UNIVERSITY OF ILORIN, NIGERIA

FACULTY OF ENGINEERING AND TECHNOLOGY

B.ENG. FOOD ENGINEERING

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

STUDENTS HANDBOOK (UNDERGRADUATE)

2024

UNIVERSITY OF 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

History of the Faculty of Engineering and Technology, University of Ilorin

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.

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, Muktar Lukman Abiodun, A.B. Shuaib, Oluseun Jolayemi, A.J. Anate, Abdulateef Bello, Hassana Adegbite, Dr. A.S. Alawaye, A.O. Shuaib, Grace A. Abajo, Mrs. 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.

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.

DEPARTMENT OF FOOD ENGINEERING

Historical Background

The Department of Food Engineering was established during the 2014/2015 academic session from the Department of Agricultural and Biosystems Engineering. It is the tenth department in the Faculty of Engineering and Technology. The pioneer students admitted to 100 level were forty-five (45) in number. The department has successfully graduated five (5) sets as of 2022/2023 academic session. The pioneer Head of Department (HOD) was Dr. J. O. Olaoye (now a Professor), and was succeeded by Dr. M. O. Sunmonu (now a Professor) and then Dr. M. M. Odewole. The current HOD is Dr. M.S. Sanusi. The Food Engineering programme is designed to capture the essential features of both food science and engineering education. The programme is structured to specifically advance food equipment development, innovate and assess novel food products, as well as design and assessment of manufacturing processes and systems specific to food production and other related activities.

VISION STATEMENT

To be a leading centre of excellence in Food Engineering, dedicated to advancing learning, research, innovation, and ethical practices, while contributing to sustainable food systems and serving humanity.

MISSION STATEMENT

To provide a world-class environment for advancing knowledge in Food Engineering, fostering innovative research, and engaging in community service to address national and global food challenges.

Staff List of the Department

S/No.	Name	Rank	Qualifications	Area of Specialization
1.	M.S. Sanusi	Senior Lecturer/Ag. HOD	BTech (Ogbomoso); MSc, Ph.D. (Ibadan); R.Eng. (Nigeria)	Food Engineering and Product Development
2.	J. O. Olaoye	Professor	BEng, M.Eng, Ph.D. (Ilorin); R.Eng. (Nigeria)	Food Machine Design
3.	M.O. Sunmonu	Professor	BEng, MEng, Ph.D. (Minna); R.Eng. (Nigeria)	Food Storage and Packaging
4.	M.O. Oke	Professor	BTech (Ogbomoso); MSc, Ph.D. (Abeokuta); R.Eng. (Nigeria)	Food Process Engineering
5.	Grace O. Ogunlakin	Professor	BTech (Ogbomoso); M.Sc (Abeokuta); Ph.D (Ogbomoso); R.Eng. (Nigeria)	Food Process Engineering
6.	A.M. Olaniyan	Professor	BSc, MSc, Ph.D. (Ilorin) ; R.Eng. (Nigeria)	Food Machine Design
7.	Temitope E. Odetoye	Professor	BTech (Ogbomoso); MSc,	Bioproducts development

			Ph.D. (Ilorin); Ph.D. (Ogbomoso); R.Eng. (Nigeria)	
8.	Y. L. Shuaib Babata	Professor	BEng, MSc, (Ilorin); Ph.D. (MINNA); R.Eng. (Nigeria)	Casting technology, Corrosion, Materials Characterization, Manufacturing, Design and Fabrication
9.	K. O. Yusuf	Professor	BEng (Minna); MEng (Ilorin), Ph.D. (Ilorin); R.Eng. (Nigeria)	Soil and Water Engineering
10.	A.O. Abioye	Reader	BSc, MSc, Ph.D. (Ilorin) ; R.Eng. (Nigeria)	Food Engineering
9.	T.A. Ishola	Reader	BEng, MEng, (Ilorin); Ph. D. (UPM); R.Eng. (Nigeria)	Food Machine Design and Automation
10.	M.M. Odewole	Reader	BEng, MEng, (Ilorin); Ph.D. (Akure); R.Eng. (Nigeria)	Food Processing and Storage Engineering
11.	E.O. Ajala	Reader	BTech, (Ogbomoso), MSc. (Ife), Ph.D. (Minna); R.Eng. (Nigeria)	Biochemical Engineering
12.	J.A. Adeniran	Reader	BTech (Ogbomoso); MSc (Lagos); Ph.D. (Ogbomoso); R.Eng. (Nigeria)	Environmental Engineering, Climate Change
13.	A.G. Adeniyi	Reader	BTech, MTech, Ph.D. (Ogbomoso); R.Eng. (Nigeria)	Process System Engineering, Process and Product Development
14.	A. I. Abdullateef	Reader	BEng, (OSUA); MEng. (BENIN); Ph.D. (IIUM, Malaysia); R.Eng. (Nigeria)	Power Engineering
15.	O.S. Zakariyya	Senior Lecturer	BEng (Zaira); MSc (EMU, Famagusta, Cyprus); PhD (Zaira); R.Eng. (Nigeria)	Digital Image Processing
16.	D. O. Adetitun	Senior Lecturer	BSc, MSc, Ph.D. (Ilorin)	Food Microbiology
17.	Muinat O. Kazeem	Senior Lecturer	BSc, (Ilorin); MSc, (Ibadan); Ph.D. (Malaysia)	Food and Industrial Microbiology
18.	H. U. Hambali	Senior Lecturer	BEng (Maiduguri); MSc (Zaria); Ph.D. (UTM, Johor Bahru); R.Eng. (Nigeria)	Catalysis of Petrochemicals production and Wastewater treatment
19.	Mary A. Ajala	Senior Lecturer	BTech; MTech; (Ogbomoso); Ph.D. (Minna); R.Eng. (Nigeria)	Environmental Engineering

20.	M. O. Iyanda	Senior Lecturer	BEng, MEng, Ph.D. (Ilorin); R.Eng. (Nigeria)	Farm Power
21.	A.B. Rabiu	Senior Lecturer	B.Eng (Kano), MEng, Ph.D. (Ilorin); R.Eng. (Nigeria)	Thermo-fluids Engineering
22.	O.T. Popoola	Senior Lecturer	B.Eng (Kano), MEng, Ph.D. (Ilorin); R.Eng. (Nigeria)	Thermo-fluids Engineering and Computational Fluid Dynamics
23.	Zainab T. Yaqub	Lecturer I	BSc, (Lagos); MTech, (Johannesburg); Ph.D. (Johannesburg); R.Eng. (Nigeria)	Biochemical Engineering
24.	Mariam T. Baker	Lecturer I	BSc, MSc, Ph.D. (Ilorin)	Food Chemistry
25.	Abiola L. Adepoju	Lecturer I	BSc (Ibadan); MEng (Minna); R.Eng. (Nigeria)	Food Processing
26.	M.A. Amoloye	Lecturer I	BEng (Bauchi); MTech (Ogbomoso); Ph.D. (Ilorin); R.Eng. (Nigeria)	Process System Engineering, Process and Product Development
27.	I. N. Aremu	Lecturer I	MSc, (Ukraine); R.Eng. (Nigeria)	Iron and Steel Making, Materials Characterization
28.	Y. O. Babatunde	Lecturer I	BEng, MEng. (Ilorin), Ph.D. (PAUSTI, Kenya); R.Eng. (Nigeria)	Structures
29.	A.B. Bello	Lecturer II	BSc (Ogbomoso); MEng (Minna)	Food Engineering and Product Development
30.	O. I. Obajemihi	Lecturer II	B.Eng (Ilorin), M.Eng (Minna); R.Eng. (Nigeria)	Food Processing
31.	Rafat O.A. Sani	Principal Technologist	BSc, MSc (Maiduguri)	Food Processing
32.	Olabamibo A. Ajiboye	Senior Technologist	HND (Kwara Poly), PGD (Ogbomoso), M.Eng.(Ilorin)	Food Processing and Storage
33.	I. Duniya	Senior Technologist	BSc (Ibadan); MEng (Ilorin); R.Eng. (Nigeria)	Food Machine Design and Processing
34.	E. O. Dada	Senior Workshop Superintendent	Trade Tests I, II & III	Food Machine Fabrication
35.	Ruth O. Aboyarin	Chief Sec. Assistant	SSC(NECO), Certificate in Computing (Unilorin), Certificate in Typing (Kwara Poly)	Registry Staff
36.	I. O. Andrew	Executive Officer	SSC (NECO)	Registry Staff
37.	Veronica B. Ajiboye	Caretaker	SSC (NABTE)	Registry Staff

B.Eng. Food Engineering

Overview

Food Engineering (FDE) is a multidisciplinary field of applied physical sciences which combines science, microbiology, and engineering education for food and related industries. Food engineering can be described as application of engineering principles and concepts to the conversion of raw agricultural products to consumers' foods at lowest possible cost. Food engineers provide the technological knowledge transfer essential to the cost- effective production and commercialization of food products and services.

The decision to revamp the curriculum of higher education in Nigeria could not have come at more opportune time. Employability rating of university graduates has been on a steady decline for years. In a bid to stem this negative trend a fresh curriculum is hereby proposed, that will allow universities to contribute a minimum of 30% innovative content to the core of the minimum academic standard prescribed by the National Universities Commission (NUC). Hence, this new BSc. Food Engineering Core Curriculum and Minimum Academic Standards (CCMAS) has been prepared and approved for use in all Nigerian universities for the educational training of Food Engineering Professionals. The Bachelor's degree in Food Engineering will provide students with a well-balanced Food technology and engineering knowledge to meet the quality standard of 21st Century workforce. The need for manpower required for processing agricultural crops and development of processes and machineries that will help Nigeria to attain food security that has been eluding the country, has been the concern of all in national development. The main objective of the programme is to provide a curriculum that will produce prospective graduates of food engineering - who can contribute to the production of adequate, safe and nutritious food products, capable of working effectively at the senior level in the food industry, the food commodity research institutes, government, private and international establishments related to food. The ultimate goal is to empower graduates to become creators of employment by virtue of their training. Prospective food engineers would at the end of their training be registered with the Council of Registered Engineers of Nigeria (COREN) as well as the Nigerian Council of Food Science and Technology (NiCoFoST). The underlying philosophy of the programme is to train technically skilled graduates with theoretical and practical knowledge in food processing, food storage and packaging, human nutrition, food product development, process design, food machinery, equipment and plant design, fabrication and maintenance.

Philosophy

The need for manpower required for the preservation of agricultural crops and development of products and processes that will provide nutritious, balanced and safe diets to the people has been the concern in national development. Food Engineering is anchored on strong foundations of mathematics, science and economics. The programme is designed to impart in students, theoretical and practical skills that empower them as Creative Design Engineers for systems (processes, machinery, equipment and plants) for processing, preservation, distribution, storage and marketing of food and Agricultural raw materials; the professional implementation of such designs, and the operation of complex systems that result.

The Food Engineer is a hybrid-engineer, trained specifically for problem-solving in the food and allied industries. He/She is equipped with sufficient grasp of the biological sciences to understand the basic biological character of agricultural inputs into the food industries. The food engineer is skilled especially to address critical problems associated with the design of food products for manufacturing in food plants and their development into profitable articles of commerce and the complexities of food quality assurance and sound environmental management for sustainable food processing and handling systems. In particular, the Food Engineering programme seeks to equip students with unique enhanced insights into basic biological, physico-chemical and engineering properties of food and phenomena responsible for changes in food quality during storage, processing and marketing. The general philosophy therefore is to produce graduates with high academic standard in the design of food processes, machinery/equipment-systems and plants anchored on sound scientific and technological foundations of understanding of causative mechanisms rather than on costly empiricism derived from trial-and-error, possessing adequate practical background for self employment as well as being of

immediate value to industry, academia and the community in global food security.

Objectives

The objectives of the programme are to adopt and integrate the principles of Science, Technology, Engineering and Mathematics (STEM) in:

1. producing graduates who will be involved in food product/process development, research and development, processing and preservation.
2. training Engineers who will serve the food industry at all levels in food process design, food machine and plant design, fabrication, maintenance and evaluation of food processing machines and plants, the conversion of raw agricultural produce into processed, packaged, shelf-stable food products and intermediate raw materials;
3. establishment, maintenance and assurance of quality of food products and processes in the plant/factory.
4. direct practical experience in the food industries, food research laboratories/stations/higher academic institutions, government establishments/ parastatals and international organizations.
5. supporting governmental agencies responsible for the formulation and enforcement of food laws and;
6. developing and imparting entrepreneurial skills that will make graduates employable or self-reliant job creation.
7. understanding all the materials, components, machines, equipment, production techniques and systems in food technology.
8. adapting and adopting exogenous technology in order to solve local technical problems.
9. managing people, funds, materials and equipment.
10. improving on indigenous technology to enhance local problems-solving capabilities
11. developing novel products, simulating imported food products, consequently helping to decrease capital flight.

Therefore, the students will be equipped to upgrade the quality of local food products, innovate new products, simulate imported food products and consequently reduce post harvest losses and promote food security. The Bachelors Degree in Food Engineering CCMAS contains 105 Units of core courses in the Basic Sciences, General Engineering, Food Science and Technology/ Food Engineering Courses. Learning outcomes have been attached to the course content for individual courses in the CCMAS to showcase content delivery. Universities are encouraged to supply the remaining 45 units according to their peculiar needs to make up a total of 150 units required for graduation.

Unique Features of the Programme

1. much reduced student workload;
2. enhanced learning and application of ICT;
3. programme is a hybrid course that shares technologies with microbiology, chemistry, chemical engineering, pharmacy, biotechnology, agricultural engineering and Nutrition;
4. production of FDE graduates that are well-equipped with all the requisite science and engineering tools to function optimally in the 21st Century;
5. curriculum design focused on graduating employers of labour rather than job seekers;
6. training graduates with very strong leadership skills;
7. champions technology advancement in line with food products development and processing;
8. guarantees safest and most environmentally friendly ways of processing, packaging, preserving, storing and distribution of foods; and
9. an acclaimed professional in the food industry and food enterprises with strong initiative and exceptional leadership and management skills.

Employability Skills

The expected outcome of the Food Engineering programme, is to mould highly informed, skilled and inspired professionals academically and professionally for the creative and effective practice of engineering in self-employment and in the food and allied industries, and in government and other local and international agencies involved in the management and regulation of food resources. The prospective graduates are empowered to generate novel food products, upgrade local food processing techniques, simulate imported food products and provide innovative solutions/equipment to the challenges in food industry, regulatory space and research institutes. This curriculum ensures that Graduates are adequately trained to be employed at the senior level in food industries, regulatory agencies, food service and extension organizations and research institutes. Graduates are also trained to be capable of establishing their own small and medium scale food enterprises and upgrade existing ones.

Generally, the job options for a Food Engineering graduate are:

Food Engineer
. Production Manager in food companies
. Product/Process development Scientist
. Quality Assurance Manager
. Regulatory Affairs Officer
. Research Officer
. Scientific Laboratory Technician
. Brewer
. Procurement Manager
. Consultant

21st Century Skills

In tandem with this objective, the Food Engineering CCMAS places a high premium on the following ten 21st Century skills as its desired programme outcome in line with global best academic and professional practices:

1. Communication Skills: the ability to present ideas effectively with confidence through aural, oral and written modes, not only with engineers but also with the community at large.
2. Creativity and innovation skills: The ability to create new ways of thinking and be able to find solutions to new problems by being innovative enough, to build new products and services.
3. Information literacy: The ability to access, evaluate, synthesis and share information from multi-disciplinary / interdisciplinary sources.
4. Competence in Application and Practice: the ability to use techniques, skills, and modern engineering tools to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability, in accordance with relevant engineering standards.
5. Team Working Skills: the ability to function effectively as an individual and in a group with the capacity to be a leader as well as an effective team member
6. Problem Solving and Decision-Ma king Skills: the ability to solve engineering problem through critical thinking, system thinking and effective decision making.
7. Engineering System Approach: the ability to utilize systems approach to design and evaluate operational performance
8. Knowledge of Contemporary Issues: the ability to continue learning independently in the acquisition of new knowledge, skills and technologies. The use of information, communication and computing technologies are very essential in the knowledge-based era.
9. Understand Professional, Social and Ethical Responsibilities: the ability to understand the social, cultural, global and environmental responsibilities of a professional engineer, and commitment to professional and ethical responsibilities.

10. Leadership: the ability to lead a multidisciplinary team in technological diagnosis, delivering efficient solutions and managing projects.

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 Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in 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 LJMB or JUPEB may be considered for admission. Candidates who have good National Diploma (ND) result in relevant Engineering Technology programmes may also be considered for admission into 200 level. Holders of upper credit pass and above at Higher National 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 register 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 academic semesters.
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.

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 four credit units of Entrepreneurship 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 it or 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, 13 semesters in the case of Direct Entry students who entered at 200-Level and 11 semesters in the case of Direct Entry students who entered at 300-Level.

Global Course Structure

Year	**General Studies**	**Basic Science**	**GET Courses**	**FDE Courses**	**SIWES and Engineering Valuation**	**Total**
1	4	16	3	2		25
2	4		20		3*	27
3	4		14	11	4*	33
4	-	-	2	10	6*	18
5	-	-	5	10		15
Total CCMAS	**12**	**16**	**44**	**33**	**13***	**105**

* All 11 SIWES units and 2 units of Engineering valuation courses are credited for GPA computation in the 2nd Semester of the 400 Level, and not included in the CCMAS credit units.

100 Level

Course code	Course Title	Units	Status	LH	PH
GST 111	Communication in English I	2	C	30	45
GST 112	Nigerian People and Culture	2	C	30	-
GET 101	Engineer in Society	1	C	30	-
GET 102	Engineering Graphics and Solid Modeling I	2	C	15	45
CHM 101	General Chemistry I	2	C	-	45
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	30	-
MTH 101	Elementary Mathematics I	2	C	30	
MTH 103	Elementary Mathematics III	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 103	General Physics III	2	C	30	-
PHY 104	General Physics IV	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
STA 112	Probability I	3	C	45	-
FDE 102	Introduction to Food Engineering	2	C	30	-
Total		**34**			

200 Level

Course Code	Course Title	Units	Status	LH	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 203	Engineering Graphics and Solid Modelling II	3	C	15	90
GET 204	Students Workshop Practice	2	C	15	90
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
GET 205	Fundamentals of Fluid Mechanics	3	C	30	45
GET 206	Fundamentals of Engineering Thermodynamics	3	C	30	45
GET 207	Applied Mechanics	3	C	45	-
GET 208	Strength of Materials	3	C	45	-
FDE 201	Fundamentals of Food Processing, Preservation and Packaging	2	E*	30	-
EEE 202	Applied Electricity II	3	R	45	
GET 299	SIWES I: SWEP - Students Work Experience and Practice	3**	C	9 weeks	
	Total	**44**			

* Elective (not added to CCMAS units)

** All SIWES units credited in the 2nd Semester of 400 Level

300 Level

Course Code	Course Title	Units	Status	LH	PH
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
GET 301	Engineering Mathematics III	3	C	45	-
GET 302	Engineering Mathematics IV	3	C	45	-
GET 304	Technical Writing and Communication	3	C	45	-
GET 305	Engineering Statistics and Data Analytics	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	
FDE 300	Gen. Food Engineering Lab.Practicals	1	C	-	45
FDE 301	Food Chemistry for Engineers	2	C	30	-
FDE 302	Food Chemistry for Engineers Laboratory	1	C	-	45
FDE 303	Conversion Ancillary Operations in Food Processing	2	C	30	-
FDE 304	Separation Operation in Food Processing	2	C	30	-
FDE 305	Principles of Food Preservation	2	C	30	-
FDE 306	Heat and Mass Transfers in Food Processing	2	E	30	-
GET 399	SIWES II	4**	C	12 Weeks	
UIL-FDE 308	Biorefining Engineering	3	E	45	
UIL-FDE 312	Food Microbiology	3	C	45	-
UIL-FDE 314	Human Nutrition	3	E	45	
UIL-GET 311	Engineering Economics	3	C	45	
Total		**50**			

* WES units credited in the 2nd Semester of 400 Level

400 Level

Course Code	Course Title	Units	Status	LH	PH
MEE 402	Theory (Mechanics) of Machines II	2	C	30	-
FDE 401	Technology of Fresh Food Products	2	C	30	-
FDE 403	Technology of Plant Food Products	2	C	30	-
FDE 405	Laboratory Practical (Animal Products, Fruits & Vegetable)	2	C	-	90
FDE 407	Food Quality Control	2	C	15	45
FDE 409	Food Process Design	2	C	30	45
FDE 423	Food Analyses	2	E	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	

UIL-FDE 405	Food Biotechnology	3	C	45	-
UIL-FDE 411	Fermentation Technology	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 and Costing	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	-
FDE 501	Food Machinery and Equipment Design	2	C	15	45
FDE 502	Food Plant Design and Economics	2	C	15	45
FDE 503	Final Year Research Project	6	C	-	270
UIL-FDE 505	Milk and Dairy Technology	3	C	30	45
UIL-FDE 521	Engineering Measurement Systems	3	C	30	45
UIL-FDE 522	Process Modelling and Optimization	3	C	45	-
UIL-FDE 524	Food Raw Materials	3	C	30	45
UIL-FDE 527	Processing of Miscellaneous Foods	3	C	30	45
UIL-FDE 532	Fruits and Vegetables Processing	3	C	45	-
UIL-FDE 538	Sugar Technology	3	E	45	-
UIL-FDE 552	Fats and Oils Technology	3	E	45	-
UIL-FDE 553	Special Problems in Food Engineering	3	E	45	-
UIL-FDE 555	Biological Nano-engineering	3	E	45	-
	Total	**45**			

***At least one (1) elective course is to be offered by each student*

Learning Outcomes and Course Contents

100 Level Courses

GST 111: Communication in English I (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, r, 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, etc. 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. identify and list the major linguistic groups in Nigeria;
2. explain the gradual evolution of Nigeria as a political entity;
3. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
4. enumerate the challenges of the Nigerian state regarding nation building;
5. analyse the role of the judiciary in upholding fundamental human rights;
6. identify the acceptable norms and values of the major ethnic groups in Nigeria;
7. list possible solutions to identifiable Nigerian environmental, moral and value problems; and
8. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times.

Course Content

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 political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of selfreliance (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 social vices]).

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 (WAI), 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.

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 Content

History, evolution and philosophy of science, engineering and technology. The engineering profession - engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. 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.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

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 apply such to solving simple everyday 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, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength, cost and improved upon, designing;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other 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 Content

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 and solid 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 edge or equivalent.

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 LeChatelier'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 Content

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 Content

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic 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 of group 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 Content

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, 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 which could be acidic/basic/ neutral organic compounds.

Course Content

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 the use 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 Content

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-Moire'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 and continuity;
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 Content

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)
(Pre-requisite –MTH 101) (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

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. Twodimensional 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 of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion

5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating 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 moving under gravity.

Course Content

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; conservation of 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 (General Physics II (Electricity and Magnetism)

(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 of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; 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; 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 II (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 of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Content

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 104 General Physics IV (2 Unit 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; and
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 students 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 Content

These introductory courses emphasise quantitative measurements, the treatment of

measurement errors and graphical analysis. A variety of experimental techniques should be employed. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc., covered in PHY 101 and PHY 102. However, emphasis should 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 students 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 Content

These introductory courses emphasise quantitative measurements, the treatment of measurement errors and graphical analysis. A variety of experimental techniques should be employed. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc., covered in PHY 101 and PHY 102. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

STA 112 Probability I (3 Units C: PH 45)

Learning Outcomes

On completion, the students should be able to:

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.

FDE 102: Introduction to Food Engineering (2 Units C: LH 30)

Learning Outcomes

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

1. identify the differences between Food Engineering, Food Science, Food Technology and Agricultural Engineering;
2. demonstrate understanding of the inter-phases of agriculture, food and nutrition;
3. demonstrate appreciation of global food situation and food security challenges especially in developing countries;
4. identify the place of Food Engineers in the Nigerian food industries and national development;
5. define/describe terms commonly used in food engineering;
6. identify the role of mathematics in solving food engineering problems; and

7. use the knowledge of the course to solve simple mass and energy balances adopting relevant engineering units and dimensions.

Course Content

Review of various engineering disciplines leading to evolution of Food Engineering, Philosophy, definition and interrelationship of Food Science, Technology and Engineering. Interphases of agriculture, food and nutrition, as disciplines of academic study and as profession. Review of global food situation with emphasis on Nigeria and Africa. Food Process engineering, security issues in developing countries. The Nigerian food industries and Engineering. The food engineer as a problem solver: roles of Food Engineers in National Development.

Description/definition of the following: Process. Food process engineering. Flow charts and descriptions of some processes. Steady and unsteady state. Batch, continuous and semi-continuous operations. Unit operations and classifications. Mathematics involved in food engineering problems. Engineering Unit and dimensions, mass and energy balances. Introduction to dimensional analysis and similarity theorem.

200 Level Courses

GST 212: Philosophy, Logic and Human Existence (2 Units C: L 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 philosophical discourse;
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 existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge; and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and 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.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

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, opportunity seeking, 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,

employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business 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 Content

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, natural and 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 and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of 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 (3 Units C: LH 45)

Learning Outcomes

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

1. apply methods from electromagnetic theory and basic physics to the analysis of electrical and electronic systems including electrical power systems;
2. devise lab experiments, collect and analyse data from physical and simulated test systems and use the results to solve technical problems. Also, use lab equipment effectively and safely to measure and analyse electronic and electrical systems, both digital and analogue;
3. design electronic and electrical systems, including electric power systems, to meet or exceed a set of performance specifications, using computational tools and packages;
4. solve common and technical problems in the design of electronics and electrical circuits, including electric power systems and seek specialist advice as needed for more complicated problems;
5. identify the process of innovation and the main factors of entrepreneurship and creative thinking and apply methods of product development;
6. apply project management methods to the planning of projects. Plan, manage and analyse projects using current best-practice methods; and
7. carry out a cost estimate for a design solution and understand the uncertainties associated with the cost estimation process.

Course Content

DC circuits: definition of electric circuit, linear circuit, non-linear circuit, bilateral circuit, unilateral circuit, dependent source, node, branch, active and passive elements, Kirchhoff's laws, source equivalence and conversion, network theorems-superposition theorem, Thevenin's theorem, Norton theorem, maximum power transfer theorem, star-delta conversions. Magnetic circuits: the concept of magnetic circuit, B-H curve, analogous

quantities in magnetic and electric circuits, Faraday's law, iron losses, self and mutual inductance, energy stored in magnetic field. AC single phase circuits: sinusoidal quantities, average and RMS values, peak factor, form factor, phase and phase difference, concept of phasor diagram, V-I relationship in R,L,C circuit, combination R,L,C in AC series, parallel and series parallel circuits with phasor diagrams, impedance and admittance, power factor, power in AC circuit, resonance in RLC series and parallel circuit, Q factor, bandwidth of resonant circuit. Three phase circuits: voltages of three balanced phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams. Power measurement by two-watt meters method. DC machines: construction, basic concepts of winding (lap and wave). DC generator: principle of operation, EMF equation, characteristics (open circuit, load). DC motors: principle of operation, torque equation, speed torque characteristics (shunt and series machine), starting (by 3 point starter), speed control (armature voltage and field control).Single phase transformer: constructional parts, types of transformers, emf equation, no load no load and on load operation, phasor diagram and equivalent circuit, losses of a transformer, open and short circuit tests, regulation and efficiency calculation. Three phase induction motor: types, construction, production of rotating field, principle of operation, slip and frequency, rotor emf and current, equivalent circuit and phasor diagram, torque slip characteristics, torque-speed characteristics, starting of induction motor by star delta starter and(DOL starter). Speed control of three phase induction motor by variation of supply frequency, supply voltage and number of poles. General structure of electrical power system: power generation to distribution through overhead lines and underground cables with single line diagram, earthing of electrical equipment, electrical wiring practice.

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 numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic 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 ceramics in 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 and natural);
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. Engineering materials 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, characterization, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical 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 and fractography 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 203: Engineering Graphics and Solid Modelling II (3 Units C: LH 15; PH 90)

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).

GET 204: Workshop Practice (2 Units C: LH 15; PH 90)

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 of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Content

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

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

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 30 PH 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 fluid flow 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 30 PH 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 using property 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 in energy 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-flow open 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, refrigerators and 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 third laws 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. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

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.

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 volume of 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 its applications to different engineering processes.

Course Content

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, 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;
4. 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;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. 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
7. 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 Content

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vectorvalued 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 a specific modern language - preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Content

Introduction to computers and computing; computer organisation - data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of 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; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (loT). Elements of software engineering.

FDE 201: Fundamentals of Food Processing, Preservation and Packaging (2 Units E: LH 30)

Learning Outcomes

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

1. state the principles behind food processing, post-harvest losses and preservation;
2. describe processing techniques such as steaming, baking, roasting frying and extrusion;
3. explain the functions of refrigeration and crystallization in food processing;
4. identify the roles of appropriate packaging technologies to increase shelf-life of products; and
5. explain and identify the role of chemical kinetic in food processing.

Course content

The chemical, physical and microbiological basis of food deterioration and spoilage. Chemical preservatives. Steaming. Baking. Roasting. Frying. Extrusion. Evaporation Refrigeration and freezing. Crystallization. Detailed description of mechanisms of operation including diagrams/sketches of different equipment involved in these preservation techniques should be emphasized. Fundamentals of food packaging. Chemical kinetics in food processing.

EEE 202: Applied Electricity II (3 Units C: LH 45)

Learning Outcomes:

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

1. differentiate between various DC and AC 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 to TV, Radio and Telephone systems.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)
Learning Outcomes

SIWES I should provide opportunity for the students to:

2. acquire industrial workplace perceptions, ethics, health and safety consciousness, interpersonal skills and technical capabilities needed to give them a sound engineering foundation;

3. learn and practise basic engineering techniques and processes applicable to their specialisations;
4. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
5. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Content

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

NOTE: Each programme to indicate additional details of programme-specific activities for their student

300 Level Courses

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

Course Content

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, realist theory 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 land disputes, 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 of conflict 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 postconflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-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 geographical location;
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 Content

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 and business 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 (loTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes

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

1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups.

Course Content

Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate

Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

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.

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 in engineering 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 Content

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 and passive 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 (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance,

format and styles of writing technical reports). Different formats for communication; styles of correspondences - 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 and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

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 them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional 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 in data 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 measurements undertaken; 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 Content

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles. Probability. Binomial, Poisson hyper-geometric, normal distributions. 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 system and Technology (3 units C: LH 30 LH 45)
Learning Outcomes

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

1. identify the types, uses and advantages of renewable energy as it relates to climate change and have the capacity to design for use the various renewable energy systems;
2. recognize and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
3. appreciate the environmental impact of energy exploitation and utilization, and pursue the sustainable development of renewable energy for various applications; and
4. recognize the exploitation, excavation, production, and processing of fossil fuels such as

coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Content

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, regional and 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; emphasize sustainability in general and in the overall concept of sustainable development and the link this with sustainable energy as the fundamental benefit of renewable energy.

Practical Content

Simple measurement of solar radiation, Bomb calorimeter determination of 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 oil into 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: Introductory Artificial Intelligence, Machine Learning and Convergent Technology (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 convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
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 with a 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 Content

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 logic foundations of "ai"; expert systems, automated reasoning and pattern recognition; distributed

systems; data and information security; intelligent web technologies; convergent technologies - definition, significance and engineering applications. Neural networks and deep learning. Introduction to python "ai" libraries.

FDE 300: General Food Engineering Practices Laboratory (1 Units C: PH 45)

Learning Outcomes

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

1. demonstrate proficiency in how to write engineering reports from lab work;
2. demonstrate proficiency in material and energy balance;
3. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
4. establish physical and thermal properties of foods;
5. determine surface properties of food materials; and
6. determine water activity and undertake water sorption studies.

Course Content

Laboratory investigation and report submission for selected experiments and projects in Material and energy balances including Pearson square rule, laws of conservation of mass and energy, and other relevant areas. Determination and measurement of physical properties such as length, width, density, porosity, sphericity, etc., Data generation from laboratory analysis and the development of empirical models. Thermal properties of food materials such specific heat capacity, thermal conductivity, thermal diffusivity etc. Surface properties such as angle of repose, coefficient of friction etc. Water activity determination. Water activity: prediction. Water vapor sorption isotherm determination and selection of food packages. Importance of the afore-mentioned experiments to food process design, equipment design and food packaging technology should be emphasized.

FDE 301: Food Chemistry for Engineers (2 Units C: LH 30) Learning Outcomes

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

1. explain the chemistry underlying the **properties** and reactions of various food components;
2. demonstrate sufficient knowledge of food chemistry to control reactions in foods; and
3. explain the major chemical reactions that limit shelf-life of foods.

Course Content

Naturally occurring constituents of foods. Their structure, chemical and physical properties and significance. Food activities. Chemical, physical and biochemical changes that occur in food during handling, processing and storage such as carbohydrates and their derivatives. Proteins in food systems, Rancidity of fats and oils etc. Food colloids, emulsions, and foam: - Food flavour and additives. Terpenoids, porphyrins. Enzymes and the use in the food industry. Toxic constituents of foods and their mode of degradation in the body.

FDE 302: Food Chemistry for Engineers Laboratory (1 Unit C: PH 45) Learning outcomes

1. On completion of the course, students should be able to:
2. distinguish how individual food components contributes to the overall quality of foods;
3. understand the important chemical/biochemical reactions amongst various food components and how they influence food quality; and
4. document, discuss, and scientifically provide inference on Food chemistry experiments.

Course contents

Qualitative and quantitative tests in foods. Preparation and standardization of reagents. Acid and bases pH determination of buffer solution. Titrations. Report writing. Methods of separation. Preparation of chromatographic columns: thin layer paper column, ion exchange. Dialysis and electrophoresis. Removal of toxic contents in foods and its determination simple enzyme reactions. Determination of Kmax and other enzymatic parameters. Food compositions/Components.

FDE 303: Conversion and Ancillary Operations in Food Processing (2 Unit: C: LH 30)

Learning Outcomes

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

1. describe theory, principles/mechanisms of operation, calculations which underpin the primary unit operations in food processing;
2. explain the importance of conversion operations in food industry for size reduction, mixing, emulsification, homogenization;
3. explain and describe ancillary operations such as water and waste treatment, steam generation, material handling; and
4. describe different sources of energy and utilization in food processing.

Course Content

Theories, principles/mechanisms of operation, calculations with necessary examples and design features of machineries which underpin the following operations in food industries: Conversion operations including size reduction. Mixing. Emulsification. Homogenization. Ancillary operations including: Plant sanitation and hygiene. Water and waste water treatment. Solid waste disposal. Food waste and management. Hygienic design. Material handling of liquid and solid foods in food industry. Concepts in energy utilization in food processing (steam generation, fuel utilization, electric power utilization). Energy mix in food industries. Prospects of renewable energy in food industries.

FDE 304: Separation Operations in Food Processing (2 Units C: LH 30)

Learning Outcomes

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

i. describe theory, principles/mechanisms of operation, calculations which underpin the separation operations in food processing;
ii. explain preliminary and preparative operations such as: Cleaning. Sorting. Grading. Peeling. De-skinning. Cutting;
iii. explain the importance, principles of operations of mechanical separation in food industry for sedimentation/floatation, centrifugation, filtration, size reduction, screening and particle size analysis; and
iv. explain the importance, principles of operations of contact equilibrium operations in food industry for Gas absorption, distillation, stripping, extraction/leaching.

Course Contents

Theories, principles/mechanisms of operation, calculations with necessary examples and design features of machineries which underpin the following separation processes: Preliminary and preparative operations including: Cleaning. Sorting. Grading. Peeling. Deskinning. Cutting. Mechanical/physical separations: sedimentation. Centrifugation. Filtration. Membrane separations (ultrafiltration and reverse osmosis). Screening, Mechanical expression. Contact Equilibrium Processes: Determination of ideal stages. Gas absorption. Distillation. Stripping, Extraction/leaching.

FDE 305: Principles of Food Preservation (2 Units C: LH 30)

Learning Outcomes

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

1. describe detailed description of mechanisms of operation including diagrams/sketches of different equipment involved in these thermal processes;
2. explain thermobacteriology, thermal process calculations;
3. conduct heat penetration studies in canned foods;
4. describe dehydration, blanching, pasteurization, sterilization (and commercial sterilization); and
5. explain non-thermal novel processing techniques: High-pressure processing, pulsed electric field processing, pulse-light, ultrasound, food irradiation etc.

Course Contents

Theories, principles/mechanisms of operation, calculations with necessary examples and design features of machineries which underpin the following preservation principles: Dehydration, Blanching, pasteurization, sterilization (and commercial sterilization), Review of Kinetics of chemical reaction. Microorganisms involved in canning. Thermobacteriology (meaning, history, thermal death time curve, decimal reduction time) and its applications to canning and aseptic processing. Heat penetration within cans; factors affecting heat penetration with cans; death order of microorganisms with cans. Thermal process calculations. Canning operations.

Introduction to the following non-thermal novel processing techniques: High-pressure processing, pulsed electric field processing, pulse-light, ultrasound, food irradiation. Detailed description of mechanisms of operation including diagrams/sketches of different equipment involved in these thermal processes should be emphasized.

FDE 306: Heat and Mass Transfers in Food Processing (2 Units E: LH 30)

Learning Outcomes

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

1. differentiate between conduction, convection and radiation as modes of heat transfer;
2. derive equations for specific problems and in different coordinate systems; and
3. discuss steady and non-steady diffusion, heat and mass transfer driven processes in the food industry.

Course Contents

Heat Transfer: Heat transfer systems (types of heat exchanger). Modes of heat transfer (conductive heat transfer- steady state in different geometries and layers, convective (free and forced) and radiative heat transfer). Estimation of convective heat and overall transfer coefficient. Fouling of heat transfer surfaces. Design of heat transfer exchanger. Unsteady state transfer. Pyschrometry and its application in food processing. Ohmic and microwave heating. Mass Transfer: Diffusion process. Convective Mass transfer. Laminar and turbulent flow (over a flat plat, in a pipe, over spherical bodies). Unsteady-state mass transfer. Transient-state diffusion. Diffusion of vapour through solid films.

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 softwares 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 chosen

careers;
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
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 Content

On-the-job experience in industry (chosen for practical working experience but not necessarily limited 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 engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation 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 troubleshooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base ■ Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to ROMS 3D design software; autoCAD 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:

(i) design of machine components
(ii) product design and innovation
(iii) part modelling and drafting in solid works
(iv) technical report writing

UIL-FDE 308: Biorefining Engineering (3 Units, C: LH = 45)

Senate-approved relevance

The versatility of graduates of engineering in a rapidly changing global workspace is a core principle in the vision and mission of the University of Ilorin. This course focuses on the development of sustainable processes for the conversion of biomass into various value-added products such as biofuels, biochemicals, and biomaterials. It is highly relevant in today's world as it aims to reduce dependence on fossil fuels, mitigate greenhouse gas emissions, and promote a circular economy. With this course, Food Engineering students will be equipped with the skills and knowledge necessary to address global challenges related to energy and the environment and to create innovative solutions for a more sustainable future.

Course overview

The aim of this course is to allow students to understand the fundamental principles of biorefinery processes and engineering, including biomass pretreatment, enzymatic hydrolysis,

fermentation, and downstream processing. The course will delves into the various technologies and approaches used in biorefinery processes, such as thermochemical conversion, biochemical conversion, and hybrid processes. Students will learn about the different types of biomass feedstocks used in biorefining, including lignocellulosic biomass, algae, and waste streams. The course will also cover the environmental and economic aspects of biorefining. Students will learn about the sustainability metrics used to evaluate biorefinery processes and how to perform life cycle assessments to determine the environmental impacts of biorefinery products.

Objectives

The objectives of the course are to:

1. define biorefining and the role of biorefinery processes in producing renewable fuels, chemicals, and materials from biomass;
2. analyze the different types of biomass feedstocks used in biorefining, including lignocellulosic biomass, algae, and waste streams, and evaluate their suitability for various biorefinery processes;
3. identify the various technologies and approaches used in biorefinery processes, such as thermochemical conversion, biochemical conversion, and hybrid processes, and analyze their advantages and limitations;
4. describe the various pretreatment methods used to prepare biomass for biorefinery processes, including mechanical, chemical, and biological methods, and evaluate their effectiveness;
5. explain the enzymatic hydrolysis process used to break down complex carbohydrates in biomass into simple sugars for fermentation;
6. explain the principles of fermentation and the various types of microorganisms used in biorefining processes;
7. evaluate the various downstream processing methods used to purify and recover products from biorefinery processes;
8. analyze the environmental impact of biorefinery processes and evaluate the sustainability metrics used to assess their performance;
9. explain the economic aspects of biorefining, including the cost of feedstocks, capital and operating costs of biorefinery processes, and market demand for biorefinery products; and
10. design a biorefinery process for the production of a specific renewable product, and evaluate its environmental and economic impact through life cycle assessment.

Learning outcomes

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

1. explain the fundamental principles of biorefining;
2. evaluate three (3) different types of biomass feedstocks used in biorefining;
3. identify and compare the thermochemical conversion, biochemical conversion, and hybrid processes, and analyze their respective advantages and limitations;
4. describe three (3) pretreatment methods used to prepare biomass for biorefinery processes;
5. explain the enzymatic hydrolysis process used to break down complex carbohydrates in biomass into simple sugars for fermentation, and evaluate the factors that influence its efficiency;
6. describe two (2) principles of fermentation and the various types of microorganisms used in biorefining processes, and assess their suitability for different products and processes;

7. evaluate four (4) various downstream processing methods used to purify and recover products from biorefinery processes, and compare their efficiency and effectiveness;
8. analyze and evaluate three (3) environmental impact of biorefinery processes, and apply sustainability metrics to assess their performance;
9. analyze the economic feasibility of different biorefinery processes; and
10. design and evaluate a biorefinery process for the production of a specific renewable product, and assess its environmental and economic impact through life cycle assessment.

Course contents

Fundamental concepts of biorefining. Principles of biorefining, Applications of biorefining engineering. Biomass feedstocks for biorefining. Biorefinery processes. Thermochemical conversion. Biochemical conversion. Hybrid processes. Pretreatment methods for biomass. Principles and methods of enzymatic hydrolysis. Principles and applications of fermentation. Methods for purifying and recovering products from biorefinery processes. Environmental impact assessment and sustainability metrics for biorefinery processes. Economics of biorefining. Integration of biorefinery processes with other industrial processes to maximize resource utilization and minimize waste generation. Methods for characterizing biomass feedstocks. Applications of biorefinery processes in renewable energy systems. Applications of biorefinery processes in producing biobased chemicals and materials, including bioplastics, biocomposites, and biofibers. Design principles and methods for biorefinery processes. Case studies in biorefining.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

UIL-FDE 312: Food Microbiology (3 Units, C: LH = 45)

Senate-approved relevance

The versatility of graduates of engineering in a rapidly changing global workspace is a core principle in the vision and mission of the University of Ilorin. This course will equip students with knowledge of food microbiology which plays a critical role in ensuring that food is safe to eat, as well as in developing and implementing effective methods of food preservation and processing.

Course overview

This undergraduate course covers the diversity and characteristics of microorganisms, including bacteria, viruses, fungi, and parasites, and their role in foodborne illness and spoilage. Students will learn how to apply their knowledge to evaluate the microbiological safety and quality of food products, design and implement control measures to prevent or minimize microbial growth and ensure compliance with food regulations and standards. The course includes laboratory exercises and case studies that enable students to develop practical skills and apply their knowledge to real-world situations.

Objectives

The objectives of the course are to:

1. describe the types of microorganisms;
2. evaluate the science of fermented foods;
3. examine the principles of food sanitation and the sanitary aspects of foodborne diseases;
4. evaluate the types of microorganisms that can be present in water, the risks they pose to human health, and the methods used to disinfect and purify

water for use in the food industry;
5. describe the methods used to control pathogens in foods, including the use of thermal processing, chemical preservatives, and other interventions;
6. describe the behavior of insects and rodents in food, including the risks they pose to food safety and the measures that can be taken to control their populations;
7. explain the most probable number (MPN) method and its use in microbial analysis, including the statistical methods used to estimate microbial populations in food samples;
8. describe the nature of microbial toxins and their effects on human health, including the types of toxins produced by different microorganisms and the symptoms they can cause;
9. evaluate the role of microorganisms in food spoilage, preservation, and processing, including the mechanisms by which microorganisms can spoil food and the methods used to prevent or delay spoilage;
10. compare the relationship between the structures and functions of prokaryotic and eukaryotic protists, including the ways in which they differ from other microorganisms;
11. explain the factors that influence microbial activities, including moisture, oxidation- reduction potential, and temperature;
12. evaluate the effects of microorganisms on processing equipment, including the types of corrosion and fouling that can occur;
13. explain alcoholic beverage production including the microorganisms involved in fermentation; and
14. develop laboratory skills for assessing different classes of food commodities, including the methods used to analyze beverages, cereals, roots and tubers, fruits and vegetables, meat, fish, and dairy products.

Learning outcomes

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

1. explain the microbiology of foods, including the types of microorganisms that can be present, their growth requirements, and their impact on food safety;
2. enumerate the microorganisms involved in fermentation processes, the biochemical reactions that occur during fermentation, and the impact of fermentation on food flavor, texture, and nutritional properties;
3. describe three (3) principles of food sanitation and explain the sources of contamination, the routes of transmission, and the measures that can be taken to prevent or control outbreaks;
4. state at least three (3) types of microorganisms that can be present in water, the risks they pose to human health, and the methods used to disinfect and purify water for use in the food industry;
5. explain the thermal processing, chemical preservatives, and other intervention used to control pathogens in foods;
6. state four (4) risks insects and rodents pose to food safety and the measures that can be taken to control their populations;
7. analyze the most probable number (MPN) method and its significance in microbial analysis;
8. describe at least three (3) types of microbial toxins and their effects on human health;
9. evaluate the mechanisms by which microorganisms can spoil food and the methods used to prevent or delay spoilage;

10. enumerate the difference between the structures and functions of prokaryotic and eukaryotic protists;
11. list five (5) factors that influence microbial activities;
12. identify four (4) effects of microorganisms on processing equipment;
13. explain the science of alcoholic beverages production; and
14. assess two (2) methods used to analyze the microbial content of beverages, cereals, roots and tubers, fruits and vegetables, meat, fish, and dairy products.

Course contents

Microbiology of foods and their raw materials. Food sanitation. Sanitary aspects of foodborne diseases. Water microbiology. Control of pathogen in foods. Insects and rodents in food and their control. Water disinfection and requirements for water in the food industry. Most portable number (MPN) and its use in microbial analysis. Microbial toxin. Microorganisms and their functions in food spoilage, preservation and processing. Classification of bacteria, fungi and yeast important in foods. Relation between structures and functions of prokaryotic and eukaryotic protists. Microbial growth. Microbial metabolism. Mechanism of pathogenicity. Factors that influence microbial activities (moisture, oxidation-reduction potential, temperature). Effects of microorganisms on processing equipment. Alcoholic beverages production and aromatic products. Laboratory methods of assessing classes of food commodities; beverages, cereals, roots and tubers, fruits and vegetables, meat, fish and dairy products.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

UIL-FDE 314: Human Nutrition (3 Units, C: LH = 45)

Senate-approved relevance

The versatility of graduates of engineering in a rapidly changing global workspace is a core principle in the vision and mission of the University of Ilorin. This course equips the students with the efficient knowledge on the biochemistry human nutrition, major components of human nutrition and metabolism of human nutrition.

Course overview

This course is very important to students who will understand the various deficiencies that may likely occur as a result of one or two deficiencies in the nutrients consumed and also likely symptoms to be developed in the individual bearing in mind that the concepts and compositions of a balanced diet so as to give a general recommendation on how to improve the diets of an individual.

This course will enable each student to be familiar with the compositions and importance of balance diet in human nutrition as well as the concept of malnutrition and their control. The course will also assist the students to prepare Food Balance Sheets and Food Composition Tables that are used in the formulation of various international food policies and programmes. The course is to be accompanied with industrial visit to related companies.

Objectives

The objectives of the course are to:

1. explain the concept of balanced diet and malnutrition;
2. list the compositions of a balanced diet;
3. discuss the status of nutrition in Nigeria;
4. describe the biochemistry of human nutrition in context of physiological systems;

5. state the importance of balanced diet;
6. itemize the important minerals and vitamins with their deficiencies;
7. construct food balance sheets and food composition tables;
8. describe various policies and programmes on food as they relate to developing countries;
9. list various food and nutrition problems;
10. explain the concepts of nutrition;
11. propose recommended dietary allowance; and
12. discuss the anti-nutritional factors in foods.

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

1. explain the concept of a balanced diet and malnutrition, providing at least three (3) examples of foods for each major nutrient category;
2. explain two (2) key roles of carbohydrates, proteins, fats and oils, vitamins, minerals, and water in maintaining a healthy diet;
3. evaluate the status of nutrition in Nigeria**,** using two (2) specific case studies or datasets to illustrate nutritional trends and challenges;
4. apply biochemistry knowledge of human nutrition to relate diet, health, nutrition, and disease management, by solving at least one (1) case scenario related to individual nutrition and disease risk;
5. develop a plan to mitigate the risk of developing common diseases (such as diabetes, hypertension, or obesity) through a balanced diet, by proposing two (2) dietary interventions**;**
6. itemize four (4) essential minerals and vitamins (e.g., calcium, iron, vitamin C, vitamin D) and describe how each contributes to improving an individual's diet;
7. project three (3) nutrient contents of common foods using food composition tables, including an analysis of calorie, protein, and fat content;
8. Use food balance sheet data to estimate the availability of specific food types for the Nigerian population, including at least two (2) examples of major staple foods;
9. discuss food and nutrition problems**,** making specific reference to Basal Metabolic Rate (BMR) and thermogenesis, while providing two (2) examples of how these factors affect energy requirements;
10. explain four (4) key nutritional aspects of carbohydrates, proteins, fats, and other macronutrients, linking them to their roles in metabolism and energy production;
11. provide recommendations for daily nutrient intake, based on the Recommended Dietary Allowance (RDA), for at least four (4) major nutrients **(**e.g., protein, calcium, iron, vitamin A); and
12. explain and categorize at least three (3) food processing methods for reducing anti-nutritional factors (e.g., soaking, fermentation, cooking), and their impact on food quality and nutrient availability.

Course contents
Situation of nutrition in Nigeria. Protein-calorie malnutrition. Biochemistry of human nutrition in context of physiological systems. Metabolism of carbohydrates, proteins, lipids, metabolism. Important mineral and vitamin deficiencies, their etiology and control. Minerals and vitamin deficiencies and their sources. Antinutritional factors in food. Classification of anti-nutritional factors. Food balance sheets, food composition tables and recommended dietary allowance. Nature of food balance sheets. Conceptual problems and accuracy of food balance sheets. Food and nutrition problems. Policy and programme on food as they relate to

developing countries. Metabolic pathways. Nutritional metabolism and energy. Processing methods for reducing anti- nutritional factors. Basal metabolic rate and thermogenesis.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

UIL-GET 311: Engineering Economics (3 Units; Compulsory; LH=45)

Senate Approved Relevance
The versatility of graduates of engineering in a rapidly changing global workspace is a core principle in the vision and mission of the University of Ilorin. This course provides engineering graduates with the requisite knowledge of the relevant principles of engineering economics so that they can be better managers, in addition to their technical competence.

Course Overview
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.

Objectives
The objectives of this course are to:

1. identify and describe the nature and types of engineering economic decisions;
2. differentiate between engineering economic decisions and design decisions;
3. identify and briefly explain the fundamental principles of engineering economics;
4. explain the meaning of economic equivalence and why its required in economic analysis;
5. explain the concept of interest operation;
6. identify and explain the types of interest formulae used to facilitate their calculations of economic equivalence;
7. identify, analyse and discuss the economic analysis of various types of interest formulae used to facilitate their calculations of economic equivalence;
8. explain the term depreciation;
9. Identify and describe the depreciation methods;
10. outline and discuss the effects of depreciation on net income calculation; and
11. evaluate the potential investment opportunities and their profitability by considering the time value of money and compare mutually exclusive investment opportunities.

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

1. outline the nature engineering economic decisions and describe at least four types of engineering economic decisions;

2. differentiate between engineering economic decisions and design decisions;
3. describe the fundamental principles of engineering economics and briefly explain at least three fundamental principles of engineering economics;
4. explain the meaning of economic equivalence and why its required in economic analysis;
5. explain the concept of interest operation;
6. explain the two types of interest formulae used to facilitate their calculations of economic equivalence;
7. implement the economic analysis of various types of interest formulae used to facilitate their calculations of economic equivalence;
8. define the term depreciation;
9. analyze the depreciation methods and describe at least two depreciation methods;
10. appraise the effects of depreciation on net income calculation; and
11. evaluate the potential investment opportunities and their profitability by considering the time value of money and compare mutually exclusive investment opportunities.

Course Contents

Definition, nature and scope of Engineering Economics. Basic Concepts of Engineering Economy. The Decision-Making Process. Engineering Economic Decisions. Engineering Economic Decisions versus Engineering Design Decisions. Role of Engineers in decision making. Break- even analysis. Time-value of money. Cash flow diagram. Economic Equivalence. Simple interest. Compound interest. Compound interest formulas and factors (P/F, F/A, A/P, P/A, F/A, A/F, A/G, G/A). Evaluation of a single proposal using PW, FW, AW, IRR and payback period analyses. Decision making among alternative proposals with equal and unequal service lives using PW, FW, AW, IRR and payback period analyses. Life-cycle costing. Depreciation – definition, purpose of, methods (straight-line, sum-of the-years-digits, declining balance). The trade-off between Risk and Reward. Effect of tax and inflation in economic analysis.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

400 Level Courses

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; and
2. Demonstrate the connection between engineering product-making and the theoretical courses 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 be achieved 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 duty and 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, and practices;
4. Prepare engineering valuation and appraisal reports and review;
5. Discuss expert witnessing and ethics in valuation; and
6. Determine price, cost, value, depreciation and obsolescence in real property, personal property, personal property, machinery and equipment, oil, gas, mines, and quarries valuation.

MEE 402: Theory (Mechanics) of Machines II (2 Unit C: LH 30)

Leaning Outcomes

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

1. identify the forces acting on a mechanism and the resolution of the forces;
2. demonstrate understanding of the performance of various mechanisms and principal machine elements as regards their kinematics and dynamics;
3. identify the types of motion and their applications;
4. identify forces on shaft and bearing due to single revolving mass;
5. demonstrate procedure for balancing several masses in different transverse planes;
6. prepare professional quality solutions and presentations to effectively communicate the results of analysis and design;
7. translate ideas and imaginations into conceptual designs using the tools of conventional engineering drawings and computer aided designs; and
8. use the knowledge of the course to solve real life problems related to production processes and to develop machines.

Course Contents

Force analysis of mechanisms, fluctuation of kinetic energy and inertia effects. Complete static and dynamic analysis. Flexible shaft couplings: belt, rope and chain drives. The flywheel and mechanical governors. Brakes and dynamometers. Balancing of multi-cylinder engines. Balancing of machinery. Vibration of machinery; free and forced vibration, damping, natural frequencies and critical speeds. Transverse vibrations of beams, whirling of shafts and torsional vibrations.

FDE 401: Technology of Flesh Food Products (2 Units C: LH 30)

Learning Outcomes

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

1. demonstrate a clear understanding of the course content, by being able to explain the value of flesh foods;
2. possess an in-depth knowledge of abattoir practices, post-mortem and ante-mortem inspection and distribution of frozen carcasses;
3. discuss biology of sea and fresh water fish production; and
4. communicate the acquired technical knowledge on fish processing technologies.

Course Contents

Definition of flesh foods, the value of meat, poultry and fish products as food, the meat industry in Nigeria, structure of meat, composition, nutritive value and conversion of muscles to meat. Abattoir practices, post-mortem and ante-mortem inspection and distribution of frozen carcasses. Biology of sea and fresh water fish production, handling methods, assessment of fish quality, microbiology, fish preservation technology, chilling, freezing, smoking, salting, canning and irradiation. Fish protein concentrate and other fish products production.

FDE 403: Technology of Plant Food Products (2 Units C: LH 30)

Learning Outcomes

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

1. demonstrate a clear understanding of the course content, by being able to explain the nutritive value of plant foods;
2. possess an in-depth knowledge of the Structure, physiology, microbiology, quality, and associated process technologies of plant foods;
3. discuss process technologies of root and tubers;
4. communicate the acquired technical knowledge on fruits and vegetable processing; and
5. explain controlled atmosphere storage of fruits and vegetables.

Course Contents

Fruits, Vegetables, Roots and Tuber technology: Structure, physiology, microbiology, quality, process technologies (canning, drying, concentration, refrigeration and freezing). Process technology of root and tubers. Fruits processing: production of Jams, jellies, marmalades from fruits; Juice extraction, refining and concentration; controlled atmosphere storage of fruits and vegetables. Fats and oils processing.

FDE 405 Laboratory Practical (Animal, Fruits & Vegetable Products) (1 Units C: PH 90)

Learning Outcomes

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

1. develop animal, fruit and vegetable products; cereal and legume products, beverage and sugar based products;
2. evaluate the quality of animal, fruit and vegetable products; and
3. develop dairy products.

Course Contents

Preparation and quality evaluation of smoked fish, smoked meat, cured meat, meat sausages, salted fish, salted and dried fish, solar dried fish, etc. Processing of milk into dairy products, e.g. ice cream, yoghurt, cheese, butter, etc. Evaluation of shell egg quality including external appearance (size, shape, shell colour, shell texture, shell cleanliness), Candling appearance, (air cell characteristics, shell characteristics, internal quality characteristics) and opened egg quality (Haugh unit, yolk index, percentage of thick and thin albumen, etc.). Shell egg pasteurization. Processing of egg products including powdered egg products (whole egg, egg yolk, egg white), Frozen liquid egg products (whole egg, egg yolk, egg white). Mayonnaise and salad cream production. Quality tests in milk and milk products. Milk products manufacture (market milk, ice cream, yoghurt and other fermented milk products, powdered milk products (full fat milk, non-fat milk.), butter, cheese, etc. Preparation and processing of fruit and vegetable products (fruit juices, squashes, fruit bar, jams, jellies, tomato ketchup, tomato puree, dried vegetables). Preparation of canned and bottled fruits and vegetables spiced and fermented vegetables.

FDE 407 Food Quality Control (2 Units C: LH 15; PH 45)

Learning Outcomes

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

i. explain and apply properly the national and international legislation/ regulation;
ii. implement food safety management systems for primary production;
iii. evaluate food safety management systems and recommend the preventive measures; and
iv. prepare presentations relating to food safety and food quality; and
v. discuss food fortification, enrichment, labeling and risk/benefit analysis.

Course Contents

Definition. Scope and significance of food quality and quality control. Quality parameters, quality assurance and specifications. Total quality management. Food laws. Food legislation and the Codex Alimentarius. Food regulations. Food standards (International food standard and Nigerian Industrial Standards (NIS)). Good manufacturing practice (GMP). Enforcement of food standards. Principles and methods of food quality control. Quality control charts. Hazard Analysis- Critical Control, Points (HACCP) system. Plant sanitation as a quality control tool. Sensory and instrumental methods of evaluating quality parameters. Food fortification and enrichment. Nutritional labeling. Risk/benefit analysis.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

FDE 409: Food Process Design (3 Units C: LH 30; PH 45)

Leaning Outcomes

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

1. demonstrate understanding of process design specifications, problem identification and definition;
2. demonstrate understanding of survey and market analysis;
3. discuss process engineering flow diagram, process charts in food processing, related symbols and conventions.;
4. demonstrate procedure for calculating mass and energy balancing;
5. handle calculations associated with typically complex food processing systems;
6. conduct optimization studies for different food processes;
7. engage in modeling and computer simulation;
8. prepare professional quality solutions and presentations to effectively communicate the results of analysis and design;
9. translate ideas and imaginations into conceptual designs using the tools of conventional engineering drawings and computer aided designs; and
10. use the knowledge of the course to solve real life problems related to production processes and to develop machines.

Course Contents

Product Development leading to design specification, problem identification and definition. The process design team. Survey and market analysis. The design data book. The use of design handbook and codes. Block diagram, symbolic representations of food equipment. Development of a Process Flow Diagram, material and energy balances in process calculations. Flow-sheeting. Pictorial representation of basic food equipment. Food process control and automation. Elements of Computer-Aided Process Design. Process engineering

flow diagram and process charts in food processing, related symbols and conventions. Mass and energy balances, contrasting food process design from chemical process design. Conception, inventorization and associated calculations for typically complex food processing systems, process instrumentation and optimization. Optimization by differentiation, programming methods, flow-sheeting software, software, applications and examples (optimization studies for different food processes). Optimization procedures: search methods, response surface method, neural network, genetic algorithms, etc. modeling, computer simulation. Fundamentals of computer simulation: Model formulation, simulation, amongst others. Report writing and presentation.

FDE 423: Food Analysis (2 Units E: LH 15; PH 45)

Learning Outcomes

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

1. demonstrate knowledge of protocols for analysis of foods for purposes of trade, compliance, quality assurance, authentication, complaint investigation, nutritional attributes and scientific research;
2. carry out experiments using basic laboratory instruments;
3. describe the operations of key laboratory instruments; and
4. analyse water and food samples.

Course Contents

The principles and application of analytical methods in food analysis, such as photometry, colorimetry, gravimetry, refractometry, Spectroscopy - Introduction (spectroscopy and spectrometry, Electromagnetic radiation, Electromagnetic spectrum, analyte spectrum, uses of spectroscopy). Atomic Spectroscopy, Molecular Spectroscopy, Fluorescence Spectroscopy. Polarimetry. Refractometry. Gravimetry. Electrophoresis. Centrifugation. Chromatography (Introduction, basic equipment and uses). Types of Chromatography - adsorption chromatography (liquid adsorption chromatography, liquid-liquid chromatography, Gas-liquid chromatography, Gas adsorption chromatography and Capillary gas chromatography, Reverse phase chromatography, High performance liquid chromatography). Partition Chromatography. Ion exchange (Cation and anion) chromatography. Molecular exclusion chromatography. X- ray diffraction analysis. Bomb calorimetry. NMR. Physical and chemical analysis of water and other major food components. Food colours, additives, trace metals, contaminants.

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 to real- life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of 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 place of 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 6 months 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 Department for overall assessment.

UIL-FDE 405: Food Biotechnology (3 Units, C: LH 45)
Senate-approved relevance
The versatility of graduates of engineering in a rapidly changing global workspace is a core principle in the vision and mission of the University of Ilorin. This course is highly relevant to food engineering students as it covers the use of biological processes and organisms in the production, processing, and preservation of food. The knowledge and skills gained from this course are essential for developing innovative food products, improving food safety, and addressing global food security challenges. Additionally, this course will play a crucial role in meeting the increasing demand for sustainable and healthy food products. Thus, food engineering students who take this course will be equipped with the necessary knowledge and skills to excel in the rapidly evolving field of food biotechnology.

Course overview
This course provides an introduction to biotechnology and its role in food production. Students will learn about the basic principles and techniques of bioprocessing, including the use of microorganisms as bioreactors, the kinetics of cell growth and product formation, and the regulation and control of bioprocesses. The course will also covers the production of ethanol and alcoholic beverages, and the microbial production of enzymes and their applications in the food industry. By the end of this course, students will have a solid understanding of the fundamentals of bioprocessing and its applications in food production, and will be equipped with the knowledge and skills necessary to design and optimize bioprocesses for food production.

Objectives
The objectives of the course are to:
1. define and explain the role of biotechnology in the food industry;
2. identify and describe the general characteristics of bioprocesses;
3. describe the function and operation of bioreactors and fermentors, as well as the use of living cells as bioreactors;
4. analyze the kinetics of cell growth and product formation in bioprocesses;
5. enumerate the regulation and control of bioprocesses;
6. analyze the production of ethanol and alcoholic beverages;
7. describe the microbial production of enzymes and their applications in the food industry;
8. evaluate the safety and ethical considerations surrounding the use of biotechnology in food production;
9. explain the role of biotechnology in the development of functional

foods and nutraceuticals;
10. develop practical laboratory skills in bioprocess engineering, including the design and operation of bioreactors and the analysis of bioprocess parameters;
11. define genetically modified organisms (GMOs) and their impact on the food industry.
12. explain the labelling and regulatory issues associated with the use of GMOs; and
13. describe the application of enzyme engineering in the production of bread, cheese and high corn fructose.

Learning outcomes

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

1. define biotechnology and outline four (4) of its role in the food industry;
2. Describe at least three (3) types of microorganisms used in bioprocesses and the products that can be produced;
3. enumerate at least five (5) characteristics of bioreactors/fermentors and explain how living cells can be used as bioreactors;
4. explain the kinetics of cell growth and product formation in bioprocesses;
5. describe the working principles of sensors used in bioprocess and explain the feedback mechanisms;
6. describe the production of ethanol and alcoholic beverages using bioprocesses;
7. explain the microbial production of enzymes and enumerate four (4) their applications in the food industry;
8. compare four (4) advantages and four (5) disadvantages of using bioprocesses in food production;
9. explain three (3) roles of biotechnology in the development of functional and nutraceuticals;
10. design and describe the operation of bioreactors and state the bioprocess parameters;
11. define genetically modified organisms (GMO) and enumerate five (5) of their roles in the food industry;
12. enumerate five (5) labellings and regulatory issues associated with the use of GMOs; and
13. describe at least three (3) applications of enzyme engineering in the production of bread, cheese and high corn fructose.

Course contents

Definition and role of biotechnology. Biotechnology and food production. General characterization of bioprocesses (microorganisms, products). Bioreactors/fermentors and living cells as bioreactor. Kinetics of cell growth and product formation. Bioprocess regulation and control. Ethanol and alcoholic beverages production. Microbial production of enzymes and their applications in food industry. Design of bioreactors. Operation principles of bioreactors. Important parameters in bioprocess. Enzyme engineering. Application of enzyme engineering in the production of bread. Application of enzyme engineering in the production of cheese. Application of enzyme engineering in the production of high-fructose corn syrup. Genetically modified organisms (GMOs) and their impact on the food industry. Labeling and regulatory issues associated with the use of GMOs.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

UIL-FDE 411: Fermentation Technology (3 Units, C: LH 45)

Senate-approved relevance

The versatility of graduates of engineering in a rapidly changing global workspace is a core

principle in the vision and mission of the University of Ilorin. Fermentation Technology is a highly relevant course for food engineering students as it provides a comprehensive understanding of the production of a wide range of food and beverage products, including bread, cheese, yogurt, beer, wine, and many others. By taking this course, students will learn about the microorganisms involved in fermentation, the biochemical reactions that occur during the process, and the factors that influence product quality and safety. Students will also gain hands-on experience in operating and controlling fermenters/bioreactors and optimizing fermentation processes for desired outcomes.

Course overview

This course provides an overview of fermentation and its usefulness in the food industry. It covers the types of fermentation processes, including batch, fed-batch, continuous, and immobilized cell fermentation, as well as the biochemical basis of fermentation, including the reactions involved in energy production and product formation. The course also explores the types of fermentation substrates used in the food industry and analyzes the kinetics of microbial growth and product formation. Students will learn about culture improvement techniques, reactor design, instrumentation, and control, and the economic aspects of industrial fermentation processes, including cost analysis and scale-up considerations. The course will examine selected examples of industrial fermentations, including locust beans production, yoghurt production, ethanol production, cheese making, and bread baking.

Objectives

The objectives of the course are to:

1. define fermentation and state its usefulness in the food industry;
2. explain the types of fermentation processes including batch, fed-batch, continuous, and immobilized cell fermentation;
3. describe the biochemical basis of fermentation, including the reactions involved in energy production and product formation;
4. explain the types of fermentation substrates used in the food industry;
5. analyze the kinetics of microbial growth and product formation;
6. describe the culture improvement techniques for industrial fermentation processes, including mutation, selection, and genetic engineering;
7. evaluate the design, including batch and continuous stirred-tank reactors, airlift reactors, and immobilized cell reactors;
8. describe the instrumentation and control of product recovery and purification in fermentation processes;
9. evaluate the economic aspects of industrial fermentation processes, including cost analysis, market demand, and scale-up considerations;
10. examine selected examples of industrial fermentations, including locust bean production, yoghurt production, cheese making, and bread baking; and
11. examine the specific fermentation conditions for wine production and its impact on wine quality and sensory attributes.

Learning outcomes

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

1. define fermentation in at least two (2) ways and explain five (5) its importance in the food industry;
2. State five (5) differences between at least three (3) types of fermentation processes used in the food industry;
3. describe the biochemical basis of fermentation and the various reactions

involved in energy production and product formation;
4. identify three (3) types of fermentation substrates used in the food industry;
5. analyze the kinetics of microbial growth and product formation;
6. briefly describe five (5) culture improvement techniques for industrial fermentation; processes, including mutation, selection, and genetic engineering;
7. evaluate the design of fermentation systems;
8. describe the basis for instrumentation and control of product recovery and purification in fermentation processes;
9. evaluate at least three (3) economic aspects of industrial fermentation processes, including cost analysis, market demand, and scale-up considerations;
10. examine the industrial fermentation process for locust beans production, yoghurt production, cheese making, and bread baking; and
11. enumerate four (4) specific fermentation conditions for wine production.

Course contents

Definition of fermentation. Role of fermentation. fermentation and food production. General characterization of biochemical basis of fermentation. Description of biochemical process for energy production. Description of biochemical process for product formation. Types of fermentation. Types of fermentation substrates. Bioprocess control. Description of instrumentation and control systems used for product recovery. Description of instrumentation and control systems used for purification. Design of fermentation system. Culture improvement techniques for industrial fermentation processes, including mutation, selection, and genetic engineering. Cost, market demand and scale-up consideration analysis during fermentation processes. Locust beans production. Yoghurt production. Cheese making. Bread making. Wine fermentation process and its impact on wine quality and sensory attributes.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

500 Level Courses

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

Learning Outcomes

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

i. explain the basics of project management as it relates to the Engineering discipline;
ii. 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;
iii. conduct, manage and execute projects in multi-disciplinary areas;
iv. possess the skills needed for project management; and
v. 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, courts and 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 an expert 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: Forms of 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 and risk. 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.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

FDE 501: Food Machinery and Equipment Design (3 Units C: LH 15; PH 45)

Learning Outcomes

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

1. employ techniques and tools for the design of food equipment, including innovative ones; 2. use appropriate standard guidelines to define design inputs for a food equipment design;
3. explain the design process and use it to develop a design concept for problem-solving;
4. recognize the classical hygienic equipment design;
5. apply the design process in the design of food machinery;
6. fabricate food equipment applying standard scientific methodologies; and
7. discuss ergonomic factors in machine design; and
8. communicate designed project to relevant stakeholders.

Course contents
Review of machine design: methods and process of design, the engineering team, Unit and dimensions, engineering materials and properties, fabrication and welding processes, fit and tolerances, stresses, deflection and buckling. Food machine component, design (shaft design and critical speed analysis, coupling, key, pins, spleens, bolts, screws belts drives, gear forces, vibrations and springs, bearing and lubrication). Hygienic equipment design. Ergonomics factors in machine design. Team design project and presentation.

FDE 502: Food Plant Design and Economics (3 Units C: LH 15; PH 45)
Learning Outcomes
At the end of the course, students should be able to:
1. employ techniques and tools for the design of food plants;
2. use appropriate symbols and block diagram in food equipment design representation and layout;
3. explain the design process and use it to develop a design concept for problem-solving;
4. recognize the classical hygienic equipment design;
5. apply the design process in the design of food machinery;
6. fabricate food equipment applying standard scientific methodologies;
7. discuss the ergonomic factors in machine design; and
8. communicate designed project to relevant stakeholders.

Course contents
Technical feasibility study of food production. Food Plant Economics. Feasibility analysis. Food factories, types and purposes. Site Selection: Location, marketing utilities and facilities, soil investigation and plant layout designs in the food industry. Facility design emphasizing planning, foundation floors, walls, drains, windows, doors, piping, Lighting, ventilation, cleaning- characteristics of suitable construction materials. Optimum design of food processing plant to include well defined spaces for the following: raw materials storage, source of water supply, waste and by-products disposal, sanitation consideration of the plant, parking space for both empty goods and finished products industries and a plant design project.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

FDE 503: Assigned Final Year Design and Research Project (6 Units C: PH 270)
Learning outcomes
At the end of this course, the student should be able to:
1. identify the problem or hypothesis to research or test;
2. describe resources and constraints;
3. choose the best approach for design process or machinery production and analyses;
4. fabricate designed equipment and conduct performance evaluation;
5. present proposal seminars;
6. carry out researches; problem identification;
7. present obtained data and conclusions in a result presentation seminar; and
8. present the final report orally and in writing.

Course contents
Student project proposal writing and presentation. Each student is expected to carry out research investigation under the supervision of a member (s) of academic staff of any area (s)

of food agricultural / food engineering. The research should be directed at solving an identified problem related to food. The Student is expected to make an oral presentation at a seminar of the project plan and or a literature review on the project topic before the investigation. Each student shall engage in a project done alone or in a team that will include problem identification, design process or machinery. Fabrication, implementation testing and seminar presentation.

UIL-FDE 505: Milk and Dairy Technology (3 Units, C: LH 30; PH 45)

Senate-approved relevance

The versatility of graduates of engineering in a rapidly changing global workspace is a core principle in the vision and mission of the University of Ilorin. This course equip the students with the efficient knowledge of quality milk procurement and developing schemes for the production of dairy products such as drinking yoghurts, ice cream, cheese and butter.

Course overview

This course is very important to students who will on their own be able to set up a dairy pilot processing plant for the production of dairy products such as pasteurized milk, whey drinks and yoghurt drinks. The course will also expose the students to the hygienic quality of dairy products including the quality control aspect as well as the hygienic condition of the processing plants. The compositions of raw milk samples as well as different ways of testing for their content in milk samples are also captured in the course synopsis. The course is to be accompanied with industrial visit to related companies.

Objectives

The objectives of the course are to:

1. explain the technology of milk and milk products;
2. describe the compositions of milk in raw milk samples;
3. describe the concept of milk storage on the farm;
4. analyze the concept of milking systems, milk collection and payment systems;
5. identify minor and major constituents of milk;
6. describe the physical properties of milk;
7. prepare common dairy product;
8. carry out some laboratory tests to determine the protein, fat and other contents present in milk and also to access milk quality;
9. analyze key components for successful dairy development; and
10. explain the concepts of dairy waste management and dairy sanitation.

Learning outcomes

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

1. explain the processing of milk and its products, including the steps involved in the production of at least two (2) common dairy products (e.g., yogurt and cheese);
2. identify five (5) factors that affect the composition of milk, and describe the differences in the composition of milk from at least two (2) different mammalian species;
3. describe two (2) physical methods (e.g., refrigeration, pasteurization) and two (2) chemical methods (e.g., use of preservatives, pH control) for preventing bacterial growth in milk;
4. list three (3) common milking systems (e.g., hand milking, automated systems), and explain two (2) methods used to assess the payment of milk based on quality and volume;
5. categorize the constituents of milk (e.g., fat, protein, lactose), non-milk substances (e.g., water, adulterants), and identify at least two (2) off-flavours that may be found in fresh

milk samples;

6. explain the appearance, density, freezing point, and pH as major physical properties of milk, and describe how these properties can be used to assess milk quality;
7. develop production schemes for common dairy products such as yoghurt, ice cream, and cheese, outlining the major steps and quality control measures for at least two (2) products;
8. carry out two (2) simple tests for assessing protein and fat contents in milk, and perform at least one (1) density test and one (1) purity test on milk samples;
9. Itemize five (5) cleaning and sanitizing procedures for maintaining hygiene in dairy plants, such as sterilization, CIP (Clean-in-Place), and regular equipment inspections; and
10. Categorize the types of waste generated in dairy plants (e.g., whey, wash water), and identify at least three (3) proper methods for disposing of dairy waste to ensure environmental safety.

Course contents

Technology of milk and milk products. Milk collection and payment systems. Milk storage on the farm. Physical and chemical methods of preventing bacterial growth in milk. Milking parlour. Compositions and structure of milk. Enzymes in milk. Physical properties of milk. Milk processing sequence. Quality of fresh milk. Production of ice cream, yoghurt, butter and cheese. Dairy development. Test for milk quality. Hygiene in processing plant (personal and plant hygiene). Concepts of HACCP/GMP. Quality control of raw milk. Methods of assessing milk quality.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

UIL-FDE 521: Engineering Measurement Systems (3 Units, C: LH 30; PH 45)

Senate-approved relevance

The versatility of graduates of engineering in a rapidly changing global workspace is a core principle in the vision and mission of the University of Ilorin. This course equips students with requisite knowledge and skills for obtaining reliable data through taking measurements with instruments during food engineering activities.

Course overview

This course will enable each student to be familiar with fundamental information needed to carry- out correct engineering measurements with the use of different measuring instruments. This course is very important for students who will be using measuring instruments used in the food industries, food research laboratories, government regulatory agencies and other related fields to be well equipped with required relevant knowledge and skills.

Objectives

The objectives of the course are to:

1. summarize the meaning of engineering measurement;
2. classify measurements into different forms;
3. explain methods and standards of measurements;
4. identify variables involved in measurement;
5. differentiate errors associated with measurements;
6. explain the principles of instrumentation systems;
7. classify measuring instruments and their functional parts;
8. outline the performance characteristics of measuring instruments;
9. explain how to calibrate measuring instruments;
10. explain signal conditioning, data collection, data storage and retrieval, data

analysis techniques;
11. demonstrate how to use different measuring instruments; and
12. justify the need for taking measurements in food engineering.

Learning outcomes

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

1. summarize the term, measurement in relation to engineering;
2. classify measurements into at least four (4) groups;
3. explain two (2) methods and four (4) standards of measurements;
4. recall at least three (3) variables involved in measurement;
5. explain at least three (3) measurement errors;
6. recall two (2) principles of instrumentation systems;
7. classify measuring instruments into at least six (6) forms and state their functional parts;
8. explain at least five (5) performance characteristics of measuring instruments;
9. explain how to calibrate measuring instruments;
10. relate at least two (2) ways of carrying out signal conditioning, data collection, data storage and retrieval, and data analysis;
11. demonstrate how to properly use at least ten (10) measuring instruments in the laboratory; and
12. defend the need for taking measurements in food engineering.

Course contents

Concept of measurement in relation to engineering. Classification of measurements. Methods of measurements. Standards of measurements. Measured variables and their types. Errors in measurements. Principles of instrumentation systems. Classification of measuring instruments. Functional elements of measuring systems. Performance characteristics of measuring instruments. Calibration of measuring instruments. Signal conditioning. Data collection and analysis procedures. Computerized data acquisition. Data storage and retrieval techniques. Operation of measuring systems. The role of measurement in food engineering.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

UIL-FDE 522: Process Modelling and Optimization (3 Units, C: LH 45)

Senate-approved relevance

The versatility of graduates of engineering in a rapidly changing global workspace is a core principle in the vision and mission of the University of Ilorin. This course equips students with knowledge and skills on effective and efficient modeling and optimization of food engineering processes. It will also develop their decision-making ability via the use models and optimized conditions.

Course overview

This course is very important for students who will develop and use food processes in the industry, laboratories and pilot-plants. It will also acquaint them with the relevant information and clearly defined steps for achieving the objective (s) of modelling and optimizing food processes. This course will enable each student to appreciate the importance of using softwares to conduct modeling, optimization and preliminary simulation of food processes against the manual approach.

Objectives

The objectives of this course are to:

1. explain the concept of modelling;
2. outline the forms, classes and uses of models;
3. describe and explain model equations features;
4. explain the stages of model equations development;
5. demonstrate and explain how to develop model equations;
6. compute and interpret the performance indices of developed model equations;
7. summarize what optimization is, and in relation to food engineering processes;
8. explain optimization techniques and algorithms;
9. explain and demonstrate how to use artificial neural network, linear programming, excel, design expert and other relevant softwares for the optimization of food engineering processes; and
10. explain the fundamentals of simulation and its application to food processes.

Learning outcomes

Upon the completion of this course, students should be able to:

1. summarize the concept of modelling;
2. outline at least three (3) forms, at least five (5) classes and at least three (3) uses of models;
3. describe and explain at least four (4) features model equations;
4. recall all the stages of model equations development;
5. develop model equations manually and with the use of at least three (3) softwares;
6. compute at least five (5) indices of judging the performance of developed model equations and interpret them;
7. recall and explain optimization, and in relation to food engineering;
8. explain at least three (3) optimization techniques and three (3) optimization algorithms;
9. demonstrate how to use artificial neural network, linear programming, excel, design expert and other relevant softwares for the optimization of food engineering processes; and
10. outline at list three (3) fundamentals of process simulation and demonstrate its application to food processes.

Course contents

The concept of modelling. Forms of models. Classification of models. Uses of models. Model equations. Components of model equations. Stages of developing model equations. Model equations development with regression analysis (manual), excel, design expert, SPSS and other relevant softwares. Performance indices of model equations. Overview of Optimization. Categories of optimization. Optimization techniques. Optimization algorithms. Basic artificial neural networks in food engineering studies. Linear programming applications to food engineering studies. Optimization with excel, design expert software and other relevant softwares. Introduction to process simulation.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

UIL-FDE 524: Food Raw Materials (3 Units, C: LH 45)

Senate-approved relevance

The versatility of graduates of engineering in a rapidly changing global workspace is a core principle in the vision and mission of the University of Ilorin. This course will help to develop knowledge and understanding of students in the areas of sourcing and utilization of raw materials for food processing to different value-added products. It would also introduce students to entrepreneurship skills development, as well as the need to consider local contents

while sourcing and utilizing food raw materials.

Course overview

The aim of this course is to enable the students have clear understanding of relevant information on the raw materials needed for producing value-added food products. Methods of sourcing food raw materials, information on local content consideration, the need to conserve scarce resources (food raw materials) and entrepreneurship skills are emphasized. Students will learn about the history of food raw materials, various categories of food raw materials and their characteristics/composition; methods of sourcing of food raw materials, role of government, food raw material conservation practices and entrepreneurship skills development. Through lectures, case studies and group discussions, students will gain a deeper understanding of the subject and be prepared to engage in real-life practice of the subject in future.

Objectives

The objectives of this course are to:

1. define food raw materials;
2. summarize the history of food raw materials;
3. state different classifications of food raw materials;
4. categorize the characteristics and composition of food raw materials;
5. outline safety issues in the handling of food raw materials;
6. describe the methods of sourcing food raw materials;
7. identify the constraints to the utilization of local food raw materials;
8. explain the prospects of local food raw materials;
9. evaluate the role of government in promoting the use of local food raw materials;
10. outline how to conserve resources for optimum utilization of food raw materials; and
11. prepare students on how to become food raw materials entrepreneurs.

Learning outcomes

Upon the completion of this course, students should be able to:

1. define food raw materials in at least three (3) different ways;
2. summarize the history food raw materials from the stone age to the modern age;
3. State at least five (5) classifications of food raw materials;
4. categorize food into at least five (5) different ways on the basis of characteristics and composition;
5. outline the basic safety issues at all the stages of food raw materials development;
6. describe at least three (3) methods of sourcing food raw materials comprehensively;
7. identify at least ten (10) major constraints to the utilization of local food raw materials;
8. explain five (5) prospects of local food raw materials utilization in food processing;
9. evaluate five (5) roles of government at all levels (federal, state and local) in promoting the use of local food raw materials;
10. outline at least three (3) ways of conserving already established scarce food raw materials for optimum utilization; and
11. Develop at least two (2) feasible plans for practicing food raw materials entrepreneurship in real-life situations.

Course contents

Definition of food raw materials. Brief history of food raw materials. Classification of food. Agro - industrial food raw materials. Conventional and unconventional raw materials for food processing. Characteristics and composition of food raw materials. Safety issues in handling of food raw materials. Methods of sourcing food raw materials. Local contents development. Constraints to local raw materials utilization for food processing. Prospects of local food raw materials. Specifications of household and industrial foods raw materials. Role of government in promoting local raw materials. Optimal utilization methods of food raw materials. Conservation practices associated with food raw materials. Upgrading traditional methods of handling food raw materials. Entrepreneurship in food raw materials.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

UIL-FDE 527: Processing of Miscellaneous Foods (3 Units, E: LH 30; PH 45)

Senate-approved relevance

The versatility of graduates of engineering in a rapidly changing global workspace is a core principle in the vision and mission of the University of Ilorin. This course provides students with relevant information to be known before processing food and how to convert different food raw materials to processed foods.

Course overview

This course will enable students to have in-depth knowledge and understanding of some important pre-processing information that will ensure the conversion of food raw materials to processed foods. Also, they will be able to use engineering/scientific principles to convert some selected food raw materials to processed foods. This course is very important for students who want to advance their future career as food processors industries or as entrepreneurs focusing on producing different processed foods.

Objectives

The objectives of this course are to:

1. define processed food;
2. categorize processed foods;
3. differentiate between processed and unprocessed foods;
4. state the importance of processed foods;
5. explain the nutritional and functional properties of processed foods;
6. describe the fundamental unit operations of processing food;
7. explain the effects of unit operations on processed food;
8. compare traditional and modern methods of food processing;
9. explain the production of non-alcoholic beverages;
10. demonstrate the production of milk and cheese from plant based raw materials;
11. explain the production of condiments from selected crops;
12. demonstrate the processing of plantain to flour;
13. explain the production of snacks from selected underutilized cereals and legumes;
14. review the term appropriate technology as related to food processing; and
15. describe the features and workings of food processing centres.

Learning outcomes

Upon the completion of this course, students should be able to:

1. define processed food in at least two (2) ways;
2. categorize processed food into at least three (3) ways;
3. differentiate between processed and unprocessed foods with at least five (5) points;
4. state at least five (5) importances of processed foods;

5. distinguish between nutritional and functional properties of processed food;
6. describe at least five (5) fundamental unit operations in food processing;
7. write on at least three (3) effects of unit operations on processed food;
8. infer four (4) similarities and four (4) differences between traditional and modern methods of food processing;
9. explain how to produce non-alcoholic beverages from at least three (3) unconventional raw materials;
10. demonstrate how to produce milk from soya beans, tiger nut and coconut, and cheese from soya beans;
11. explain the processing of condiments from locust beans, pepper and parts of selected edible plants;
12. demonstrate the processing of plantain to flour;
13. explain the production of snacks from selected underutilized cereals and legumes;
14. apply the knowledge of appropriate technology in food processing at least three (3) food; and
15. plan, sketch and develop the layout of processing centres for at least three (3) different foods.

Course contents

Definitions of processed food. Classification of processed food. Differences between processed and unprocessed foods. Importance of processed foods. Nutritional and functional properties of processed foods. Fundamental unit operations in food processing. Effects of unit operations on the properties of processed foods. Comparisons between traditional and modern methods of food processing. Processing of non-alcoholic beverages from unconventional raw materials. Recent advances in the production of non-alcoholic beverages in Nigeria. Production of milk from soya beans, tiger nut and coconut. Production of cheese from soya beans. Production of condiments from locust beans, peppers and other parts of selected edible plants. Production of snacks from underutilized cereals and legumes. Production of flour from plantain. Appropriate technology in food processing. Study visits to different food processing centres.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

UIL-FDE 532: Fruits and Vegetables Processing (3 Units, E: LH 45)

Senate-approved relevance

The versatility of graduates of engineering in a rapidly changing global workspace is a core principle in the vision and mission of the University of Ilorin. This course equips the students with the efficient knowledge of preserving different kinds of fruits and vegetable to make them edible and safe for consumption thereby increasing their shelf life.

Course overview

This course is very important to students who will develop modern preservation technologies for fruits and vegetables preservation to be used in various food industries, bearing in mind the nutrient retention in each of the technologies/methods so as to give a general recommendation after preservation. This course will enable each student to be familiar with different preservation methods, general procedures for preserving fruits and vegetable, equipment for each of the method as well as advantages and disadvantages of each method. The course is to accompanied with industrial visit to related companies.

Objectives

The objectives of the course are to:

1. identify various methods of preserving fruits and vegetable;
2. differentiate between enzymatic and non-enzymatic changes in processed fruits;
3. state the general procedures for preserving fruits and vegetable;
4. explain methods of reducing deterioration in fruits and vegetable;
5. state the importance of fruits and vegetable;
6. explain various deterioration factors in fruits and vegetables and their control;
7. discuss the structural features, general properties, chemical compositions and nutritional aspects of fruits and vegetable;
8. discuss the current trends in fruits and vegetable preservation;
9. analyze fruits specific preservation technologies;
10. explain quality control aspects of fruits and vegetable preservation; and
11. itemize various methods of packaging fruits and vegetables after preservation.

Learning outcomes

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

1. identify at least two (2) modern methods of fruits and vegetable preservation;
2. explain enzymatic and non-enzymatic changes in processed fruits with at least three (3) specific examples;
3. outline at least two (2) procedures and principles of preserving fruits and vegetables;
4. explain at least two (2) concepts of fruits and vegetable deterioration and their controls;
5. outline at least four (4) importances of fruits and vegetable in human nutrition;
6. identify and classify three (3) deterioration factors in fruits and vegetable and their controls;
7. discuss two (2) structural features, two (2) general properties, two (2) chemical compositions and two (2) nutrients stability strategies in fruits and vegetables;
8. outline at least five (5) current trends in fruits and vegetables preservation;
9. discuss at least two (2) technologies for fruits preservation and vegetable processing;
10. discuss at least three (3) various aspects of quality control and hygiene practices/requirements in preserving fruits and vegetables; and
11. discuss at least three (3) methods of packaging fruits and vegetables with their merits and demerits.

Course contents

Methods for preserving fruits and vegetables. Importance of fruits and vegetable in human nutrition. Enzymatic changes in processed fruits. Non-enzymatic changes in processed fruits. General procedures and principles for preserving fruits and vegetable. General properties and structural features of fruits and vegetables. Chemical compositions and nutritional stability of fruits and vegetable. Various deterioration factors in fruits and vegetable and their control. Procedures for preserving fruits and vegetable. Current trends in fruits and vegetable preservation. Fruits specific preservation technologies. Vegetable specific processing technologies. Methods of packaging fruits and vegetable. Quality control in fruits preservation. Quality control in vegetable processing. Importance of vegetable and fruit processing industries. Merits and demerits of different fruits and vegetable preservation/processing techniques.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

UIL-FDE 538: Sugar Technology (3 Units, E: LH 45)

Senate-approved relevance

The versatility of graduates of engineering in a rapidly changing global workspace is a core principle in the vision and mission of the University of Ilorin. This course equips the students with the efficient knowledge involved in the production, refinement and packaging of sugar from sugar cane. This course also exposes the students to the manufacturing and its techniques and the by- products of sugarcane for ethanol production to the students.

Course overview

This course is very important to students because it will broaden their knowledge on the step by step production of sugar from sugar cane and sugar beet. The also stress the needs of using sugar as alternative source of energy and also as alternative sources of materials for chemical industries. The use of different byproducts from the sugar production process is also captured in the course synopsis. The course is to be accompanied with industrial visit to related companies.

Objectives

The objectives of the course are to:

1. explain the current technology of sugar production from sugar cane and sugar beet;
2. define sugar and give the technical name for sugar;
3. differentiate between kinds and types of sugar;
4. describe the sources for manufacturing sugar;
5. discuss the process involved in the production of sugar from sugar cane and sugar beet;
6. outline the equipment used in the production of sugar from sugar cane and sugar beet;
7. discuss the use of byproducts from sugar production;
8. discuss the use of sugar and its byproducts as alternative energy source;
9. identify hazards in sugar industry;
10. discuss the environmental impact of sugar industry; and
11. identify the most common challenges faced by the sugar industry.

Learning outcomes

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

1. apply the use of ultrafiltration, juice softening and chromatographic separation in the production of sugar;
2. State at least three (3) differences between sucrose and two (2) other sugars (fructose and glucose);
3. explain the concept behind dairy, fruit and table sugars;
4. identify sugar cane and sugar beet as sources of manufacturing sugar;
5. develop a flowchart describing the processes involved in the production of sugar right from the raw material to the end product;
6. list at least five (5) common equipment used in the production of sugar as well as their maintenances;
7. discuss three (3) uses of molasses and beet pulp as major by-products from sugar production;
8. explain three (3) uses of phenol, sucrose and ethylene oxide as raw materials in plastic and chemical industries;
9. discuss five (5) major risks present in sugar industries;
10. discuss at least four (4) effects of wastewater, emissions and solid waste from sugar production on the society; and
11. outline five (5) common problems facing the sugar industries in Nigeria.

Course contents
Technology of sugar production. Definition and technical name for sugar. Types and kinds of sugar Uses of sugar. Health benefits of sugar. Sources of raw materials for the production of sugar. Processing of sugar. Sugar cane and sugar beet. Equipment and machineries used in the production of sugar. Sugar byproducts. Sources and uses of byproducts of sugar. Application of sugar byproducts in plastic and chemical industries. Hazards of the sugar industry. Environmental impact of sugar industry. Safety, economics and environmental consideration of sugar industry. Energy recovery from sugar production. Application of ion exchange resin in sugar industry.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

UIL-FDE 552: Fats and Oils Technology (3 Units, E: LH 45)

Senate-approved relevance
The versatility of graduates of engineering in a rapidly changing global workspace is a core principle in the vision and mission of the University of Ilorin. This course equip the students with the efficient knowledge of origin of fats and oils as well as different methods of recovering oils and fats from oil bearing tissues.

Course overview
This course is very important to students who will develop modern extracting technologies (equipment) from getting oil from oil different producing seeds bearing in mind the yield from different sources so as to give a general recommendation after extraction. This course will enable each student to be familiar with different extraction methods, general principles and procedures for oil extractions, equipment for each of the method as well as advantages and disadvantages of each method. The course is to accompanied with industrial visit to related company.

Objectives
The objectives of the course are to:
1. identify various methods of extracting fats and oils;
2. differentiate between oils and fats;
3. state the general procedures and principles for extracting fats and oils;
4. explain methods of recovering fats and oils from different oil seeds;
5. state the importance of fats and oils;
6. outline the characteristics, compositions and uses of fats and oil;
7. list and categorize the various raw materials for the vegetable oil;
8. discuss the current trends in fats and oils extraction as well as the status of fats and oils industry in Nigeria;
9. analyze the effects of climatic conditions, harvesting and storage on quality of glycerides;
10. explain quality control aspects of fats and oils extraction;
11. itemize various processing equipment and machineries of oil production; and
12. discuss extensively the refining of oil and storage quality indices.

Learning outcomes
On completion of the course, students should be able to:
1. identify at least three (3) modern methods of fats and oils extraction;
2. outline four (4) major difference between fats and oils with specific examples;
3. outline three (3) general procedures and principles for extracting fats and oils;
4. categorize and explain three (3) methods of recovering fats and oils from oil seeds;

5. outline three (3) importances of fats and oils in human nutrition;
6. outline three (3) characteristics, five (5) compositions and five (5) uses of fats and oil;
7. List and categorize five (5) raw materials for the vegetable oil industry;
8. outline at least two (2) current trends in fats and oils extraction as well as the status of fats and oils industry in Nigeria;
9. discuss four (4) effects of climatic conditions, harvesting and storage on quality of glycerides;
10. discuss five (5) aspects of quality control and hygiene practices/requirements in extracting fats and oils from at least two (2) sources;
11. Itemize at least five (5) processing equipment and machineries for fats and oils extraction; and
12. discuss extensively at least three (3) stages of refining of oil and three (3) storage quality indices.

Course contents

Modern methods of fats and oils extraction. Status of the fats and oils industries in Nigeria. General procedures and principles of fats and oils extraction. Methods of fats and oil recovery from different sources. Importance of fats and oils in human nutrition. Economic importance of fats and oils. Characteristics, composition and uses of fats and oils. Raw materials for vegetable oils. Current trends in fats and oils extraction. Effects of climatic conditions, harvesting and storage on quality of glycerides. Quality control aspects of fats and oils extraction. Hygiene practices requirement in extracting fats and oils from oil seeds. Processing equipment and machineries for fats and oils extraction. Refining of oil and storage quality indices of fats and oils. Dairy fats. Types of fats and oil. Applications of fats and oils in pharmaceutical industries.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

UIL-FDE 553: Special Problems in Food Engineering (3 Units, E: LH 45)

Senate-approved relevance

The versatility of graduates of engineering in a rapidly changing global workspace is a core principle in the vision and mission of the University of Ilorin. This course will help the students to properly understand the fundamental problems facing food engineering; improve their critical thinking ability and develop their problem-solving skills.

Course overview

The aim of this course is to enable the students have in depth knowledge and understanding of problems militating against the growth and development food engineering. Also, some methods of the addressing the problems are emphasized. Students will learn through lectures, case studies, group discussions, seminar presentation and interaction with others engaged in food engineering activities. At the end of the course, the students will gain deeper knowledge and understanding on problems facing food engineering, as well as relevant skills needed address the problems.

Objectives

The objectives of this course are to:

1. appraise the evolution of food engineering;
2. assess views of students on food engineering;
3. differentiate between classical and contemporary food engineering problems;
4. identify global problems in food engineering;
5. explain causes and effects of problems in food engineering;

6. state the classification of problems in food engineering;
7. order identified food engineering problems and select the most critical ones;
8. outline the contributions of global crises to the problems;
9. review case studies and articles on the problems in food engineering;
10. use SWOT analysis techniques to handle problems in food engineering; and
11. apply appropriate technology and system approach to solve related food engineering problems.

Learning outcomes

Upon the completion of this course, students should be able to:

1. summarize the evolution of food engineering in at least two (2) ways;
2. recognize at least four (4) views of people on food engineering;
3. list at least seven (7) global food engineering problems;
4. categorize at least six (6) food engineering problems into classical and contemporary;
5. explain at least three (3) causes of problems in food engineering and their effects;
6. recall at least five (5) classes of food engineering problems;
7. rearrange at least five (5) identified food engineering problems in order of severity to select the most critical ones;
8. justify three (3) global crises that contribute to food engineering problems;
9. establish two (2) important information on food engineering problems;
10. apply SWOT analysis techniques in handling food engineering problems; and
11. explain how to use system approach to solve related food engineering problems.

Course contents

Appraisal of evolution of food engineering (FE). Perception of people to FE. Classical and contemporary problems in FE. General identification of problems in FE. Causes and effects of problems in FE. Classification of problems in FE. Ranking of classified problems. Identification of critical problems in FE. Contributions of global crises to the problems in FE. Case studies on FE problems. Review and Critique of articles on FE problems. SWOT analysis of FE problems. Paradigm shifts in FE education curriculum. Future needs in FE. Application of appropriate technology to solving related FE problems. System approach to solving FE problems. Seminar presentation and term paper submission on identified FE problems and solutions within students' locality.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

UIL-FDE 555: Biological Nano-engineering (3 Units, E: LH 45)

Senate-approved relevance

The versatility of graduates of engineering in a rapidly changing global workspace is a core principle in the vision and mission of the University of Ilorin. This course has significant relevance to food engineering students, as it involves the manipulation of biological systems at the nanoscale to develop innovative food products and processing techniques. It provides opportunities to create functional materials, develop advanced sensors, and design new methods for food preservation and delivery. Understanding the principles of Biological Nano-engineering can enable food engineering students to develop sustainable and effective solutions for the food industry, meeting the demands of consumers for safe, nutritious, and convenient food products.

Course overview

This course is designed for food engineering students to explore the application of nanotechnology in the food industry. This course covers fundamental principles of nanotechnology, materials science, and biology, and their integration for designing and developing novel food products with improved functional properties. This course will allow students to learn about current research trends, opportunities and challenges in the field of biological nano-engineering for food applications.

Objectives

The objectives of the course are to:

1. explain the concept of biological nano-engineering and its applications in food engineering;
2. describe the types of nanomaterials;
3. enumerate the use of nano-biosensors for food quality and safety control;
4. explain the concepts of nano-encapsulation;
5. describe the role of nanomaterials in food packaging and their impact on food safety and preservation;
6. describe biomimetic nanostructures and their applications in food engineering;
7. state the use of nanoparticles in food delivery systems and their impact on food bioavailability;
8. describe the biopolymer-based nanostructures and their applications in food; explain role of microfluidics;
9. evaluate nano-toxicology and its relevance to food safety; and
10. explain the regulatory aspects of nano-engineered foods.

Learning outcomes

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

1. explain the concept of biological nano-engineering and its applications in food engineering;
2. identify four (4) types of nanomaterials and their properties;
3. enumerate uses of at least three (3) nano-biosensors for food quality and safety;
4. explain at least two (2) concepts of nano-encapsulation, and its potential applications in the food industry;
5. describe two (2) roles of nanomaterials in food packaging and their impact on food safety and preservation, including barrier properties and antimicrobial properties;
6. explain biomimetic nanostructures and at least two (2) areas of application in food engineering;
7. state three (3) uses of nanoparticles in food delivery systems and their impact on food bioavailability, including improving solubility and absorption of nutrients;
8. describe biopolymer-based nanostructures and three (3) areas of applications in studies;
9. explain three (3) roles of microfluidics in the production and analysis of nanostructures;
10. evaluate nanotoxicology and three (3) of its relevance to food safety; and
11. explain at least four (4) regulatory aspects of nano-engineered foods, including labeling and safety regulations, and the challenges in regulating these emerging technologies in food industry.

Course contents
Introduction to biological nano-engineering. Basic principles of biological nano-engineering. Types of nanomaterials and their properties. Nano-biosensors. Applications of biosensors in food. Nano-encapsulation and delivery systems. Food packaging and nanomaterials. Biomimetic nanostructures. Nano-encapsulation of food ingredients. Nano-emulsions and their applications in food products. Nanoparticles in food delivery systems and bioavailability enhancement. Biopolymer-based nanostructures. Microfluidics in food engineering. Nano-toxicology and food safety. Regulatory aspects of nano- engineered foods. Emerging trends in biological nano engineering for food applications. Case studies of nanotechnology in food industry.

Minimum Academic Standards: As specified in the NUC 70% CCMAS requirement

Minimum Academic Standards

Equipment, Laboratories & workshop required for the Programme

Although, other laboratories and workshops not listed here will be shared with many other departments in the faculty and the University in general, the laboratories and facilities listed below should be provided and equipped specifically for the Food Engineering programme.

Laboratories/Workshops

1. **Food Processing/ Pilot Plant Laboratory**
2. **Food Fabrication/ Engineering Workshop**
3. **Food Chemistry Laboratory**
4. **Food Biotechnology/Microbiology Laboratory**

This workshop ought to be equipped with facilities for wood work, metal work and glasswork where possible.
This studio will enable students to gain practical engineering drawing skills. The Studio should have adequate number of tables, chairs, drawing boards and other accessories. It will be very strategic to acquire drawing softwares like Alias, Autocad, FORMET, etc. for digital drawing and sketching.

Equipment
Although other laboratories and workshops not listed here will be shared with many other departments in the faculty and the University in general, the laboratories and facilities listedin the Table below should be provided and equipped specifically for every Food Science andTechnology programme

Food Chemistry and Analysis Laboratory

S/N	Name of Equipment
1	Colorimeter
2	Balance (Research)
3	Manesty steel
4	Water Bath
5	pH Meter
6	Standing Freezer
7	Refrigerator
8	Hot Plate
9	Homogenizer
10	Refracto meter – hand
11	Laboratory benches/slabs, cupboards
12	Fume Chamber
13	pH Meter 020 JENWAY
14	Magnetic Stirrer
15	Kjehldal Distiller
16	Water bath Shaker
17	Battery operated Electronic balance
18	Top loading balance
19	Cole palmer fume hood
20	Flame photometer
21	Hot air oven
22	Kjeldahl digester
23	Markhan apparatus
24	Thermolyne bench-top muffle furnace
25	Soxhlet extraction unit
26	Magnetic stirrer
27	Analytical balance
28	Cole palmer UV/Vis spec
29	Electric table top centrifuge

Food Microbiology Laboratory

S/N	Name of Equipment
1	Kjeldahl Nitrogen apparatus
2	Soxhlet apparatus
3	Muffle furnace
4	Chromatography-Gas/Liquid
5	Digester (1007)
6	Soxtec System, Service Unit (1044)
7	Evatec System; 600 Microwave Drier
8	Cyclotec; 1093 Sample Mill
9	Markham Distiller
10	Hot Air Oven
11	Hot Air Oven (bad) size one

12	Incubator
13	Water bath (small)
14	Electric Stirrer
15	Microwave Oven
16	Hot plate
17	Balance, Top loading
18	pH Meter
19	Hot air oven
20	Microscopes
21	Cole Palmer polystat cooling/heating circulators bath (6.5 liters)

Animal Products Laboratory

S/N	Items
1	Motor driven, pickle machine
2	Hand operated pickle machine
3	Ice making machine
4	Kenwood Mincer
5	Desiccator
6	Water activity meter
7	Hauth Meter
8	Weighing balance
9	Cole Palmer fume hood

Food Processing Laboratory

S/N	Items
1	Tower pots
2	Juice extractor
3	Food mixer
4	Blender
5	Chopping boards
6	Grater
7	Scale
8	Stainless spoons (divine success)
9	Stainless forks (divine success)
10	Tin cutter
11	Rolling pins
12	Wooden sticks (spatula)
13	Perforated Stainless spoons (frying)
14	Perforated spoon
15	Flat serving plates (big)
16	Flat serving plates (small)
17	Deep soup plates (big)
18	Deep soup plates (small)
19	Cooking spoons
20	Knives
21	Flat bottom sieve
22	Sieves (with handle)
23	Stainless steel bowls

24	Plastic basin (big)
25	Plastic basin (small)
26	Plastic bowl (small)
27	Glass tumblers
28	Bread knife
29	Crown corking machine
30	Gas cooker (single burner)
31	Baking oven
32	Gas cylinders
33	Domestic gas cylinder regulator
34	Baking pans
35	Baking trays
36	Stainless trays
37	2-burner kerosene stoves (high standing)
38	Big saucer pan/pot (tower brand)
39	Medium saucer pan/pot (tower brand)
40	Cooking spoons (stainless steel)
41	Can openers
42	Cutlery forks
43	Blender (sorex brand)
44	Drinking glass/tumbler
45	Gas regulator (paca brand)
46	Hand towels
47	Ceramic plates (flat)
48	Ceramic plates (bowl)
49	13.5 kg gas cylinder (total brand)
50	Basins (stainless steel)
51	Basin plastic
52	Trays (stainless steel)
53	Buckets – plastic with cover
54	25 litre gallon black for kerosene
55	Kitchen knives with black handle
56	7 x 7 Projector screen
57	Kenwood mixer (with accessories)
58	Anerobic jar (22 x 12 mm)
59	100-liter steam jacketed kettle with tap
60	100-liter steam jacketed without tap
61	Electric Generating Plant (3.2 KVA)
62	Water bath sterilizer
63	Stuart scientific SAB vortex mixer
64	Coors porcelain mortar Z529508
65	Coors porcelain pestle
66	Magnetic stirrer X603813-IEA

Sensory Evaluation Laboratory

S/N	List of Facilities
1	Product Preparation Area • A fully equipped kitchen with storage area. It should have refrigerators/freezers, conventional ranges/ovens, dishwashers • convection oven, microwave ovens, &professional grills

	Positive air pressure and air conditioners •
2	Sensory Testing Areas • It should have individual booths with computers for ballot presentation. The computers need to be equipped with sensory evaluation softwares like Compusense (https://compusense.com/) . SPSS and Food Processor® softwareinstalled could also be installed to the computers The booth ought to be fitted with tap water and waste water drainage wash hand/basin. Adequate lighting is to be provided within the booth.
3	Meeting room with conference table seating for 12-15 panelists, for briefing andbrainstorming.
4	Objective Testing Area • Analytical balance and electronic food scales • Hydrometers, pH meter, Refractometer, Consistometer • Moisture Analyzer,Saltmeter, Specific Gravity Pycnometer

Bakery – (Pilot Plant)

S/N	Item	Units
1	Wood fired baking oven	2
2	Electric baking oven	2
3	Dough mixer	2
4	Dough milling machine	2
5	Dough cutter/divider	1
6	Dough moulder	1
7	Baking pans	500 lbs
8	Bread slicer	1
9	Dough conditioner	5
10	Racks for bread cooling	5
11	Diesel engine	1
12	Stainless steel tables	4
13	Trolleys	3

Garri Processing Plant

S/N	Item	Units
1	Diesel powered grater	1
2	Hydraulic press	2
3	Wood fired garri fryer	1
4	Weighing balance (50 kg & 20 kg)	1 each
5	Manual Sealing machine	2
6	Industrial Sealing machine	2
7	Cassava grater (Weston Specialist Product, Ltd.)	

Malting Plant

S/N	Item	Units
1	Malting bin	1
2	Malting bin/dryer	2
3	Washing basin	1
4	Humidifier	1
5	Dryer	1

Canning Line

S/N	Item	Units
1	Electric steam boiler (Reimers Cleanbrook, Virginia. RH60)	1
2	Autoclave /Retort equipped with thermocouples	1
3	Blancher	1
4	Cooker	1
5	Can seamer	1
6	Steamer	1

Grains Processing/Milling Plant

	Item	Units
1	Rice Miller and Polisher (Lewis C. Grant Ltd, Dysart, Scotland)	1
2	Attrition Grinder (Bental)	1
3	Mixer	1
4	Single or twin-screw Extruder	1
5	Hammer Mill (Horvic)	1
6	Dehuller	1
7	Drum dryer	1

Smoking Unit

S/N	Item	Units
1	Smoking kiln and Improved smoking kiln	2
2	Parboiling/scalding station	1
3	Poultry feather plucking machine	1
	Dressing table	1

Engineering Fabrication Workshop (Could be shared)

This workshop ought to be equipped with facilities for wood work, metal work and glassworkwhere possible.

Drawing Studio (Could be shared)

This studio will enable students to gain practical engineering drawing skills. The Studio should have adequate number of tables, chairs, drawing boards and other accessories. It will

be very strategic to acquire drawing software like Alias, AutoCAD, FORMIT, etc. for digital drawing and sketching.

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 equivalentsof Staff in the department. There is need to have a reasonable number of Staff with doctoraldegrees as well as sufficient industrial experience. With a minimum load of 15 Units 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's and supervision of projects.

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, practical's 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 staff 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.

Student/Staff Ratio

The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library

In addition to the university and faculty libraries, the programme must have a departmental library well equipped with specialised books and journals in both **physical collections** and **E-collections (E-Resources)** of various types. Various field and research reports of the programme must also be available in the library for staff, students and researchers. The library must be connected to subscribed repository of:

1. institutions (national and international);
2. open access sources (Agora, Science direct, OARE, HINARI amongst others);
3. professional bodies' E-learning platforms; and
4. Relevant international organisations;

The library must also have adequate facilities for reading, lending and reservation of specialised materials.

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,computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves,computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves,computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves,computer unit.
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%)

List of Reviewers

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,	
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

Title	Surname	First Name	Institution	Programme
			City	
Professor	ADEMILUYI	Falilat Taiwo	Rivers State University, Port Harcourt	Petrochemical Engineering
Professor	ONYEKONWU	Mike	University of Port Harcourt	Petroleum Engineering
Professor	IKIENSIKIMAMA	Sunday Sunday	University of Port Harcourt	Petroleum and Gas Engineering
Professor	JOEL	Ogbonna Friday	University of Port Harcourt	Petroleum and Gas Engineering
Professor	YELEBE	Zakieni Robert	Niger Delta University, Bayelsa	Natural Gas Engineering
Professor	WAZIRI	Baba Shehu	University of Maiduguri	Water Resources Engineering
Professor	AIYESIMOJU	Kola Oluyomi	University of Lagos	Civil Engineering
Professor	OGUNTI	Erastus O.	Federal University of Technology, Akure	Structural Engineering
Professor	OLUFEMI	Babalola	Federal University of Technology, Akure	Wood Products Engineering
Professor	AISIEN	Felix A.	University of Benin, Benin-City	Biomedical Engineering
Professor	ODETUNDE	Christopher	Augustine University, Illara, Epe.	Aerospace Engineering
Professor	ATAYERO	Aderemi A.	Covenant university, Ota	Information and Communication Engineering
Professor	AIBINU	Musa Abiodun	Federal University of Technology, Minna	Information and Communication 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. bunoluwa 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