough grasp of the principles, techniques, and considerations pertinent to readying agricultural land for cultivation. The curriculum encompasses various subjects, such as machinery selection, environmental impact assessments, safety measures, and sustainable methodologies. Through hands-on activities, students analyze soil attributes, evaluate economic ramifications, and delve into the incorporation of precision farming technologies.

Objectives

The objectives of this course to:

1. identify suitable techniques for agricultural land clearing;
2. enumerate the environmental impact of land clearing methods;
3. demonstrate proficiency in operating land clearing equipment;
4. develop a land clearing plan based on site analysis;
5. evaluate soil conditions and drainage requirements for agricultural development;
6. implement soil erosion control measures during land clearing and development;
7. incorporate precision agriculture technologies for efficient land use;
8. analyze the economic feasibility of land clearing and development projects;
9. collaborate with stakeholders to address land use regulations and permits; and
10. assess the success and sustainability of land development projects over time.

Learning Outcomes

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

1. analyze the various land tenure systems and the Nigerian land resources and land use act in relation to agriculture;
2. outline the objectives of proper land clearing for commercial agriculture;
3. identify at least three (3) suitable techniques for agricultural land clearing;
4. develop at least one (1) land clearing plan based on site analysis, including soil type and topography;
5. identify the various techniques or methods influencing land factors that can affect the rate of land clearing;
6. demonstrate proficiency in operating at least one (1) types of land clearing equipment through practical exercises;
7. examine how vegetation cover influences the rate of land clearing and describe at least three (3) vegetation zones in Nigeria;
8. explore the factors to be considered in selecting appropriate machinery for agricultural land clearing;
9. Evaluate soil conditions and drainage requirements for agricultural development, considering at least five (5) soil parameters;
10. implement erosion control measures during land clearing and development, utilizing a minimum of two (2) erosion control techniques;
11. assess the performance of machines selected for any farm operations;
12. describe the daily and periodic maintenance procedures for various agricultural machines;
13. explore the use precision agriculture technologies such as GPS mapping and monitoring systems; and
14. analyze the economic feasibility of land clearing and development projects, considering factors such as cost-benefit analysis and return on investment.

Course Contents

Land resources and Land Use Act in relation to Nigerian Agriculture. Objectives, methods, and equipment for land clearing and development. Landscaping and leveling techniques for agricultural development. Machinery selection and mechanics of operation for various vegetation types. Environmental impact assessment and sustainability considerations in land clearing. Performance criteria and economic analysis of land clearing projects. Machinery

maintenance procedures for sustainable operation. Site studies and analysis, including soil and topographical assessments. Integration of precision agriculture technologies in land development. Implementation of erosion control measures during land clearing and development. Compliance with regulatory standards and environmental regulations. Utilization of sustainable land management practices. Incorporation of biodiversity conservation measures in land development projects. Application of GIS and remote sensing techniques in site analysis. Evaluation of soil fertility and nutrient management strategies. Assessment of social and economic impacts on local communities. Documentation and reporting of site studies and project outcomes.

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

UIL-ABE 507: Application of Electricity to Agricultural and Biological Systems

(2 Units; C: LH = 30)

Senate-approved relevance

To achieve the national goals and objectives of industrialisation and self-reliance, this course is towards the development of thorough practice in broad – based training in general engineering and technology. This aim aligns with the vision of the University as a centre of excellence in learning, research and service to humanity. The relevance of this course is to produce graduates of Agricultural and Biosystems Engineering that are highly skilled in the design, installation, and operation of modern electrical gadgets in the farm to improve agricultural productivity in Nigeria.

Overview

This course offers the fundamental principles behind the application of electricity to the farm. The course introduces students to the application of electricity to handling, processing and storage of agricultural and biological materials. The course teaches the use of farm electricity to mechanize the different aspects of irrigation and drainage usage of farm machinery.

Objectives

The objectives of this course are to:

1. outline the needs and modern methods of the application of electricity in the farm;
2. describe the various methods of using electricity to prevent deterioration and maintain crop physical, frictional, thermal, optical, dielectric, electrical, acoustic, rheological, and textural properties during harvesting, post-harvest handling, processing, and storage;
3. explain the principles behind the usage of robots, temperature and moisture sensors, aerial images and GPS technology in agricultural activities;
4. investigate the use of sensors in agriculture to monitor crop and soil water content;
5. discuss digital farming and the utilization of IoT in agriculture;
6. monitoring of climate conditions, ensuring farm security and livestock conditions using smart farming techniques;
7. explain the basic electronic applications to farm processes, e.g., powering of large-scale irrigation projects like centre pivot, end pivot etc;
8. examine the basic principles behind the operation of instrumentation and measurement of agricultural and biological systems, such as dynamometers and pH meters;

9. analyze the principles behind the transmission and distribution of electricity and the use of transformers for voltage reduction on the farm; and evaluate the use of electric motors for powering processing machines such as grinders, dehuskers, mixers, sieves, conveyors, etc.

Learning Outcomes

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

1. identify the needs and describe modern methods for applying electricity to the farm, recognizing at least three (3) different methods;
2. describe various methods of utilizing electricity to prevent deterioration and maintain crop properties during harvesting, post-harvest handling, processing, and storage, outlining at least five (5) methods;
3. explain the principles behind the usage of robots, temperature and moisture sensors, aerial images, and GPS technology in agricultural activities, identifying at least four (4) key principles;
4. investigate the use of sensors in agriculture to monitor crop and soil water content, identifying and evaluating the effectiveness of at least three (3) different types of sensors;
5. discuss digital farming and the utilization of IoT in agriculture, examining at least three (3) applications of IoT technologies;
6. implement smart farming techniques to monitor climate conditions, ensure farm security, and oversee livestock conditions, demonstrating proficiency in at least three (3) smart farming techniques;
7. illustrate the basic electronic applications to farm processes, such as powering large-scale irrigation projects like center pivot and end pivot systems, identifying and explaining the functions of at least three (3) electronic applications;
8. examine the basic principles behind the operation of instrumentation and measurement of agricultural and biological systems, such as dynamometers and pH meters, describing the principles and functionality of at least three (3) instruments;
9. analyze the principles behind the transmission and distribution of electricity and the use of transformers for voltage reduction on the farm, outlining at least three (3) principles of electrical transmission and distribution; and
10. evaluate the use of electric motors for powering processing machines such as grinders, dehuskers, mixers, sieves, and conveyors, comparing and contrasting the effectiveness of electric motors in at least three (3) different processing machines.

Course Contents

Application of electricity to the handling, processing, and storage of agricultural and biological materials. Basic electronic applications to farm processes. Role of electrical systems in agricultural efficiency. Selection and implementation of electrical equipment. Instrumentation and measurement in agricultural and biological systems. Impact of electrical systems on biological processes. Farmstead power systems and distribution. Selection and use of electric motors, machines, and transformers in agricultural and biological systems. Integration of renewable energy sources in agricultural and biological applications. Automation and control systems in agricultural and biological processes. Safety considerations in the application of electricity to agricultural and biological systems. Energy efficiency practices in electrical applications for agriculture and biology. Troubleshooting and maintenance of electrical systems in agricultural and biological settings. Regulations and standards governing electrical

installations in agricultural and biological facilities. Advancements in electrical technologies for sustainable agriculture and biology. Case studies and practical applications of electricity in agricultural and biological contexts. Emerging trends and future directions in the application of electricity to agriculture and biology.

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

UIL-ABE 509: Food and Agricultural Biotechnology (2Units C: LH = 30)

Senate-approved relevance

Situated strategically in the North Central region, our university recognizes the specific agricultural challenges in this locale. Aligned with the university's vision to be a center of excellence in learning, research, and service, this course embodies our commitment to advancing knowledge in biotechnology for sustainable agricultural practices. By exploring the applications of biotechnology in food and agriculture, the program aligns seamlessly with our mission to produce graduates equipped to address regional agricultural needs. The Senate believes that this course not only enhances our academic offerings but also reflects our dedication to fostering innovation, economic development, and environmental stewardship in the North Central region and beyond.

Overview

This course is designed to train students the principles, applications, and ethical considerations in biotechnology within the context of food and agriculture. Through a balanced curriculum, students will explore the utilization of biotechnological innovations for sustainable agriculture and students will be equip with the knowledge and skills needed to address the challenges and opportunities in the evolving field of biotechnology in agriculture.

Objectives

The objectives of this course are to:

1. analyze the principles and applications of food and agricultural biotechnology;
2. evaluate ethical considerations and societal impacts associated with biotechnological practices;
3. assess the role of genetic engineering in crop improvement and livestock production;
4. examine the application of biotechnology in soil and water management for sustainable agriculture;
5. develop skills in the application of molecular techniques in food safety and quality control;
6. evaluate the impact of biotechnology on pest and disease control in agriculture;
7. analyze the development and utilization of genetically modified organisms (GMOS) in agriculture;
8. explore the integration of biotechnology in sustainable food production systems;
9. investigate advancements in precision agriculture facilitated by biotechnological innovations; and
10. apply critical thinking to propose ethical and sustainable biotechnological solutions in agriculture.

Learning Outcomes

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

1. demonstrate a comprehensive understanding of the principles and applications of food and agricultural biotechnology, covering at least five (5) key principles and applications;
2. apply knowledge to critically assess ethical considerations and societal impacts related to biotechnological practices, examining at least three (3) ethical considerations and societal impacts;
3. utilize critical analysis to evaluate the role of genetic engineering in enhancing crop and livestock productivity, analyzing the effectiveness of genetic engineering in at least four (4) crop and livestock species;
4. apply knowledge in utilizing biotechnology for effective soil and water management in sustainable agriculture, demonstrating proficiency in at least three (3) biotechnological methods for soil and water management;
5. apply molecular techniques in ensuring food safety and maintaining quality control, demonstrating proficiency in at least three (3) molecular techniques for food safety and quality control;
6. evaluate the impact of biotechnological interventions on pest and disease control in agricultural systems, examining the effectiveness of biotechnological interventions in controlling pests and diseases in at least four (4) agricultural systems;
7. analyze the development and utilization of genetically modified organisms (GMOs) in agriculture, examining the development and utilization of GMOs in at least three (3) different agricultural contexts;
8. explore and apply the integration of biotechnology in creating sustainable food production systems, demonstrating understanding and application of biotechnology integration in at least three (3) sustainable food production systems;
9. demonstrate proficiency in implementing biotechnological solutions for enhancing nutrient uptake and utilization in agricultural crops, utilizing techniques such as genetic modification and biofortification; and
10. evaluate the environmental impact of biotechnological applications in agriculture, analyzing factors such as biodiversity, soil health, and ecosystem resilience to assess sustainability and long-term viability.

Course Contents

Principles and applications of food and agricultural biotechnology. Agricultural biotechnology. Food biotechnology. Environmental biotechnology. Industrial biotechnology. Medical biotechnology and pharmaceutical biotechnology. Bioresources development., Bioinformatics. Genetically modified animals, plants and food. Microorganisms in agriculture: applications and engineering. Biotechnology in food processing and preservation. Environmental biotechnology for agricultural sustainability. Soil and water Biotechnology. Biotechnology in sustainable food production systems. Cost analysis and economics of biotechnology. Safety standards in biotechnology. Bioreactors. Applications of biotechnology in agricultural waste management. **Advanced** strategies in agricultural biotechnology.

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

UIL- ABE 511: Transportation System for Agricultural and Rural Development (3 Units C: LH = 45)

Senate-approved relevance

Strategically situated in the North Central region, our university acknowledges the distinct agricultural challenges prevalent in this locale. In harmony with the university's vision to be a hub of excellence in learning, research, and service, this course epitomizes our commitment to advancing knowledge in transportation systems for sustainable agricultural practices. By exploring the intricacies of transportation methods and their impact on rural development, the program aligns seamlessly with our mission to produce graduates equipped to address regional agricultural needs. The Senate is confident that this course not only enriches our academic portfolio but also signifies our dedication to fostering innovation, economic development, and environmental sustainability in the North Central region and beyond.

Overview

This course explores the pivotal role of transportation in fostering agricultural and rural progress. This course focuses on analyzing transportation systems' role in facilitating agricultural and rural development. Students will examine strategies for optimizing transportation infrastructure to enhance accessibility, efficiency, and sustainability in rural areas. Topics include transportation planning, logistics, and the utilization of modern technologies to improve connectivity and facilitate the movement of agricultural products and resources.

Objectives

The objectives of this course are to:

1. analyze the role of transportation systems in promoting agricultural and rural development;
2. evaluate the efficiency and effectiveness of different transportation modes in rural contexts;
3. assess the impact of transportation infrastructure on market accessibility for rural products;
4. examine strategies for optimizing logistics and supply chain management in agricultural transport;
5. develop skills in designing and planning transportation systems tailored to rural needs;
6. analyze the economic implications of transportation policies on agricultural and rural economies;
7. evaluate the integration of technology in enhancing transportation efficiency for rural development;
8. explore sustainable and eco-friendly practices in rural transportation planning;
9. apply knowledge and skills to troubleshoot and solve practical challenges in rural transportation systems; and
10. investigate the socio-cultural factors influencing transportation decisions in rural areas.

Learning Outcomes

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

1. assess the efficiency of at least three (3) transportation modes in rural environments;
2. analyze the influence of transportation infrastructure on market accessibility for rural products.
3. enumerate at list two (2) strategies for optimizing logistics and supply chain management in agricultural transport;
4. plan and design transportation systems that address at least three (3) needs and challenges in rural areas;

5. compare at least two (2) transportation modes for rural contexts, assessing their effectiveness.
6. explain at least five (5) impacts of transportation policies on rural economies;
7. implement at least three (3) optimization strategies for agricultural transport.
8. integrate technological advancements to enhance the efficiency of transportation systems for rural development; solve three (3) practical challenges in rural transportation systems;
9. identify three (3) sustainable practices for rural transportation planning; and
10. assess efficiency gains from technology integration in rural transport;

Course Contents
Introduction to agricultural and rural transportation. Efficiency and effectiveness of transportation modes. Transportation infrastructure impact on market accessibility. Supply chain management in agriculture. Design of rural transportation systems. Economic implications of transportation policies. Technology integration in rural transport. Socio-cultural factors in transport decisions. Safety protocols in rural transport. Environmental considerations in agriculture transport. Emerging trends in rural transport. Challenges and opportunities in rural transport.
Minimum Academic Standards
As stated in 70% developed NUC CCMAS

UILABE 513: Automation and Control of Agricultural and Biosystems (2 Units; E; LH = 30; PH = 45)
Senate - approved relevance
The workspace, landscape and vegetation cover provide world-class environment for learning, research and training of high-quality graduates who are highly skilled and knowledgeable in the development, control and maintenance of automated agricultural and biosystems in savannah ecotone areas of Nigeria. This is in line with the mission of the University of Ilorin, popularly known as UNILORIN to address Africa human capacity challenges in producing Agricultural and Biosystems Engineering graduates. This will provide opportunity to digitalize agriculture and equip graduates of Agricultural and Biosystems Engineers from the UNILORIN to develop and conceive automated agricultural and biosystems that will transform current status of agricultural operations to mechanized and automated systems.

Overview
Significant efforts have been concentrated on the development of hardware and software components of agricultural systems at different levels of sophistication to help produce foods and raw materials within the field of agricultural sector over the last years. Nowadays, the agro-alimentary sector is the object of special attention, and many initiatives are being developed to incorporate new technologies, aimed at increasing production, and achieving diversity, quality, and market presentation requirements, as well as solving the problems of the deficiencies in and scarcity of the manual labour available. Technological renovation of the agricultural sector is required, and control engineering can play a decisive role. This technological renovation is to incorporate automatic control and robotics techniques at all levels of agricultural production: planting, production, harvest and post-harvest processes and transportation.
This course is, therefore, designed to introduce future agricultural engineers to gaining knowledge on how to use, understand, and implement the new advances in automation in the agricultural sector. A classical engineering course dealing with the analysis and design of control systems, as well as identification of modern control (optimal, predictive, and robust control), robotics, and

image analysis. The objectives of the course, learning outcomes, and contents are structured to address and achieve the needs of sustainable development goals (SDGs) numbers 2, 8, 9, and 12 in the areas of Zero Hunger; Decent Work and Economic Growth; Industry, Innovation and Infrastructure; and Responsible Production and Consumption, respectively.

Objectives

The objectives of this course are to:

1. identify dynamic behaviour characteristics of control systems in automated agricultural systems;
2. design and implement mathematical models for agricultural and biosystems, describing the relationships between controlled variables and input variables;
3. enumerate the uses of dynamic models in control system design;
4. explain the primary objective of control systems: maintaining variables within desired intervals with defined behaviour;
5. enumerate agricultural processes controlled by automatic systems;
6. describe the essential procedure for designing control systems using classical Proportional-Integral-Derivative (PID) algorithms;
7. describe the key challenges in sequential control of agricultural and biosystems using Programmable Logic Controllers (PLCs);
8. analyze crop growth concerning environmental climatic variables, irrigation, and fertilizer supply;
9. describe greenhouse climate and fertigation control systems, including sensors, actuators, and various control algorithms used in commercial and research equipment;
10. identify agricultural tasks suitable for robot manipulators, such as harvesting;
11. understand the fundamentals of robot manipulators technology (elements, control, programming) and their potential applications in agriculture;
12. identify areas of mobile robotics application in agriculture for specific tasks or enhancing the autonomy of agricultural machines;
13. explain the applications of machine vision in agriculture, such as fruit sorting, seed germination quality control, and fruit location in harvesting; and
14. describe commercial and research robotic developments in order to increase the autonomous level of agricultural machines, production harvest in trees and plants, or processes like transplanting or cutting or sticking.

Learning outcomes

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

1. identify at least three (3) characteristics of dynamical behaviour of control system in an automated agricultural system;
2. itemize step by step design and implement concept of a model of the agricultural and biosystems consisting of a mathematical description of the relations between the controlled variables and the input (disturbance and control) variables;
3. enumerate at least four (4) uses of a dynamic model in the design of a control system;
4. state the main objective of a control system is the maintenance of a variable into a desired interval with a determined behavior;
5. enumerate at least three (3) processes in the agricultural sector controlled by automatic systems;

6. itemize the general procedure essential in the design of the control system based on the classical PID algorithms;
7. list at least three (3) basic issues involved in the sequential control of agricultural and Biosystems using PLCs (Programmable Logic Controllers);
8. analyse the crop growth in respect to the climatic variables of the environment, the irrigation and the supply of fertilizers;
9. use graphical illustration to describe greenhouse climate and fertigation control systems showing the sensors, actuators, and the different control algorithms used in commercial and research equipment;
10. state at least seven (7) agricultural tasks that can be carried out by robot manipulators, like the harvesting process;
11. describe fundamentals of robot manipulators (elements, control and programming) technology and its possible applications in agriculture;
12. state at least five (5) areas of application of mobile robotics in the field of agriculture for specific tasks or for augmenting the autonomy of agricultural machines;
13. state at least three (3) features of machine vision in the agricultural sector such as fruit sorting in post-harvesting processes, quality control of the seeds germination in nurseries, or fruit location in harvesting processes; and
14. differentiate between commercial and research robotic developments in order to increase the autonomous level of agricultural machines, production harvest in trees and plants, or processes like transplanting or cutting or sticking.

Course contents

Types and dynamical behaviour of control systems in an automated agricultural system. Concept of automation of agricultural and biosystems. Modelling and simulation of agricultural systems. Objectives of Control systems. Automatic control of dynamic systems. Sequential control of processes. Design of Control Systems. Agricultural sector controlled by automatic systems. Automatic control of agricultural systems. Crop growth models. Greenhouse climate and fertigation control systems. Types and Functions of robots. Manipulation robotics. Mobile robotics. Motion generator. Machine vision applied to agriculture. Agricultural robots. Commercial and research robotic developments. Maintenance of Agricultural Robots.

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

UIL- ABE 516: Agricultural Machine (2 Units E: LH 30)

Senate-approved Relevance

Located strategically within the North Central region, our university is keenly aware of the distinct agricultural challenges prevalent in this area. Aligned with the university's overarching vision to emerge as a hub of excellence in learning, research, and service, this course serves as a tangible manifestation of our commitment to advancing expertise in sustainable agricultural machinery practices. Through a deep exploration of machinery applications, the program seamlessly aligns with our overarching mission to produce graduates who are adept at addressing the specific agricultural needs of the region. The Senate expresses confidence that this course not only enhances our academic offerings but also underscores our unwavering dedication to fostering

innovation, economic development, and environmental sustainability, both within the North Central region and beyond.

Overview

This course designed to acquaint students with various agricultural machinery and their applications. Students are exposed to the design, operation, and maintenance of agricultural equipment, focusing on enhancing efficiency and productivity in farming operations. Key topics include tractor technology, implements, harvesting machinery, and precision agriculture technologies. Students are to acquire the skills necessary to select, operate, and manage agricultural machinery effectively, contributing to sustainable agricultural practices and improved crop yields.

Objectives

The objectives of this course are to:

1. analyze the fundamental principles and mechanics of various agricultural machines;
2. evaluate the selection and utilization of appropriate machinery for different agricultural tasks;
3. critically assess the impact of technological advancements on modern agricultural machinery;
4. examine the principles of precision agriculture and its integration with advanced machinery;
5. develop skills in analyzing and troubleshooting common issues in agricultural machines;
6. evaluate the economic implications of machinery selection and utilization in agriculture;
7. analyze safety protocols and risk management strategies associated with agricultural machinery;
8. explore sustainable practices in agricultural machinery operations and maintenance;
9. investigate the role of data analytics and automation in optimizing agricultural machine performance; and
10. apply analytical thinking to design and improve agricultural machinery for specific tasks.

Learning Outcomes

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

1. enumerate at least three (3) fundamental principles and mechanics of agricultural machines;
2. assess and justify the selection and utilization of at least two (2) machinery for diverse agricultural tasks;
3. analyze the efficiency and effectiveness of at least two (2) impact of technological advancements on modern agricultural machinery;
4. explain and integrate precision agriculture principles with advanced machinery to optimize farming practices;
5. apply analytical skills to identify and troubleshoot at least three (3) common issues encountered in agricultural machines;
6. evaluate and interpret the economic implications of machinery selection and utilization in agriculture;
7. implement at least five (5) safety protocols and devise risk management strategies for the safe operation of agricultural machinery;
8. explore and propose at least three (3) sustainable practices for the operation and maintenance of agricultural machinery, considering environmental impact;
9. apply at least two (2) data analytics and automation techniques to enhance agricultural machine performance and efficiency;

10. design at least one (1) agricultural machinery tailored to solving at least one (1) agricultural operation.

Course Contents

Introduction to Agricultural Machinery. Machinery Selection, Utilisation and Deployment. Machinery Operation Techniques. Force analysis of tillage equipment. Maintenance and Servicing. Performance Optimization of farm machinery. Safety Protocols and Risk Management. . Economic Analysis of Machinery Usage. Hitching methods. Power requirements for operating farm equipment and machines. Operation and maintenance of various farm machinery. Field evaluation. Criteria for replacement. IoT and AI in agricultural machinery systems. Data Analytics and Automation in Machinery. Troubleshooting and Problem-Solving. Environmental Impact Assessment.

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

UIL-ABE 522: Agricultural Land Drainage (3 Units E: LH = 45)

Senate-approved relevance

To ensure production of high-quality graduates that are highly skilled and knowledgeable in irrigation and drainage engineering. This falls in with the vision of the University as a centre of excellence in learning, research, probity and service to humanity. The relevance of the course is in the ability of Agricultural and Biosystems Engineering graduates of the University to incorporate the principles of drainage engineering into irrigation projects to ensure optimum crop yield.

Overview

This course teaches the fundamental principles behind the design and operations of surface and sub-surface systems in the farm. The course introduces students to the application of drainage systems to remove excess water from the farm due to over irrigation or flooding, design of surface and sub-surface drainage systems under steady and non-steady state conditions. Also, students should be able to determine the most effective method of removal of excess water from the farm considering the prevailing situations. Students are also taught the legal aspects of drainage and well interference.

Objectives

The objectives of this course include to:

1. evaluate and analyse the need for agricultural land drainage;
2. explain the causes of drainage problems, the effects of poor drainage on soil, plants, livestock, and humans;
3. distinguish between surface and sub-surface drainage systems;
4. explain the principles behind the design of surface and subsurface drainage systems;
5. explain the need of filter and envelope materials and their design;
6. explain the effects of different loads on conduits;
7. explain the methods of construction, installation and maintenance of surface and sub-surface drains;
8. describe what is drainage pumping;
9. explain the basic principles of well drainage; and
10. teach the legal aspects of drainage.

Learning Outcomes

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

1. explain at least five (5) benefits of agricultural land drainage;
2. enumerate at least three (3) causes of drainage problems;
3. explain at least five (5) effects of poor drainage on soil, plants, livestock and humans;
4. enumerate and explain at least two (2) types of surface and sub-surface drainage systems;
5. design at least two (2) surface and subsurface drainage systems;
6. discuss the use of at least two (2) filter and envelope materials;
7. evaluate at least three (3) types of loads on conduits under different conditions;
8. construct, install and maintain at least one (1) surface and sub-surface drains;
9. explain at least four (4) basic principles of well drainage; and
10. mention at least two (2) legal aspects of drainage.

Course Contents

Introduction to agricultural land drainage. Purpose/Importance of drainage, causes of drainage problems. Effect of poor drainage systems. Subsurface drainage. Design of drainage systems. Soil-Water relations and drainage principles. Types of agricultural drainage systems. Surface drainage techniques. Subsurface drainage techniques. Drainage Planning and Design Considerations. Drainage Installation and Construction Methods. Drainage system maintenance and management. Drainage water quality and environmental impacts. Drainage system monitoring and evaluation. Drainage system performance assessment. Filter and envelope materials and their design. Loads on conduits and drainage pumping. Economic and legal aspects of drainage.

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

UIL-ABE 523: Rural Water Supply and Sanitation (2 Units E: LH = 30)

Senate-approved relevance

Good knowledge and skill in planning, design, operation and maintenance of rural water and sanitation infrastructure are generally required of graduates of Agricultural and Biosystems Engineering and their training to meet this requirement is consistent with the mission of global excellence and service to humanity of University of Ilorin. The relevance of the course is in the graduates of the university being able to plan, design, operate, and maintain systems for rural water supply and sanitation; thus, locally contributing to the global attainment of a key aspect of one of the sustainable development goals of the United Nations, i.e., Clean Water Supply and Sanitation.

Overview

Rural water supply and sanitation is vital for a healthy living and thriving agricultural productivity in the rural population hence the relevance of the course in the production of Agricultural and Biosystems engineers knowledgeable in the planning, design, operation and maintenance of the associated engineering infrastructure. The course is designed to expose the students to the techniques of assessment of water and sanitation requirements of rural population centres, quality and capacity of potential water sources and the health consequences of insufficient and non-potable water supply. It would also build the capacity of the students in the planning, design, and operation of the systems for water treatment conveyance and distribution as well as those for sanitation.

Objectives

The objectives of the course are to:
1. explain the factors influencing water requirement and the temporal variation of water demand of a population centre;
2. explain the methods of projecting water requirement based on population forecast;
3. identify the physical, chemical and biological indices of water quality in relation to Nigerian potable water standards (NIS 554);
4. describe the various sources of water supply and the assessment of capacity of wells;
5. describe diseases and physical conditions associated with unsafe water supplies and their control measures;
6.anlyse the operating principles and design of water treatment systems for rural water supply;
7. analyse the operating principles and design of water lifting and transportation systems for rural water supply;
8. describe the types of pipe layout for water distribution their advantages and limitations;
9. describe the features of the various refuse and sewage collection and disposal systems; and
10. analyse the operation and design principles of rural septic tanks, digestion ponds, and privies.

Learning outcomes
On completion of the course, students should be able to:
1. mention at least five (5) factors influencing water requirement and diurnal variation in water demand;
2. forecast using periodic census data the population of a community using at least five (5) methods of population projection and compare the results;
3. relate water quality indices to the specifications of Nigerian Water Quality Standards (NIS 554);
4. analyse data from a recuperation well test and make inferences thereof;
5. explain with examples water-washed, water-borne, water-based diseases stating at least three (3) control measures;
6. state at least five (5) main components and unit operations in a small treatment plant for raw water and surface source;
7. identify at least three (3) types of hydrodynamic lifting systems and their characteristics;
8. identify at least four (4) types of pipe layout for water distribution, their advantages and disadvantages;
9.identify five (5) methods of solid waste management, and two (2) methods of sewage disposal; and
10. analyse and design septic tanks and privies for rural households and oxidation ponds for rural livestock production systems.

Course contents
Water requirements and estimation methods. Water quality standards, including the physical, chemical, and biological indices. Water-related diseases (i.e., water-washed, water-borne, and water-based). Potable water impurities. Sources and treatment methods of rural water supply. Unit processes in a water treatment plant. Water lifting devices. Water transportation and distribution systems. Piped water conveyance systems. Treatment and disposal of sewage from rural homes. Family privies. Septic tanks and soak away pits. Oxidation ponds. Rainwater harvesting concept and techniques for rural communities. Community-Based water management initiatives. Water conservation strategies for rural areas. Integrated Water resource management in rural Settings.
Minimum Academic Standards

As stated in 70% developed NUC CCMAS

UIL-ABE 524: Advanced Irrigation Engineering (3 Units E: LH 30)

Senate-approved relevance

The training of high-quality graduates who are to be highly skilled and knowledgeable in the field of hydraulics, and become technical expertise in the design, construction, operation and maintenance of irrigation systems in the diverse agro-ecological zones of Nigeria to improve agricultural productivity and protect it from the vagaries of weather and rainfall is in accordance with the vision of the University as a centre of excellence in learning, research, probity and service to humanity. The relevance of the course is in the ability of Agricultural and Biosystems Engineering graduates of the University to develop irrigation engineering theories and adapt contemporary techniques and practices in the planning, design, installation, operation and maintenance of irrigation engineering systems for the field water application and control to sustainably improve agricultural productivity and conserve the ecosystem.

Overview

The course is designed to equip students with the knowledge of the theories and skills for planning, design, operation, and performance evaluation of surface and overhead irrigation systems. Reclamation of lands salinized by over-irrigation as well as environmental and economic considerations for feasibility of irrigation projects are also included in the course.

Objectives

The objectives of the course are to:

1. describe the factors relating to design, installation, operation, and maintenance of irrigation systems which affect efficient field water management;
2. explain the volume balance method of analysis of the surface irrigation hydraulics;
3. explain the design principles based on the volume balance method for basin, furrow and border irrigation systems;
4. explain the hydraulics and design principles of overhead irrigation systems namely sprinkler, and centre pivot irrigation systems;
5. explain the principles operation and design of drip irrigation systems;
6. describe the principles and features of chemigation systems;
7. describe the hydraulics and design of water measurement and control structures of irrigation systems;
8. identify the indices of irrigation systems performance evaluation and their measurement procedures;
9. identify the common types of irrigation water delivery schedules and their distinguishing features;
10. explain the indices for irrigation water quality assessment and classification;
11. explain the methods of classification and reclamation of saline and alkali soils; and
12. describe the procedures for feasibility studies of irrigation projects and criteria for assessment of economic and financial feasibility of farm irrigation schemes.

Learning outcomes

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

1. describe with examples at least three (3) factors require for consideration in the design, installation, operation and maintenance of an irrigation system;
2. analyse and apply the volume balance method in the design of at least two (2) surface irrigation systems;
4. design at least one (1) overhead irrigation system and centre pivot irrigation systems based on the analysis of the hydraulics of the systems;
5. describe the drip irrigation systems and enumerate at least two (2) principles of operation;
6. explain at least three (3) features and principles of chemigation systems and their application;
7. discuss at least three (3) operating principles of flow measurement equipment in piped and open channel irrigation water delivery systems;
8. state at least five (5) indices of irrigation systems performance evaluation and their measurement procedures.
9. explain at least three (3) common types of irrigation water delivery schedules stating their advantages and limitations;
10. identify at least four (4) quality classes of irrigation water and the field conditions for useability of irrigation water of the respective quality classes;
11. describe at least one (1) method (FAO or USDA) of classification salt-affected soils and reclamation procedures for saline, alkali and sodic;
12. describe at least two (2) procedures for feasibility studies of irrigation project.
13. demonstrate the use of modern technologies and tools in advanced irrigation engineering, such as remote sensing, Geographic Information Systems (GIS), and computer simulation models for optimizing irrigation practices;
14. analyse the impact of climate change on irrigation systems;
15. describe the regulation frameworks governing water resources management and irrigation practice.

Course contents

Factors affecting efficient farm water management. Elements of the volume balance method of analysis of surface irrigation hydraulics. Design of irrigation systems; basin, furrow, level and graded border. Operating principles and design of overhead irrigation systems: sprinkler and centre-pivot systems. Drip irrigation systems and their design considerations. Operating principles and design of irrigation water measuring, water dividing and water diversion structures. Evaluation of irrigation systems and practices. Irrigation water delivery scheduling. Irrigation water management. Quality of irrigation water. Classification of salt-affected soils. Reclamation of saline, alkali and sodic soils. Feasibility studies of irrigation projects. Economic and financial feasibility of a farm irrigation system. Advanced technologies in irrigation. Emerging issues and future directions. Regulatory frameworks and policy implications.

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

UIL-ABE 527: Advanced Hydraulic Engineering (2 Units E: LH 30)

Senate-approved relevance

Training of high-quality graduates to have a thorough grounding in the design and construction of hydraulic structures. The graduates are to be highly skilled in the designing of open channels and computation of discharge through network pipes. This is in accordance with the vision of the University as a centre of excellence in learning, research and service to humanity. The relevance

of the course is to produce graduates of Agricultural and Biosystems Engineering that are highly skilled in the design, construction and maintenance of hydraulic structures, pumps and irrigation and drainage channels.

Overview

The course is designed to equip students with the knowledge of the theories and skills in engineering hydraulics, flow of water through the network pipes, and energy losses in the pipes. The course is to equip the students with principles of design of weirs, flumes, dams, water flow in pipe network based on Hardy Cross method, hydraulic jump and open channels. The course will prepare the graduates of Agricultural and Biosystems Engineering in handling hydraulics related problems, equip the graduates with the knowledge of theory and practical of flow of water through pipe, principles of water flow through open channels and pipes to handle drainage problems in the society.

Objectives

The objectives of this course are to:

1. explain various energy losses in pipe;
2. determine energy loss in pipe using different methods;
3. explain laminar and turbulent flows;
4. explain cavitation and water hammer;
5. compute the Reynolds number for determination of the type of a flow (laminar or turbulent flow);
6. calculate discharge of water or liquid through pipes;
7. design of water flow in pipe network using hardy-cross method;
8. describe open channel and flow of water open channel;
9. explain the difference between open channel flow and flow through a pipe;
10. explain hydraulic jump and state its applications;
11. design of open channel for irrigation and drainage of agricultural land;
12. identify weirs and flumes;
13. identify different types of pumps and compute discharge from pumps;
14. explain the process of priming a water pump, and
15. demonstrate the use of advanced mathematical and computational methods for complex hydraulic systems.

Learning outcomes

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

1. identify at least three (3) energy losses in pipe;
2. compute energy loss in pipe using at least two (2) different methods (Darcy-Weisbach, Hazen-William);
3. identify at least two (2) differences between laminar and turbulent flows;
4. calculate the Reynolds number;
5. define cavitation and water hammer;
6. identify at least two (2) pipe systems and compute discharge in the pipe network;
7. design water flow in pipe network using at least one (1) method;
8. define open channel water flow;
9. enumerate at least two differences between the open channel flow and pipe flow;

10. describe hydraulic jump and state at least two (2) applications of hydraulic jump;
11. design open channel for irrigation and drainage of agricultural land;
12. explain and outline at least three (3) differences between weirs and flumes;
13. identify at least three (3) types of irrigation pump and calculate their discharge rate;
14. define priming of water pump; and
15. develop and utilize hydrodynamic models to simulate flow behaviour in natural and engineered hydraulic systems.

Course Contents
Energy loss in pipes. Analysis of pipe systems. Computation of discharge of water pipes in series, parallel, and branching pipes. Analysis of simple pipe network. Computation of pressure using Bernoulli's Equation. Hardy-Cross methods. Cavitations. Water hammer. Open channel flow. Laminar and turbulent flows. Hydraulic jump. Channel transitions and controls. Back water curves. Weirs and flumes. Pumps and machines. Priming of water pump. Hydrodynamic modeling.
Minimum Academic Standards
As stated in 70% developed NUC CCMAS

UIL-ABE 528: Soil and Water Conservation (3 Units C: LH 45)
Senate-approved relevance
Training of quality graduates to become highly skilled and knowledgeable in soil and water conservation engineering, land reclamation, control measures for soil degradation and erosion control to have more arable land for agricultural production. This goal aligns with the vision of the University as a centre of excellence in learning, research and service to humanity. The relevance of the course is to produce graduates of Agricultural and Biosystems Engineering that are highly skilled in the application of strategies and methods for soil and water conservation, land reclamation, soil loss from different locations and flood control measures to ensure sustainability of agricultural land and improve agricultural productivity in Nigeria.

Overview
The course is designed to equip students with the requisite skills and knowledge of the theories in soil and water conservation engineering, land reclamation, control measures for land degradation and erosion control to have more arable land for agricultural production in Nigeria.

The course will acquaint the graduates of Agricultural and Biosystems Engineering with the knowledge of conservation principles of soil and water, watershed characteristics influencing runoff and erosion, factors influencing desertification and its control measures, stream flow analysis, and methods of preventing soil degradation.

Objectives
The objectives of this course are to:
1. equip students with fundamental knowledge of soil and water measures and techniques;
2. enumerate the purposes or objectives of soil and water conservation;
3. introduce the river basin in 6 geopolitical zones of Nigeria;
4. describe the hydrologic processes of soil and water conservation principle;
5. explain water and wind erosion;
6. explain universal soil loss equation (USLE) and its applications;

7. determine the soil loss from a given area using USLE;
8. explain control measures for soil erosion;
9. describe sediment transport mechanisms in water bodies;
10. explain types of earth dams and enumerate the functions of dam;
11. explain desertification, causes of desertification and prevention of desertification;
12. state the economic and legislative principles of soil conservation; and
13. equip students with knowledge and skills in designing and implementing soil and water conservation plans.

Learning outcomes

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

1. define soil and water conservation;
2. state the at least three objectives of soil and water conservation;
3. mention river basin in 6 geopolitical zones of Nigeria;
4. describe different types of soil erosion;
5. explain water and wind erosion;
6. state universal soil loss equation (USLE);
7. calculate the amount of soil loss from a particular area using the USLE;
8. acquaint with erosion prediction models and tools;
9. proficient in implementing erosion control measures and sedimentation management techniques;
10. identify types of earth dams;
11. define desertification, state cause desertification and prevention of desertification;
12. recognize the economic and legislative principles of soil conservation;
13. explain the concept of Nature-based solutions to soil and water conservation; and
14. integrate soil and water conservation into land use planning.

Course Contents

Historical background of soil and water conservation. Soil and water conservation development in Nigeria. Types of soil erosion, soil erosion by water and by wind. Universal soil loss equation (USLE). Soil erosion prediction and modeling. Erosion control and sedimentation management. Design of control structures. Earth dams and farm ponds. Economic principle of soil conservation. Desertification and control measures. Monitoring and evaluation of conservation practices. Hydrologic processes of soil and water conservation. Watershed management principle. Sediment transport and control. Sustainable land and water use planning. Sustainable practices and stewardship of natural resources. Soil and water conservation policy and legislation. Communication and outreach on soil and water conservation.

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

UIL-ABE 533: Processing and Storage (2 Units C: LH 30)

Senate-approved relevance

The Senate-approved relevance for Agricultural Processing and Storage emphasizes the critical need to produce highly skilled graduates proficient in the principles, technologies, and practices of post-harvest management in the agricultural sector. This aligns with the University's vision of becoming a center of excellence in learning, research, and service to humanity. The course aims

to equip students with the knowledge and skills necessary to minimize post-harvest losses, maintain product quality, and ensure food security. By focusing on topics such as cleaning, grading, packaging, and storage techniques, graduates of Agricultural and Biosystems Engineering will play a pivotal role in enhancing the efficiency and sustainability of agricultural supply chains, thereby contributing to the socio-economic development of Nigeria and addressing global food security challenges.

Overview

This course exposes students to post-harvest management practices essential for preserving agricultural products. Covering a broad spectrum of topics such as harvesting methods, cleaning, grading, packaging, and storage techniques, the course will equip students with the necessary knowledge and skills to minimize post-harvest losses, maintain product quality, and ensure food security. In addition, value-added processing methods, quality control principles, and regulatory compliance standards will also be covered.

Objectives

Sure, here are the revised course objectives:

1. identify various processing methods used in agricultural production;
2. analyze the principles underlying effective storage techniques for agricultural products;
3. evaluate the role of processing in preserving nutritional value and quality of agricultural commodities;
4. demonstrate proficiency in operating processing equipment commonly used in agriculture;
5. apply quality control measures during the processing of agricultural products;
6. assess the environmental impact of processing and storage practices in agriculture;
7. develop strategies for minimizing post-harvest losses through efficient processing and storage;
8. implement safety protocols and regulations in processing and storage facilities;
9. utilize appropriate packaging materials for maintaining product freshness during storage;
10. design and optimize storage facilities for different types of agricultural products;
11. investigate the economic implications of processing and storage decisions in agriculture;
12. integrate technology and automation for enhancing processing and storage efficiency;
13. monitor and maintain optimal storage conditions to prevent spoilage and contamination; and
14. implement traceability systems to track the journey of agricultural products from processing to storage.

Learning Outcomes

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

1. apply at least three (3) processing methods to enhance the value of agricultural products;
2. demonstrate proficiency in implementing effective storage techniques for at least three (3) agricultural commodities;
3. assess the nutritional quality and integrity of at least two (2) processed agricultural products;
4. operate at least one (1) processing equipment accurately to ensure product quality and safety;
5. implement quality control measures to maintain standards during processing;
6. analyze at least five (5) environmental impact of processing and storage activities;
7. develop at least one (1) strategy to minimize post-harvest losses through efficient processing and storage practices;

8. adhere to at least three (3) safety protocols and regulations to ensure a secure processing and storage environment;
9. select three (3) appropriate packaging materials to preserve the freshness and quality of stored products;
10. design at least one (1) storage facilities tailored to the specific requirements of different agricultural products;
11. evaluate the economic implications of processing and storage decisions in agriculture;
12. integrate technology and automation to optimize processing and storage efficiency;
13. monitor storage conditions to prevent spoilage and contamination of agricultural products; and
14. implement traceability systems to track the origin and handling of processed products.

Course Contents

Introduction to Post-Harvest Management (importance of post-harvest handling, processing, and storage in preserving agricultural products). Post-Harvest Physiology (understanding the physiological changes that occur in harvested crops and their impact on quality and shelf life). Harvesting methods and techniques. Post-Harvest Handling Practices. Cleaning and Grading. Pre-cooling and temperature management. Packaging materials and methods (types of packaging materials suitable for different agricultural products and methods to optimize packaging for preservation). Controlled atmosphere storage (principles and applications of controlled atmosphere storage for maintaining product quality and extending storage life). Drying and dehydration (techniques for drying and dehydrating agricultural products to reduce moisture content and prevent spoilage). Refrigeration and cold storage. Ripening and ethylene control (strategies for controlling the ripening process and managing ethylene levels to prolong the shelf life of fruits and vegetables). Post-harvest disease management. Value-added processing (introduction to value-added processing techniques such as juicing, canning, freezing, and fermentation to enhance product value and marketability). Quality control and assurance.

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

UIL-ABE 534: Application of Solar Energy to Agricultural and Biological Systems
(2 Units C: LH 30)

Senate-approved relevance

Graduates in agricultural engineering must have a thorough understanding of solar energy technology to be competitive in the agriculture industry, as its use is becoming increasingly important. The utilization of solar energy has become a critical component of the agricultural sector, and graduates must develop proficiency in the application of solar energy tools and techniques. As solar energy technology continues to evolve and shape the agricultural industry, a firm understanding of this field will equip graduates to excel and succeed in this dynamic area of agriculture.

Overview

This course focuses on harnessing solar energy to meet the energy needs of agricultural and biological systems. Students will explore the design and installation of solar energy systems for various applications, such as irrigation, greenhouse heating, and ventilation. The course also covers principles of photovoltaic technology, solar thermal energy, and energy storage, emphasizing economic and environmental benefits in the agricultural sector.

Objectives

The objectives of this course are to:

1. explain the basic principles of solar energy and its relevance to agriculture and biological systems;
2. describe the principles of solar energy and its potential applications in agricultural and biological systems;
3. evaluate the economic and environmental benefits of solar energy use in agriculture;
4. analyze the design and operation of solar energy systems for various agricultural and biological applications;
5. demonstrate the ability to calculate energy requirements and perform energy audits in agricultural systems;
6. develop strategies for integrating solar energy with existing agricultural systems;
7. identify the challenges associated with the use of solar energy in agricultural and biological systems and propose solutions to address them;
8. apply knowledge of solar energy to design and optimize energy systems for specific agricultural and biological applications;
9. evaluate and compare different types of solar energy systems in terms of their efficiency and cost-effectiveness;
10. develop design skills for implementing solar energy systems for agricultural and biological use; and
11. evaluate and compare the benefits and limitations of solar energy systems with conventional energy sources.

Learning Outcomes

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

10. Demonstrate comprehension of solar energy principles and their application in agriculture and biological systems;
11. Describe the potential applications of solar energy in various agricultural and biological contexts;
12. evaluate the economic and environmental advantages of employing solar energy in agricultural practices;
13. Analyze the design and operation of solar energy systems tailored to agricultural and biological needs;
14. Apply quantitative methods to determine energy requirements and conduct audits in agricultural settings;
15. Develop strategies to effectively integrate solar energy into existing agricultural infrastructure;
16. Identify challenges related to solar energy utilization in agriculture and propose viable solutions;
17. Utilize solar energy knowledge to optimize energy systems for specific agricultural and biological purposes;
18. assess different solar energy system types for efficiency and cost-effectiveness in agricultural applications; and
19. Acquire design proficiency in implementing solar energy solutions for agricultural and biological use.

Course Contents
Introduction to Solar Energy (basic principles of solar energy, types of solar energy technologies and their potential applications in agriculture and biology). Solar energy technologies (Solar Photovoltaics (PV), Concentrated Solar Power (CSP) and Solar Thermal. Energy requirements analysis. Solar energy storage technologies. Design and implementation of solar energy systems. Economic and environmental benefits of solar energy. Sustainable agriculture and solar energy. Integration of solar energy into agricultural and biological Systems. System Design and Implementation. Solar energy system optimization. Solar energy system maintenance. Limitations and challenges of solar energy in agriculture and biology. Solar Energy Economics and financing. Economic and environmental benefits.
Minimum Academic Standards
As stated in 70% developed NUC CCMAS

UIL-ABE 535: Handling of Agricultural and Biological Materials (2 Units E: LH 30)

Senate-approved Relevance
The Senate enthusiastically approves the introduction of the course Handling of Agricultural and Biological Materials. Located strategically in the vibrant North Central region of the country, this course is designed to address the specific agricultural challenges prevalent in our geographical area. Aligned with the university's vision to be a center of excellence in learning, research, and service, the program embodies our commitment to equipping students with knowledge and skills crucial for sustainable agricultural practices. By focusing on material handling techniques, safety, and environmental considerations, the course aligns seamlessly with our mission to produce graduates who actively contribute to the economic development and environmental stewardship of our region and beyond. The Senate believes that this course not only enhances the academic curriculum but also reflects our dedication to addressing regional agricultural needs and fostering responsible practices.

Overview
This course is designed to equip students the fundamentals of safe and efficient handling of agricultural and biological materials. Students explore storage, transportation, processing, and disposal practices, learning to mitigate risks and ensure quality. Through theoretical study and practical exercises, they develop skills to manage these materials effectively, considering environmental sustainability and safety regulations. This course equips students to navigate the complexities of handling agricultural and biological materials in diverse settings.
Objectives
The objectives of this course are to:
1. analyze the principles and techniques involved in the safe handling of agricultural and biological materials;
2. evaluate the environmental and health implications of various material handling practices;
3. assess machinery and equipment used in the efficient handling of agricultural and biological materials;
4. examine safety protocols and risk management strategies associated with material handling processes;
5. develop skills in analyzing material properties and characteristics for optimal handling;

6. evaluate the economic implications of material handling methods, considering cost-effectiveness and sustainability;
7. analyze the impact of material handling on environmental conservation and waste management;
8. explore sustainable practices in the handling of agricultural and biological materials;
9. investigate the role of technology in optimizing material handling processes; and
10. apply analytical thinking to propose and implement improvements in material handling techniques.

Learning Outcomes

At the end of this course students would be able to:

1. assess and address at least three (3) environmental and health implications associated with material handling practices;
2. select at least two (2) appropriate machinery and equipment for efficient material;
3. employ at least five (5) safety protocols and risk management strategies in the handling of agricultural and biological materials;
4. assess at least four (4) material properties and characteristics for optimal handling;
5. conduct economic analyses to inform decision-making on material handling methods;
6. optimize material handling processes and enhance efficiency through technology integration;
7. familiarize students with at least five (5) processing food operations (cleaning, grading, size reduction, mixing, filtration, and material handling);
8. enumerate at least five (5) food packaging materials and packaging methods;
9. explain at least five (5) methods and equipment for handling small and large scale of agricultural products;
10. explain at least five (5) equipment for handling small and large scale of agricultural products; and
11. select at least five (5) agricultural produce handling equipment such as elevators, cranes, forklifts, trucks, carts, etc.

Course Contents

Principles and techniques of material handling. Environmental and health implications. Machinery and equipment in material handling. Design and construction of appropriate material handling equipment for agricultural and biological materials. Safety protocols and risk management. Material properties and characteristics. Economic implications of material handling. Integration of automation and robotics in material handling processes. Ergonomic in material handling design and operations. Application of Internet of Things (IoT) in optimizing material handling efficiency. Adoption of lean manufacturing principles in material handling systems. Newtonian and non-Newtonian fluids. Impact on environmental conservation and waste management. Quality control in material handling processes. Optimization of material handling workflows. Advanced in material handling techniques.

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

UIL-ABE 536: Processing of Agricultural and Biological Materials (2 Units E: LH 30)
Senate-approved Relevance
Nestled strategically in the North Central region of the country, our university is uniquely positioned to address the distinctive agricultural challenges prevalent in this geographical area. Aligned with the university's vision to be a center of excellence in learning, research, and service, this course is a testament to our commitment to fostering expertise in processing techniques vital for sustainable agricultural practices. By delving into the intricacies of material processing, safety protocols, and environmental considerations, the program mirrors our mission to produce graduates who actively contribute to the economic development and environmental sustainability of our region and beyond. The Senate believes that this course not only enriches our academic offerings but also resonates with our dedication to addressing regional agricultural needs and promoting responsible practices.

Overview
This course is designed to examine techniques for handling agricultural and biological materials effectively. The focus of the course will be on storage, transportation, processing, and disposal practices, emphasizing risk mitigation and quality assurance. Additionally, factors influencing the selection of processing methods and their respective impact on the quality and safety of end products will be taught. Students will develop skills to optimize processing parameters for efficiency and quality.

Objectives
The objectives of this course are to:
1. analyze principles and techniques pertinent to processing agricultural and biological materials;
2. evaluate factors influencing the selection of processing methods for diverse raw materials;
3. assess the impact of processing on the quality and safety of agricultural and biological products critically;
4. examine advancements in processing equipment technology and its applications;
5. develop skills in analyzing and optimizing processing parameters to enhance efficiency and product quality;
6. evaluate the economic aspects of processing operations and their industry implications;
7. analyze the environmental impact of processing methods and explore sustainable alternatives;
8. investigate emerging trends in processing technologies and their potential applications;
9. assess regulatory frameworks governing processing practices for agricultural and biological materials; and
10. explore innovative approaches to improve processing efficiency and diversify product offerings.

Learning Outcomes
1. apply at least three (3) processing principles and techniques to agricultural and biological materials;
2. evaluate and select at least four (4) appropriate processing methods based on raw material characteristics and processing requirements;
3. analyze the effects of processing on product quality and safety, assessing at least five (5) different product attributes.;

4. Demonstrate proficiency in at least three (3) types of processing equipment;
5. optimize at least three (3) processing parameters to improve efficiency and enhance product quality;
6. enumerate at least four (4) economic factors that impact the profitability of processing operations;
7. propose at least two (2) sustainable processing alternatives and their benefits to minimize;
8. enumerate at least five (5) recent technological advancements in processing technologies and their applications;
9. demonstrating at least three (3) relevant regulations or standards governing processing agricultural and biological materials; and
10. develop at least one (1) novel processing method or technique to enhance processing efficiency and product diversification.

Course Contents

Introduction to agricultural and biological material processing. Principles and techniques of agricultural and biological material processing (heat processing, drying, milling, extrusion, fermentation, and preservation). Factors influencing the selection of processing methods (raw material characteristics, efficiency, product quality, market demand, and nutritional value). Impact of processing on product quality, safety, and shelf life. Technological advancements in processing equipment (modern processing equipment, automation, robotics, and precision control systems). Optimization of processing parameters for efficiency and product quality. Economic analyses of processing operations (cost-benefit analysis, market value, and profitability). Environmental impact assessment and sustainable alternatives (waste management, energy efficiency, and resource conservation). Emerging trends in processing technologies (nanotechnology, bioprocessing, and smart packaging). Regulatory requirements and quality standards in agricultural and biological material processing. Food safety and hygiene practices in processing facilities. Value addition and product diversification strategies. Process automation and control systems in food and biological material processing. Supply chain management and logistics in processed food distribution. Consumer preferences and market trends in processed agricultural and biological products. Food packaging technologies and materials for product protection and preservation. Case studies and practical applications in agricultural and biological material processing.

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

UIL-ABE 537: Bioprocess Engineering (2 Units E: LH 30)

Senate-approved relevance

It is essential that agricultural engineering graduates have in-depth knowledge of the design, development, and optimization of bioprocesses for various agricultural applications to prepare them for the global job market in a bioprocess-driven industrial landscape. Graduates with a solid understanding of bioprocess engineering will be well-equipped and employable in this expanding field as bioprocess engineering developments continue to influence the agricultural industry.

Overview

The design, optimization, and operation of biological processes used to produce food, fuel, and other products will be the focus of this course. In addition, the course covers the application of

biological and engineering principles to create efficient processes that maximize yields, minimize costs, and minimize waste. Biological systems used in bioprocess engineering, such as fermentation, enzyme production, biorefinery concepts and bioprocessing for the circular economy, as well as the design of bioreactors, separation systems, and downstream processing will be taught.

Objectives

The objectives of this course are to:

1. define the principles and concepts of bioprocess engineering, including biochemical reaction kinetics, mass transfer, and bioreactor design.
2. analyze and model bioprocesses, including fermentation, enzyme catalysis, and cell culture systems.
3. develop skills in bioreactor design, operation, and optimization.
4. evaluate the different types of bioprocesses, including batch, fed-batch, and continuous systems.
5. analyze and optimize downstream processing, including purification, separation, and formulation of by-products.
6. evaluate the environmental and economic impacts of bioprocess engineering.
7. identify and describe the biological processes used to produce food, fuel, and other products.
8. apply engineering principles to optimize the design and operation of bioprocess systems.
9. evaluate the economic and environmental impacts of bioprocess engineering in agricultural systems.
10. design bioreactors, separation systems, and downstream processing systems for specific bioprocess applications.
11. analyze and interpret data from bioprocess experiments and simulations.
12. apply emerging trends in bioprocess engineering to agricultural applications, such as biorefinery concepts and bioprocessing for the circular economy.

Learning Outcomes

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

1. describe the fundamental principles of bioprocess engineering;
2. analyse the basic principles and applications of bioprocessing as it relates to the production of valuable products and by-products from agricultural materials and agricultural waste materials;
3. analyse the impact of process variables on bioprocess performance and make informed decisions to improve process efficiency;
4. design, construct, and operate bioprocess engineering systems, such as bioreactors and waste treatment systems;
5. analyze the environmental impact of bioprocessing, including the production of greenhouse gases, waste disposal, and the impact on water and soil resources;
6. apply mathematical modeling and simulation techniques to design, optimize, and predict the performance of bioprocesses;
7. evaluate the performance of bioprocesses using process and product quality control methods;
8. evaluate the economic and environmental feasibility of bioprocesses and develop strategies to minimize costs and waste;
9. demonstrate proficiency in the use of analytical and computational tools to simulate and model bioprocesses;

10. utilize modern bioprocess technologies, such as single-use bioreactors, advanced separation and purification methods, and process intensification techniques;
11. implement quality control measures to ensure product consistency and safety.

Course Contents

Introduction to Bioprocess Engineering (Definition, scope, and applications of bioprocess engineering). Bioreactors (types of bioreactors, design and selection criteria, mathematical modeling of bioreactors). Bioprocess control and monitoring (process variables, process control strategies, process monitoring techniques, instrumentation and control systems). Bioproduct formation (mechanisms of bioproduct formation, effect of process variables on product yield, product formation kinetics). Bioprocess economics (capital and operating costs, economic analysis of bioprocesses, bioprocess optimization). Separation and purification processes (separation and purification techniques, scale-up considerations, and optimization). Bioprocess applications (biofuels). Bioprocess safety, health and environmental considerations. Emerging bioprocess technologies and bioprocess innovation. Future trends in bioprocess engineering.

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

UIL-ABE 538: Storage of Agricultural and Biological Materials (2 Units E: LH 30)

Senate-approved relevance

Nestled strategically within the North Central region, our university is finely tuned to the unique agricultural challenges inherent in this locale. Aligned with the university's visionary aspiration to establish itself as a hub of excellence in learning, research, and service, this course symbolizes our unwavering commitment to enhancing expertise in the storage of agricultural and biological materials for sustainable practices. Through a thorough exploration of storage methodologies, the program seamlessly harmonizes with our fundamental mission to cultivate graduates thoroughly prepared to address the specific agricultural needs of the region. The Senate holds firm in its confidence that this course not only enhances our academic portfolio but also underscores our resolute efforts to promote innovation, economic development, and environmental sustainability both within the North Central region and beyond.

Overview

This course aims at teaching students the most effective storage methods and techniques for agricultural and biological materials. Topics include storage methods, preservation techniques, and quality maintenance strategies. Additionally, students will develop the skills to mitigate risks such as spoilage and contamination while optimizing storage conditions for prolonged shelf life and product quality.

Objectives

The objectives of this course are to:

1. analyze the principles and theories behind the storage of agricultural and biological materials;
2. evaluate factors influencing the selection of appropriate storage techniques for diverse commodities;
3. evaluate the impact of storage conditions on the quality and shelf life of agricultural and biological materials;
4. investigate the role of technology in optimizing storage processes and minimizing losses;

5. assess the impact of storage conditions on the quality and shelf life of agricultural products;
6. evaluate the economic implications of storage practices and their influence on industry sustainability;
7. develop skills in designing and implementing effective storage strategies for diverse biological materials;
8. analyze the environmental sustainability of various storage methods in the context of agriculture;
9. investigate emerging trends in the field of agricultural and biological material storage; and
10. optimise the storage agricultural and biological material.

Learning Outcomes

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

1. demonstrate a thorough understanding of the theoretical foundations of agricultural and biological material storage;
2. discuss at least three (3) appropriate storage methods for specific agricultural products;
3. evaluate and interpret data related to the quality and shelf life of at least three (3) stored materials;
4. utilize technology to optimize at least four (4) storage conditions and minimize losses in agricultural supply chains;
5. enumerate and analyze at least three (3) economic impact of storage practices on the agricultural industry;
6. design and implement at least two (2) effective storage strategies for at least two (2) biological materials;
7. assess the environmental sustainability of at least five (5) storage methods in the agricultural context;
8. adapt storage strategies to meet at least two (2) specific regional or seasonal requirements for agricultural and biological materials;
9. monitor and evaluate the effectiveness of implemented storage solutions through the analysis of at least two (2) key performance indicators.
10. identify and address at least five (5) potential risks and challenges associated with agricultural and biological material storage in diverse environmental conditions;
11. Collaborate with stakeholders to develop comprehensive storage management plans tailored to specific agricultural contexts and needs; and
12. apply at least one (1) IoT and data analytics to monitor and optimize storage conditions.

Course Contents

Introduction to agricultural and biological material storage. Principles of storage (temperature, humidity, and ventilation requirements). Factors influencing selection of storage techniques (commodity characteristics, crop types, shelf life, market demands and environmental conditions influencing storage techniques). Impact of storage conditions on quality (analysis of changes in nutritional content, flavor, and texture). Optimization of storage parameters. Automated storage monitoring. Smart sensors monitoring. Storage data analytics. Economic implications of storage practices (cost-benefit analysis, market trends, and storage infrastructure). Carbon footprint. Energy efficiency. Waste reduction. Innovations and emerging trends in storage. Design and implement effective storage strategies (case studies, simulations, and practical exercises).

Minimum Academic Standards
As stated in 70% developed NUC CCMAS

UIL-ABE 541: Renewable Energy Engineering (2 Units E: LH 30)
Senate-approved relevance
To prepare agricultural engineering graduates for the global job market in a renewable energy-driven industrial landscape, they must have a thorough understanding of the development and implementation of renewable energy systems across a variety of agricultural activities. Renewable energy technologies have become an integral part of the agricultural industry, and graduates must be proficient in the application of renewable energy tools and techniques.

Overview
Renewable energy engineering is a course that introduces agricultural engineering students to the fundamental principles and technologies used in the design, development, and implementation of renewable energy systems. Renewable energy sources, such as solar, wind, hydro, and biomass, offer sustainable alternatives to traditional fossil fuels and have great potential for application in the agricultural sector. Students will learn how to evaluate energy needs, design and optimize renewable energy systems, and analyze their economic and environmental impacts. The course will also cover policy and regulatory issues, as well as emerging trends in renewable energy engineering, preparing students to become leaders in the transition to a more sustainable energy future for the agricultural industry.

Objectives
The objectives of this course are to:
1. analyze the principles and technologies of renewable energy sources;
2. evaluate the feasibility of implementing renewable energy systems in various contexts;
3. design and optimize renewable energy systems for specific applications;
4. assess the environmental impact of renewable energy projects;
5. implement safety protocols and risk management strategies in renewable energy engineering;
6. conduct economic analyses to evaluate the cost-effectiveness of renewable energy solutions;
7. integrate renewable energy technologies with existing infrastructure for enhanced efficiency;
8. explore innovative approaches to harnessing renewable energy resources;
9. develop skills in project planning and management for renewable energy initiatives;
10. analyze policies and regulations governing the deployment of renewable energy systems;
11. conduct research to advance the understanding and application of renewable energy technologies.

Learning Outcomes
At the end of the course, students should be able to:
1. enumerate at least five (5) renewable energy sources;
2. assess the feasibility of implementing at least three (3) renewable energy systems for at least three (3) purposes;
3. apply design principles to optimize renewable energy systems in various applications;

4. evaluate at least three (3) the environmental impacts of renewable energy projects;
5. discuss at least four (4) safety protocols and risk management strategies in renewable energy engineering practices;
6. conduct economic analyses to determine the cost-effectiveness of at least two (2) renewable energy sources;
7. integrate at least two (2) renewable energy technologies to enhance overall efficiency;
8. develop project planning and management skills for renewable energy initiatives;
9. analyze policies and regulations influencing the deployment of renewable energy systems;
10. implement at least two (2) monitoring and performance evaluation techniques to ensure the optimal operation of renewable energy systems; and
11. monitor and evaluate the optimal performance of at least two (2) renewable energy systems.

Course Contents

Fundamentals of renewable energy systems and technologies; Solar energy systems and technology; Wind energy systems and technology; Biomass energy systems and technology; Geothermal energy systems and technology; Applications of renewable energy; Renewable energy integration, including microgrids and smart grids; Energy storage systems and technology; Energy efficiency and conservation methods, such as energy audits and energy management systems; Agricultural energy demand analysis; Environmental impact assessment of renewable energy systems; Life cycle assessment of renewable energy systems; Economic analysis of renewable energy systems; Renewable energy's role in climate change mitigation; Emerging renewable energy technologies; Future trends in renewable energy research and development.

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

UIL-ABE 542: Waste Management Engineering (2Units E: LH 30)

Senate-approved relevance

To prepare agricultural engineering graduates who can be competitive in the current job market, engineering graduates must have a thorough understanding of the design, development, and implementation of waste management technologies for various agricultural applications. Graduates will be well-prepared and employable in this dynamic sector of agriculture if they have a comprehensive grasp of waste management technology as it continues to transform the agricultural business.

Overview

This course covers the classification and characterization of agricultural waste, as well as methods for collection, treatment, and disposal. The course also covers emerging technologies for the conversion of agricultural waste into value-added products, such as biofuels, biogas, and fertilizer, as well as strategies for reducing waste generation through improved production practices, and resource conservation and the associated environmental and health risks of wastes.

Objectives

The objectives of this course are to:

1. define the principles and concepts of waste management engineering, including waste generation, characterization, and treatment;
2. list and describe different waste management techniques for agricultural systems;

3. identify and evaluate the different types of waste management systems and technologies available;
4. analyze the environmental and health impacts of different waste management strategies;
5. analyze the environmental impact of waste management on agricultural systems;
6. evaluate the effectiveness of different waste management techniques for agricultural systems;
7. develop design skills for implementing waste management systems, including landfill, composting, recycling, and incineration;
8. identify the economic factors that influence waste management decisions in agricultural systems.
9. evaluate the efficiency and effectiveness of waste management systems; and
10. apply acquired skills to evaluate and improve waste management practices in agricultural systems.

Learning Outcomes

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

1. analyze the generation and characterization of at least three (3) types of waste streams;
2. explain the hierarchy of waste management: reduction, reuse, recycling, recovery, characterization and disposal to minimize waste generation and promote circular economy;
3. apply at least three (3) principles of waste management engineering to identify and analyze at least three (3) sources of waste generation in different settings;
4. analyze the at least five (5) physical, chemical, and biological properties of at least three (3) types of waste;
5. list at least three (3) impacts of waste on air quality, water quality, and soil quality and human health;
6. analyze and evaluate at least three (3) waste management policies and regulations, and develop waste management plans and strategies;
7. develop and apply at least two (2) appropriate methods for waste collection, transportation, and disposal;
8. analyse of the technical and economic feasibility of waste-to-energy and energy recovery;
9. analyse at least four (4) benefits and challenges of different waste management practices and systems;
10. evaluate at least four (4) environmental impact of waste disposal methods and recommend sustainable alternatives.
11. use at least one (1) mathematical models and statistical analysis to estimate waste generation and predict future trends.

Course Contents

Introduction to waste management (definition and scope of waste management, types of waste and basic concepts in waste minimization and pollution control). Waste generation and characterization. (waste generation patterns and trends and Collection and measurement of waste data). Collection and transportation of waste. Waste storage (techniques for safe storage, handling, and disposal of hazardous and non-hazardous waste materials). Waste treatment. Waste disposal. Recycling and resource recovery (Collection, sorting, and processing of recyclable materials). Waste management planning and regulation (analysis of waste management policies and regulations, including local, state, and national). Environmental impacts. Health impacts. Life Cycle assessment and sustainability (assessment of the environmental and social impact of waste

management practices, from generation to disposal). Waste-to-energy and energy recovery. Special topics in waste management (specific focus on agricultural waste).

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

UIL-ABE 544 Bioenvironmental Engineering (2 Units E: LH 30)

Senate-approved relevance

Given the university's strategic location in the North Central region of the country, this program is uniquely positioned to address the specific environmental challenges prevalent in this region. Aligned with the university's vision to be a center of excellence in learning, research, and service, this course embodies our commitment to sustainable practices and environmental stewardship. It integrates engineering principles with a focus on bioenvironmental solutions, ensuring graduates contribute to the advancement of ecologically conscious practices. The Senate firmly believes that this course not only aligns with the university's mission but also positions our institution as a leader in addressing the pressing environmental issues in the North Central region and beyond.

Overview

This course is multifaceted as it is an intersection of biology, engineering, and environmental science. This course focuses on applying engineering principles to address environmental challenges. Students study topics such as pollution control, waste management, ecosystem conservation, the design and implementation of bioenergy systems, biological processes in wastewater treatment, and controlled environment agriculture. The course emphasizes sustainable solutions for improving environmental quality while considering biological factors

Objectives

The objectives of this course are to:

1. analyze the fundamental principles of bioenvironmental engineering and its applications;
2. evaluate the impact of bioenvironmental engineering solutions on environmental sustainability;
3. assess the design and implementation of bioenergy systems for sustainable practices;
4. examine the integration of biological processes in wastewater treatment and environmental restoration;
5. develop skills in analyzing and designing controlled environment agriculture systems;
6. evaluate the ecological impact of bioenvironmental engineering interventions in diverse ecosystems;
7. analyze the role of bioengineering in mitigating environmental pollution and promoting public health;
8. explore the application of bio-based materials in sustainable construction and infrastructure;
9. apply analytical skills to troubleshoot and solve real-world challenges in bioenvironmental engineering;
10. design innovative solutions for waste management and resource recovery;
11. assess the environmental impact of bioenergy production and utilization;
12. investigate the potential of bioremediation techniques in environmental cleanup efforts;
13. analyze the principles of phytoremediation and its applications in soil and water remediation;
14. evaluate the effectiveness of biofiltration systems in air quality improvement; and
15. explore the use of biotechnology in environmental monitoring and assessment.

Learning Outcomes

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

1. define at least three (3) fundamental principles and applications of bioenvironmental engineering;
2. assess the effectiveness of bioenvironmental engineering solutions to at least four (4) environmental challenges;
3. analyze and evaluate at least two (2) bioenergy systems for sustainable practices;
4. enumerate at least three (3) biological processes for wastewater treatment and environmental restoration;
5. analyze and design at least one (1) controlled environment agriculture systems;
6. evaluate at least five (5) ecological impacts of bioenvironmental engineering interventions in diverse ecosystems;
7. analyze the role of bioengineering in mitigating at least three (3) environmental pollution;
8. utilization of at least three (3) bio-based materials in sustainable construction projects;
9. design at least two (2) innovative solutions for waste management and resource recovery;
10. assess at least four (4) environmental impact of bioenergy production and utilization;
11. evaluate the effectiveness of at least three (3) bioremediation techniques in environmental cleanup;
12. analyze at least five (5) principles of phytoremediation and their applications in soil and water remediation;
13. evaluate at least three (3) performance of biofiltration systems in improving air quality; and
14. apply at least three (3) biotechnology tools in environmental monitoring and assessment.

Course Contents

Introduction to bioenvironmental engineering. Environmental sustainability assessment bioenergy systems. Biological processes in wastewater treatment. Controlled environment agriculture. Ecological impact assessment. Bioengineering for pollution mitigation. Bio-based materials in construction. Urban ecology and green infrastructure. Bioremediation techniques for contaminated sites. Carbon capture and sequestration technologies. Climate change adaptation strategies in bioenvironmental engineering. Social and cultural aspects of environmental conservation. Environmental remediation techniques. Sustainable waste management practices. Advanced topics in bioenergy systems. Innovative applications of biotechnology in environmental engineering. Integration of renewable energy sources in environmental management. Ethical considerations in bioengineering applications.

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

UIL-ABE 552 Fundamental of Food Engineering I (2 Units E: LH 30)

Senate-approved relevance

Recognizing the strategic location of our university in the North Central region of the country, this program is meticulously designed to address the unique agricultural and food processing challenges prevalent in this geographical area. Aligned with the university's vision to be a center of excellence in learning, research, and service, this course embodies our commitment to advancing knowledge and expertise in food engineering. It lays a foundation for future professionals who will contribute to the enhancement of food processing practices, agricultural

productivity, and economic development in our region. The Senate is confident that this course not only aligns with the university's mission but also positions our institution as a catalyst for positive change in the food industry within the North Central region and beyond.

Overview

This course is designed to examine the foundational principles and applications in food engineering. The course will delve into the physical and chemical properties of food materials, understanding their significance in various engineering processes and also cover topics such as heat and mass transfer phenomena, fluid mechanics applications, and the role of thermodynamics in food processing. Practical aspects include the design and analysis of basic food processing operations, exploration of preservation techniques, and an in-depth examination of unit operations like milling and separation and the impact of packaging on food quality and safety.

Objectives

The objectives of this course are to:

1. analyze the fundamental principles of food engineering and their applications in food processing;
2. evaluate the physical and chemical properties of food materials relevant to engineering processes;
3. assess heat transfer mechanisms and their role in food preservation and processing;
4. examine mass transfer phenomena in the context of food engineering and preservation;
5. develop skills in analyzing and designing unit operations used in food processing;
6. analyze the principles of fluid flow and their applications in food engineering processes;
7. evaluate the role of heat exchangers and their efficiency in food processing applications;
8. explore principles of food packaging and assess their impact on product quality and safety;
9. investigate the integration of automation and technology in modern food engineering practices; and
10. apply analytical thinking to troubleshoot and solve practical challenges in food engineering processes.

Learning Outcomes

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

1. define food engineering;
2. assess at least five (5) physical and chemical characteristics of food materials in engineering contexts;
3. apply heat transfer mechanisms to optimize food preservation and processing techniques;
4. analyze mass transfer phenomena and their significance in food engineering and preservation of at least two (2) agricultural produce;
5. design and implement at least one (1) food processing unit for one food product;
6. apply at least three (3) principles of fluid flow to enhance efficiency in food engineering processes;
7. enumerate at least two (20) principles of food rheology and texture analysis;
8. discuss the principles of food packaging and their implications for product quality and safety at least two (2) food products;
9. employ at least two (2) quality control measures to ensure the safety and integrity of food products; and

10. utilize at least one (1) mathematical modeling and simulation technique to optimize food production processes.

Course Contents

Introduction to Food Engineering. Physical and Chemical Properties of Food Materials. Heat Transfer Mechanisms in Food Processing. Application of heat transfer principles for preservation and processing. Mass Transfer Phenomena in Food Engineering. Unit Operations in Food Processing. Principles of Fluid Flow in Food Engineering. Heat Exchangers in Food Processing. Food Packaging Principles. Principles of food rheology and texture analysis. Food emulsions and colloidal systems. Food sensory evaluation techniques. Food safety and quality assurance. Food process modeling and simulation. Innovative food processing technologies. Sustainability and environmental considerations in food engineering. Automation and Technology in Food Engineering.

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

UIL-ABE 554 Fundamental of Food Engineering II (2 Units E: LH 30)

Senate-approved relevance

Recognizing the strategic positioning of our university in the North Central region of the country, this program is intricately designed to tackle the distinct agricultural and food processing challenges prevalent in our locale. Aligned with the university's vision to excel in learning, research, and service, this course exemplifies our dedication to advancing knowledge and proficiency in food engineering. The course establishes the framework for future professionals who will actively contribute to improving food processing practices, agricultural productivity, and economic development in our region. The Senate is confident that this course not only aligns with the university's mission but also positions our institution as a trailblazer in shaping the trajectory of the food industry within the North Central region.

Overview

Fundamentals of Food Engineering II is an advanced course that delves into intricate principles and applications in the dynamic field of food engineering. Building upon foundational knowledge, the course outlines complex scenarios involving heat and mass transfer phenomena, fluid mechanics optimization, and advanced thermodynamics concepts in food processing. Advanced unit operations, such as extraction and encapsulation, are thoroughly examined, alongside the influence of the processing conditions on the nutritional and sensory properties of food.

Objectives

The objectives of this course are to:

1. analyze advanced principles and applications of food engineering in complex food processing scenarios;
2. evaluate the intricate interplay of heat and mass transfer phenomena in diverse food systems;
1. assess the role of fluid mechanics in optimizing complex food processing operations;
3. examine advanced thermodynamics concepts and their applications in food engineering;
4. develop skills in analyzing and designing innovative food processing techniques;
5. evaluate emerging technologies in food preservation and their impact on food quality;

6. analyze unit operations involved in complex food processing, including extraction and encapsulation;
7. investigate the impact of processing conditions on the nutritional and sensory properties of food;
8. explore the utilization of novel packaging materials and techniques in food engineering; and
9. apply analytical skills and knowledge to address contemporary challenges in food engineering.

Learning Outcomes

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

1. discuss at least two (2) of principles in food engineering in complex processing;
2. apply fluid mechanics principles to optimize complex food processing operations effectively;
3. utilize advanced thermodynamics concepts in the analysis and optimization of at least two (2) food engineering processes;
4. design at least two (2) food processing techniques for enhanced efficiency;
5. evaluate and apply emerging technologies in food preservation for improved food quality;
6. investigate at least two (2) nuanced impact of processing conditions on the nutritional and sensory properties of food;
7. examine at least two (2) packaging materials and techniques in food engineering;
8. develop advanced skills in mathematical modeling and simulation for optimizing food processing operations;
9. investigate the use of nanotechnology in enhancing at least two (2) food product quality and safety;
10. evaluate the role of at least two (2) bioprocessing and enzymatic reactions in food engineering applications; and
11. enumerate at least two (2) principles and applications of sensory evaluation techniques in assessing food quality and consumer acceptance.

Course Contents

Advanced principles in food engineering. Advanced heat and mass transfer phenomena. Optimizing complex food processing operations. Advanced thermodynamics in food engineering. Innovative food processing techniques. Advanced unit operations in food processing. Processing conditions and food properties. Utilization of novel packaging materials. Advanced principles of fluid mechanics in food engineering. Cutting-edge developments in food nanotechnology. Advanced enzymatic reactions and bioprocessing in food engineering. High-pressure processing and its applications in food preservation. Advanced techniques in food product formulation and optimization. Computational modeling and simulation in food engineering. Advanced sensory evaluation methods for food quality assessment. Food safety management systems and regulatory compliance. Sustainable packaging solutions for food products.

Minimum Academic Standards

As stated in 70% developed NUC CCMAS

PUIL-ABE 562: Basic Aquacultural Engineering (2 Units E: LH 30)

Senate-approved relevance

The training of high-quality graduates who are to have good knowledge in the design and construction fish ponds, recirculatory aquaculture, hydraulic structures and management of environmental pollution of fish ponds. Graduates will have skill in design of open channels, fish

pond, principles of sedimentation and feeding of fishes. This is in agreement the vision of the University as a centre of excellence in learning, research and service to humanity. The relevance of the course is to produce graduates of Agricultural and Biosystems Engineering that are highly skilled in the design, construction and maintenance of fish ponds, recirculatory aquaculture, control and management of water pollution in aquaculture.

Overview

The course is designed to equip students with knowledge of the theories and skills in hydraulics, flow of water through the network pipes, open channels, energy losses in the pipes and management of environmental pollution of fish ponds. The course is designed to equip the students with principles of design of aquacultural buildings and structures and management of fishes in aquaculture.

The course will prepare the graduates of Agricultural and Biosystems Engineering in handling hydraulics problems in aquaculture, equip the graduates with the knowledge of theory and practical maintenance of fish pond, recirculatory aquaculture, flow of water in fish pond, control and management of water pollution in fish pond to enhance high production of fishes in the country.

Objectives

The objectives of this course are to:

1. identify various energy losses in pipe;
2. compute energy loss in pipe using different methods;
3. determine flow rate through the network pipe;
4. analyse the effect of loading feeds rate on fish growth and health;
5. discuss the principle of recirculation;
6. explain the principles of sedimentation;
7. describe bioinfiltration and mass transfer;
8. identify equipment for ozonization;
9. define irradiation;
10. design aquacultural buildings and structures; and
11. explain aquaponics

Learning outcomes

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

1. state three (3) various energy losses in pipe;
2. compute energy loss in pipe using at least two (2) methods;
3. determine flow rate through the network pipe;
4. evaluate at least three (3) different feeds loading rate;
5. enumerate at least three (3) principles of recirculation;
6. discuss at least three (3) principles of sedimentation;
7. describe bioinfiltration and mass transfer;
8. identify at least three (3) equipment for ozonization;
9. define irradiation
10. design at least one (1) aquacultural building; and
11. discuss at least three (3) types of aquaponics.

Course Contents
Introduction to aquaculture systems. Aquatic habitat and water quality management. Aquatic species selection and husbandry practices. Pond construction and design principles. Water circulation and aeration systems. Aquatic feeds and feeding practices. Aquatic health management and disease prevention. Aquatic farming equipment and machinery. Aquatic harvesting and post-harvest handling. Aquaponics Systems and Integration. Recirculating Aquaculture systems (RAS) design and operation. Waste management in aquaculture operations. Environmental Impact Assessment in Aquaculture. Regulatory Frameworks and Compliance in Aquaculture. Water quality monitoring and control systems. Aquatic habitat Restoration and Enhancement. Integration of aquaculture and hydroponics. Remote sensing applications in aquaculture management.
Minimum Academic Standards
As stated in 70% developed NUC CCMAS

UIL-ABE 564: Aquacultural and Animal Production Engineering (2 Units E: LH 30)
Senate-approved relevance
The training of high-quality graduates who are to have good knowledge in the design and construction equipment for handling fish, equipment for production and processing fish feeds and feeding techniques for aquaculture. Graduates that will have skill in the aquacultural engineering and management of fish farms. This is in agreement the vision of the University as a centre of excellence in learning, research and service to humanity. The relevance of the course is to produce graduates of Agricultural and Biosystems Engineering that are highly skilled in the design, construction and maintenance of equipment for fish and marine animals.

Overview
The course is designed to equip students with the knowledge of the theories and skills in handling equipment for fish feeds production, equipment for slaughtering animals and packaging materials for fish and animal feeds. The course is designed to equip the students with principles of design of aquacultural equipment for handling fishes in aquaculture.
The course will prepare the graduates of Agricultural and Biosystems Engineering in handling equipment in aquaculture, equip the graduates with the knowledge of theory and practical for maintenance of equipment for fishery to enhance high production of fishes in the country.

Objectives
The objectives of this course are to:
1. identify various crops and food materials for fish meals;
2. identify techniques for fish meal production;
3. recognize the food materials for production of marine fish meals;
4. identify machines and structures for fishery production;
5. design simple equipment for cutting, handling fishes and slaughtering animals;
6. recognize the packaging materials for fish meal and fish product;
7. describe the principles of operation some various machines for fishery;
8. recognize the various methods of repairs and maintenance of the fishery equipment
9. design recirculatory aquaculture; and
10. recognize the various preservation methods forfish products and animal products.

Learning outcomes
At the end of the course, students should be able to:
1. list at least five (5) crops and foods materials for fish meal;
2. enumerate at least three (3) techniques for fish meal production;
3. identify at least food materials for production of fish meals;
4. identify at least three (3) machines and structures for fishery production;
5. design at least two (2) simple equipment for cutting, handling fishes and slaughtering animals;
6. state at least three (3) packaging materials for fish meal and fish product each;
7. explain at least three (3) principles of operation of at least one (1) fishery machines;
8. identify at least five (5) methods of repairs and maintenance of the fishery equipment;
9. list some various methods of repairs and maintenance of the fishery equipment; and
10. list at least two (2) preservative methods for fish products.

Course Contents
Principles of aquaculture and animal production. Water quality management in aquaculture systems. Aquatic animal nutrition and feeding practices. Design and construction of aquaculture facilities. Aquatic animal reproduction and breeding techniques. Aquaculture system dynamics and modeling. Aquatic habitat enhancement and management. Mechanical and electrical systems in aquaculture. Aquatic animal welfare and ethics. Aquaponics: integration of aquaculture and hydroponics. Pond and cage culture systems design and operation. Recirculating aquaculture systems (RAS) design and management. Feed formulation and manufacturing for aquatic animals. Waste management and environmental sustainability in aquaculture. Remote sensing applications in aquaculture management. Fish processing and value addition techniques. Livestock housing design and management. Precision livestock farming technologies and applications.

Minimum Academic Standards
As stated in 70% developed NUC CCMAS

UIL-ABE 598: Agricultural and Biosystems Engineering Research II (4 Units C PH 180)
Senate-approved relevance
Recognizing the strategic location of our university in the North Central region of the country, this initiative is carefully curated to confront the distinctive agricultural and biosystems challenges prevalent in our locality. Aligned with the university's vision to champion excellence in learning, research, and service, this research program showcases our commitment to advancing knowledge and proficiency in agricultural and biosystems engineering. It establishes a framework for groundbreaking research that will actively contribute to the development of sustainable agricultural practices, technological innovation, and environmental stewardship in our region. The Senate is confident that this program not only aligns with the university's mission but also positions our institution as a pacesetter in shaping the future of agricultural and biosystems engineering research within the North Central region.

Overview
This course is a culmination of academic learning, providing students with a hands-on opportunity to apply theoretical knowledge to real-world scenarios. Aimed at final-year students, this course engages participants in the planning, execution, and completion of comprehensive engineering projects within the agricultural and biosystems domain. Students delve into practical problem-

solving, project management, and innovation, fostering critical thinking and creativity. The emphasis is on developing solutions to address challenges in agricultural and biosystems engineering, equipping students with valuable skills for their transition into the professional realm. Through this course, students gain a holistic understanding of project development, enhancing their readiness for the dynamic demands of the field.

Learning Outcomes
The project will enable students to:
1. Synthesis all that was learnt in the programme to develop technology or obtain data that can be deployed to solve a major agricultural and biosystems engineering problem.

Course Contents
Individual student project to deepen knowledge, strengthen practical experience and encourage creativity and independent work. The project ends in a comprehensive written report and seminar.

Minimum Academic Standards
As stated in 70% developed NUC CCMAS

Minimum Academic Standards
Equipment

Minimum Laboratories, Workshops and Studios

Category	Minimum Requirement
Laboratories	Farm Power and Machinery Engineering
	Soil and Water Engineering
	Agricultural Processing and Storage Engineering
	Farm Structures and Environmental Control Engineering
Workshops	Farm Mechanics
	Machinery Maintenance
Studio	Engineering Graphics and Drawing

List of Laboratories/Workshops/Equipment/Instruments/ToolsFarm Power and Machinery Laboratory

S/No.	Equipment
1	Tractors for field operation
2	Disc and moldboard ploughs
3	Disc ridger
4	Disc harrow-offset and tandem
5	Planter with fertilizer unit
6	Seed drill
7	Hydraulic boom and hand sprayers
8	Grain combine harvester
9	Agricultural trailer
10	Conveyor test belt
11	Knapsack sprayer test rig
12	Tillage and traction model study unit
13	Single cylinder engine test bed
14	1. Variable compression ration petrol engine test bed
15	Tractor power take-off dynamometre
16	Exhaust calorimetre heat exchanger
17	Fuel consumption measurement system for engine testing
18	Lubricating oil rig
19	Hydraulic power pack
20	Tractor model showing working parts
21	Six speed gear box
22	Tractor real axle section
23	Tractor electrical system
24	Basic transducers for measuring torque, pressure, temperature, etc.
25	Tachometre
26	Single Axle Tractor
27	Blacksmith Furnace
28	Soil Bin for traction Studies

S/No.	Equipment
29	PTO 3-pt linkage Dynamometre
30	Drawbar Dynamometre
31	Ergometre (Hand, Bicycle)
32	Stethoscope
33	Oxygen metre
34	Four-cylinder engine test bed
35	Soil cone penetrometer
36	Solar PV modules
37	Inverters
38	Charge controllers
39	Deep cycle batteries
40	Solar PV training kits
41	Gas chromatograph analyseanalyser for biogas
42	Laboratory anaerobic digester systems
43	Laboratory wind turbine
44	Laboratory wind energy conversion kit
45	Laboratory hydro-power kit
46	Mechanical tool box
47	Electrical tool box
48	Solarimetres
49	Sun metres

Soil and Water Laboratory

S/No.	Equipment
1	General Purpose Theodolite
2	Liquid prismatic compass
3	Surveyor's umbrella
4	Stereoscope
5	Nylon-coated steel tapes-50m
6	Leveling staff
7	Abney level
8	Planimetres
9	Physical Survey Basic Set (Pocket Altimetre, range finder, automatic level set, double prismatic square, ranging rods, land chains-30m, chain, arrows, clinometres)
10	Soil Sampling Augers
11	Soil Texture set
12	Sieve sets with shaking machine
13	Centrifuge
14	Weighing balance
15	Tension metres
16	Double ring Infiltrometre
17	Various types of flumes
18	Current Metres

S/No.	Equipment
19	Pump test set
20	Pump impeller display panel
21	Laboratory infiltration apparatus
22	Sprinkler irrigation set
23	Drip irrigation set
24	Rainfall simulator
25	Rain gauges
26	Hydrological cycle apparatus
27	Constant head permeametres
28	Falling head permeametres
29	Oven
30	Irrigation pipes
31	Beakers
32	Funnels
33	Measuring cylinders-10ms
34	Plain roller
35	Thermometres
36	Hydrometres
37	Rammers
38	Compaction mould
39	Spatula
40	Soil scoops
41	Tensiometre
42	Permeametre
43	Penetrometre/Penetro-logger
44	Soil auger
45	Soil extruder
46	Portable soil metre
47	Analytical balance
48	Electrical balance (3kg)
49	Timer (electric)
50	Stopwatch
51	Liquid limit device machine
52	Glass plate for plastic limit
53	Proctor mould
54	Density bottle
55	High speed stirrer
56	Automatic soil compactor
57	Shrinkage limit apparatus
58	Neutron probe
59	Lysimetres

Agricultural Processing and Storage Laboratory

S/No.	Equipment
1	Standard Rheometres (Digital)
2	Standard Rheometres (Analogue)
3	Muffler furnace
4	Refrigeration and air conditioning cycles kits impact test apparatus (ACV)
5	Elastic behaviours test kits standing hydraulic press
6	Portable crane hoist
7	Vernier calipers
8	Micrometre screw gauges
9	Extrusion press
10	Strain gauges
11	Steam boilers
12	Assorted measuring tools
13	Assorted woodwork tools
14	Assorted carpentry tools
15	Various hand tools
16	Assorted instruments
17	Assorted tools for maintenance, repairs
18	Gas calorimetres
19	Bomb calorimetres
20	Power jack
21	Stroboscope
22	Grading machine
23	Laboratory gravity separator
24	Hammer mills with kit
25	Burr mill with kit
26	Sets of Tyler sieves
27	Métier Electronic (digital readout) balance Universal testing machine)
28	CBR machine (digital)
29	Wind Tunnel (terminal velocity equipment)
30	Drum-type mixers
31	Vibrators
32	Thermocouple print thermometres
33	Crack detection microscopes
34	Ordinary microscopes
35	Modulus of elasticity kit
36	Electronic extensometer
37	Pendulum impact tester
38	Dry-ice maker
39	Hydraulic extruder
40	Dry shrinkage test machine
41	Colour standard test
42	Laboratory air compressors

S/No.	Equipment
43	Moisture determination balance
44	Stop watches, omega
45	Conductivity metre (Wind tunnel for TV)
46	Magnetic stirrers
47	pH-metre (Digital)
48	Laboratory trolley wheel barrows portable digital press
49	Dry mixers
50	Muffle oven
51	Infra-red moisture metre
52	Dryers
53	Drying test apparatus
54	Centrifugal fans
55	Axial fans
56	Cold storage cabins
57	Cabinet refrigerators
58	Deep freezers
59	Humidity measuring equipment
60	Incubations
61	Microwave ovens
62	Air conditioning units
63	Tachometre
64	Robin mixers
65	Tensiometre
66	Silos
67	Shelling machine
68	Centrifuge, standing type
69	Planimetres
70	Stabilizers
71	Laboratory air cleaning machine
72	Laboratory sorting machines
73	Laboratory grading machines
74	Laboratory gravity separators
75	Grain storage bins
76	Centrifugal fans
77	Axial flow fans
78	Grain moisture metres
79	Compression testing machine
80	Tension test machine
81	C.B.R Marshall Tester
82	C.B.R Mould and accessories
83	Feed mill (complete)
84	Apparatus for tensile tests
85	Apparatus for compression tests
86	Bulk density measuring machine

S/No.	Equipment
87	Portable water pumps
88	Grain storage bins
89	Thermometres
90	Sieve shakers
91	Digital weighing balances
92	Standard floor weighing machine, 1000kg
93	Top loading electronic balance
94	Sunshine recorders
95	Standard drawing boards sets
96	Coefficient of friction test apparatus
97	Table top inclination plane (Adjustable)
98	Standard inclination plane (Adjustable)
99	Electrical motor- 10hp
100	Thermographs
101	Pre-cleaners
102	Oil expellers
103	Juice extractor
104	Desiccators
105	Stop watches/clocks
106	Rotary evaporators
107	Gas chromatograph
108	pH-metres
109	Egg incubator
110	Glassware (Assorted)
111	Standard generator
112	Individual computer set
113	Laptops
114	Printers
115	Special computer tables
116	Complete public address sets, high voltage, high frequency
117	Projectors
118	Field vehicles
119	Photocopiers
120	Laboratory chairs, tables, and complete form work

Farm Structure and Environmental Control Laboratory

S/No.	Equipment
Load Measurement Equipment	
1	Compression testing machine
2	Integral boss load measuring rings on compression and tension application
3	100-kN compression/500-kN tension machine
4	33-kN flexural and transverse machine
5	100kN heavy beam flexural and transverse machine

6	Drying and weighing:
7	General purpose electric laboratory oven
8	Incubators
9	Electronic weighing machine
10	Semi-automatic balance
11	Counter flat form scale
12	Mettle weighing machine
13	Spring balance
Soil Equipment	
1	Melting pot
2	Extruder (big and small)
3	Sample mixer
4	Liquid limit device machine
5	Grooving tools
6	Spatulas (big and small)
7	Measuring cans
8	Glass plate for plastic limit
9	Shrinkage limit apparatus
10	Density bottle
11	High speed stirrer
12	Hydrometre (big and small)
13	Standard compaction rammer
14	Automatic soil compactor
15	Procter mould
16	Compaction mould
17	C.B.R -Marshall Tester
18	C.B.R -Mould and accessories
19	Sand cone
20	Trays (big and small)
21	Scoops
22	Desiccators
23	Field density tools
24	Field density spoons
25	Field rubber headed mailer
26	Field club hammers
27	Field density chisel
28	Field metal dibber tool
29	Field scrappers
30	Field density hand pick
31	Field steel pointed rod
32	Glass jar
33	Mortar
34	Rubber headed pestle
35	Glass evaporating dish
36	Filter paper

37	Conical beaker
Concrete Equipment	
1	Slip test apparatus
2	Compacting factor apparatus
3	Penetrometre
4	100mm cube mould
5	150mm cube mould
6	Bean mould
7	Cylinder mould
8	Standard curing tank
9	Three-gang mould for 50mm mortal cube
10	Hand steel float
11	Head pans
12	Wheel barrows
13	Diggers
14	Band trowel
Sand Aggregates and Fillers Equipment	
1	Aggregate impact value apparatus abrasion machine
2	Metal measurement (115mm x 180mm deep)
3	Asphalt Equipment
4	Thermometre
5	Laboratory thermometer
6	Surface thermometer
7	Muffler furnace
8	General Equipment
9	Distiller
10	Measuring tapes
11	Refrigerator
12	Stain gauge indicators
13	Sieve shakers
14	Sets of sieves
15	Set of 200mm diametre (various sizes)
16	Set of 300mm diametre (various sizes)
17	Set of 450mm diametre (various sizes)
18	Vanier caliper
19	Shear box
20	Oedometre (Consolidometre)
21	AAS
22	Automatic weather station
23	Current metre
24	Geometre
25	High performance liquid chromatography (HPLC)

Agricultural Engineering WorkshopsFarm Mechanics Workshop

S/No.	Equipment
Measuring Tools and Instruments	
1	Pocket rule with belt clip (235m)
2	Steel measuring tape caliper rule
3	Procession external micrometre
4	Universal measuring instrument for depth measurement
5	Procession inside micrometre
6	Dial indicator
7	Outside spring caliper
8	Inside spring caliper
9	Metal bar divider
10	Precision tri square
11	Metric threading gauge
12	Wielding and soldering accessories
13	Wielding shield
14	Wielding helmet
15	Goggle clear
16	Wielding goggle
17	Electrode holder
18	Earth clamp
19	Wielding hammer
20	Wire brush
21	Wielding and cutting touches set oxygen acetylene hoses
22	Safety helmet
23	Working and wielding gloves
24	Blowlamp with butane
25	Electrode-All sizes
26	Soldering iron (all sizes light-heavy duty)
27	Soldering lead wire (2mm)
28	Soldering lead in rod
Workshop Hand Tools (Technicians)	
1	Hacksaw frame
2	Hacksaw blades high speed steel Tube cutter 3 – 32mm; 3 – 16mm
3	Steel wire brush
4	Clip plier for external clip
5	Clip plier for internal clip
6	Combination of plier (160, 180mm)
7	Heavy duty diagonal cutter constructed steel cutter (800mm)
8	Universal grip plier (250mm)
9	Welding grip plier (280mm)
10	Riveting tool set
11	Engineering hammer (200g – 250g)
12	Sledge hammer

13	Rubber hammer
14	Clipping chisel (150 – 250mm)
15	Welding hammer
16	Standard ring spanners
17	Combination spanner set
18	Scrapper
19	Hand gloves
20	Centre punch set (120x12) mm
21	Chisel set
22	Flat file (150-300) mm
23	Square file (150-300) mm
24	Half round file (150-300) mm
25	Round file (150-300) mm
26	Blacksmith tong (150-300) mm
27	All steel vices (100-175) mm
28	Pipe cutter (10-60) mm; (42-10) mm
29	Anvil with two horns (100 kos)
30	Technician tool box (empty)
Woodwork Equipment	
1	Band saw-table size-700 x 980mm - 3hp
2	Radial arm saw 3hp (with extra blade)
3	Circular saw-blade dia-400mm with external blades
4	Universal woodworker combined-4hp seven works model
5	Single cylinder planner-4hp (surface planner with extra blades)
6	Vertical Motorize-chain motorise-3hp with extra bits
7	Router drilling machine-3hp
8	Combined tennoning and scribing machine
9	Belt sanding machine-2hp (with extra sanding paper reels)
Hand Tools (Carpentry)	
1	Marking gauge
2	Mortise gauge
3	B. spirit level universal
4	Motorize chisel-(6.4, 9.6, 12.7, 16) mm
5	Flat chisel-(6.4, 9.6, 12.7, 16) mm
6	Bevel edge chisel – (6.4, 9.6, 12.7, 16) mm
7	Round chisel (6.4, 9.6, 12.7, 16) mm
8	Smooth plane-jack plane, plough plane
9	Wood rasp
10	Hand saw or panel saw
11	Ripsaw, crosscut
12	C- Clamp
13	F- Clamp
14	Wood bench vice
15	Jack plane
16	Hand drilling machine/rachet brazed bits

17	Sanding machine-heavy duty
18	Surface and thickness (100-150) mm blade
19	Extra knives carpentry machine planner and thicknesser
20	Air compressor-tank capacity 500 litres complete with accessories-type spraygun and air blow-gun
21	Hydraulic garage jack (1, 2, 6 ton)
22	Hydraulic workshop crane (2.5 tones)
23	Battery tester, cell tester, acid tester
24	Battery fast and slow charger (6-24V,20Λ)
25	Battery service equipment
26	Spark plug tester and cleaner
27	Hydraulic mobile crane (1.5 – 5tons)
28	Wire rope winch- (1500 – 3000kg)
29	Chain host
30	Pedal operated grease gun
31	Hand lever grease gun
32	Exhaust gas tester
33	Standard tool box mechanics
34	Standard tool box for electricians
35	Electric hand drill 100mm
36	Electric two speed drill 23mm
37	Electric hand drill 13mm
38	Straight electric hand grinder 125mm
39	Angle electric hand grinder 230mm

Machinery Maintenance Base

S/No.	**Equipment**
1	Hydraulic trolley
2	Wheel alignment gauge
3	Electrical/Electronic kit
4	Clutch alignment gauge
5	Vacuum tester
6	Battery charging equipment
7	Injector repair machine
8	Carburetor service kit
9	Hydraulic press
10	Vulcanizing set
11	Oxyacetylene equipment
12	Nozzle testing outfit
13	Tool boxes
14	Complete set of various maintenance kits

Engineering Graphics and Design Studio

S/No.	Equipment
1	50 Computer work stations with design and graphic software from theAutoCad suite (FUSION 360, etc.), 3-D printers and accessories.
2	50 drawing boards and T-squares
3	Large screen and projector

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalent of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 18 credits per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical and supervision of projects. Each workshop or laboratory should have adequate number of staff with the right mix, so that each unit or section in that workshop or laboratory can run efficiently.

NUC requirement encourages all academic staff to have PhD degrees, hence appointmentof academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practicals and field work. This category of personnel is not expected to be regular staff as they are tobe paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staffs that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC:

1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academicstaff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix,such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate caliber forthe office of the Head of Department to run.

Library

There must be adequate library facilities to cater for the interest of all the programmes in the faculty. These include current journals, handbooks, textbooks, manuals, codes of practice, standards and specifications in sufficient numbers.

Classrooms, Laboratories, Workshops, Clinics and Offices

The NUC recommends the following physical space requirement:

Academic	**m^2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

S/No	Office	No in Room	Facilities
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computerunit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computerunit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computerunit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computerunit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

REGULATIONS
EXAMINATION CODE OF CONDUCT, OFFENCES AND PENALTY

Candidates shall:

a. Not use or consult books, papers, instruments or other materials or aids during the examination except permitted or provided by the University;
b. Not introduce or attempt to introduce into the examination venue, hand bags, books, notes, mobile phones, instruments or aids that are not permitted;
c. Not enter the examination venue with any inscriptions on any part of the body e.g. palm, arm, thigh, etc. and/or any material if such inscriptions bear relevance to the examination;
d. Not pass or attempt to pass any information from one person to another during an examination;
e. Not act in collaboration with any other candidate(s) or person(s) or copy or attempt to copy from another candidate or engage in any similar activity;
f. Not disturb or distract other candidate(s) during examination;
g. Not be allowed to leave the examination venue until after 75% of the time allocated for that particular paper has expired;
h. Not use other people to sit for the University examination on their behalf;
i. Not smoke in the examination hall;
j. Not be in possession of incriminating material(s) either used or unused during the examination or involved in any other serious examination misconduct including impersonation before, during or after the examination; and
k. Be orderly and abide by rules or guidelines at the centre in the case of CBT examinations.

Any candidate found guilty of these offences; the penalty is EXPULSION.

APPENDIX

Appendix I: List of Reviewers (NUC 70%)

Title	Surname	First Name	Institution	Programme
Professor	FABORODE	Michael O.	Obafemi Awolowo University, Ile-Ife	**Discipline Chairman**
Professor	OLOCHE	O. B.	University of Abuja, Abuja	Mechanical Engineering
Professor	EKECHUKWU	Onyemaechi Valentine	University of Nigeria, Nsukka	Mechanical Engineering
Engineer	ALI	Kashim	COREN	Mechanical Engineering & General Discipline
Professor	OLORUNMAIYE	John Adesiji	University of Ilorin,	Mechanical Engineering & General Discipline
Lt. Col. Dr	IMAM	A.S.	Nigerian Defence Academy, Kaduna	Mechatronics Engineering
Professor	ASERE	Abraham	Elizade University, Ilara-Mokin.	Automotive Engineering
Professor	EDOKPIA	Raphael Olumese	University of Benin, Benin-City	Industrial and Production Engineering
Professor	FUBARA-MANUEL	Isoteim	Rivers State University, Port Harcourt	Marine Engineering
Professor	FAKINLEDE	O. A.	University of Lagos, Lagos	Systems Engineering
Professor	OGBONNA	Chibueze Achimba	Babcock University, Ilishan Remo	Computer Engineering
Professor	BOYI	Jimoh	Ahmadu Bello University, Zaria	Electrical Engineering
Professor	ADEDIRAN	Yinusa Ademola	University of Ilorin	Electrical and Electronics Engineering
Professor	AZUBOGU	Augustine Chukwuemeka O.	Nnamdi Azikiwe University, Awka	Electronics Engineering
Professor	NYITAMEN	Dominic Saaityo	Nigerian Defence Academy, Kaduna	Telecommunication Engineering
Professor	LETON	Tambari Gladson	University of Port Harcourt	Environmental Engineering

Professor	ITODO	Isaac Nathaniel	Joseph Sarwan Tarka University, Makurdi	Agricultural and Biosystems Engineering
Professor	OKAFOR	Gabriel Ifeanyi	University of Nigeria Nsukka	Food Science and Technology
Professor	HASSAN	Suleiman Bolaji	University of Lagos, Lagos	Materials and Metallurgical Engineering
Professor	AJAYI	John Ade	Federal University of Technology, Akure	Metallurgical Engineering
Professor	IKHU-OMOREGBE	Daniel	Benson Idahosa University, Benin-	Chemical Engineering

List of NUC Representatives

Title	**Surname**	**First Name**	**Programme**
Mr	MALLAM	Gambo	Electronics Engineering & Industrial and Production Engineering; **Discipline Representative**
Mr	WACHUKWU	Obinna	Mechanical Engineering
Mr	OHANME	Bartholomew	Mechatronics Engineering & Petrochemical Engineering
Mrs	EMMANUEL	Chinenye Augustine	Automotive Engineering & Agricultural and Biosystems Engineering
Mr	EMENEM	Chinweokwu	Marine Engineering
Mrs	AKAUBA	Vivian	System Engineering
Mr	AKINOLA	Akinlabi	Computer Engineering
Mr	NWAGWU	James Chile	Electrical Engineering
Miss	ADENIJI	Yemisi	Electrical and Electronics Engineering
Mr	WADA	Arome J.	Telecommunication Engineering
Mrs	ABIMBOLA	Oni	Environmental Engineering
Mrs	OKPEKU	Omoh	Food Science and Technology
Mr	OSEMEKE	Bright	Materials and Metallurgical Engineering
Mr	ZAMUNA	Musa	Metallurgical Engineering
Mr	ADEBAYO	Ibrahim	Mining Engineering/ Aerospace Engineering
Mrs	ZANG	Aara A.	Chemical Engineering
Mrs	EYO	Esther	Petroleum Engineering
Mr	MUHAMMAD	Adam Ibrahim	Petroleum and Gas Engineering (Oil and Gas)
Mr	AHMED	Nakaka	Petroleum and Gas Engineering (Oil and Gas)

Mr	ABORELE	Gabriel	Natural Gas Engineering
Mr	OGUNNUSI	Afolabi	Water Resources Engineering
Mrs	MADU	Happiness Ozichi	Civil Engineering
Mrs	AGBAJI	Stella Ene	Structural Engineering
Mrs	OPARAUGO	Lilian N.	Wood Products Engineering
Mrs	EFFIONG	Itoro	Biomedical Engineering
Mr	NKESHITA	Valentine	Information and Communication Engineering

Appendix II: Senate Committee on 30% Delivery for UNILORIN CCMAS

1. Prof. O. A. Omotesho - Chairman
2. Prof. G. T. Arosanyin - Director, Academic Planning Unit
3. Prof. M. O. Yusuf
4. Prof. L. A. Yahaya
5. Prof. A. C. Tella
6. Prof. A. A. Baba
7. Prof. A. A. Adeoye
8. Prof. Omenogo V. Mejabi
9. Prof. O. A. Lasode
10. Prof. M. S. Ajao
11. Prof. G. B. Adesiji
12. Ebunoluwa O. Osagbemi
13. Taiwo K. Afolayan
14. A. G. Dauda
15. I. Dauda
16. Omobukola G. Omotoye - Secretary
17. A. A. Lawal - Co-Secretary

Appendix III: Members of the Programme Working Group

1. Prof. G.T. Arosanyin
2. Dr. S. B. Akanbi
3. Dr. A. A. Kilishi
4. Dr. M. F. Ajide
5. Dr. H. A. Yusuf