MICHAEL OKPARA UNIVERSITY OF AGRICULTURE, UMUDIKE

COLLEGE OF ENGINEERING AND ENGINEERING TECHNOLOGY
DEPARTMENT OF CHEMICAL ENGINEERING

B.Eng. Chemical Engineering

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

2025

MICHAEL OKPARA UNIVERSITY OF AGRICULTURE, UMUDIKE (MOUAU)

MOUAU's PHILOSOPHY

The Michael Okpara University of Agriculture, Umudike conceives food as one of the indicators of state power and national security. The University is anchored on the philosophy that national development could be enhanced by properly integrated and coordinated agricultural education. Thus, the University strives to contribute to Nigeria's greatness through self-sufficiency in food and fibre production as disseminated through teaching, research, training and extension.

MOUAU's VISION

The **Vision** of the University encapsulates its original purpose and what used to be referred to as its Mission and Mandate. The rehearsing of this vision gives anyone associated with it the expectations of the Institution. The University aims to provide the knowledge base for achieving food security, hence its motto: **Knowledge, Food and Security**. The University, therefore, has the vision to serve Nigeria and humanity through processes that will lead to the alleviation of hunger.

MOUAU's MISSION

The **Mission** of the University is to provide high-quality practical training for students to become professionally competent, and confident persons capable of self-employment, to develop environment-friendly and person-sensitive technologies; and to enhance the well-being of the people through extension services and other interventions.

MOUAU's CORE VALUES

Excellence, Integrity, Commitment, Fairness, and Justice.

MOUAU's GOAL

The overall **goal** is to provide the training of students in a rural setting, aimed at self-reliance, through the inculcation of appropriate entrepreneurship skills.

MOUAU's OBJECTIVES

The objectives of Michael Okpara University of Agriculture, Umudike are as follows;-

1. To encourage the advancement of learning and to hold out to all persons without distinction of race, creed, sex or political conviction, the opportunity of acquiring a higher education in Agriculture;
2. To develop and offer academic and professional programmes leading to the award of diplomas, first degrees, postgraduate research and higher degrees which emphasize planning, technical, maintenance, developmental and adaptive skills in Agriculture, Agricultural Engineering and Engineering Technology and allied professional disciplines with the aim of producing

socially mature persons with capacity to improve on those disciplines and develop new ones, but also to contribute to the scientific transformation of agriculture in Nigeria;

3. To act as agents and catalysts, through postgraduate training, research and innovation for the effective and economic utilization, exploitation and conservation of Nigeria's natural, agricultural, economic and human resources;
4. To offer to the general population as a form of public service, the results of training and research in agriculture and allied disciplines and to foster the practical application of those results;
5. To establish appropriate relationship with other national institutions involved in training, research and development of agriculture;
6. To identify the agricultural problems and needs of Nigeria and to find solutions to them within the context of overall national development;
7. To provide and promote sound basic scientific training as a foundation for the development of agriculture and allied disciplines, taking into account indigenous culture, the need to enhance national unity, the need to vastly increase the adequate preparation of graduates for self-employment in agriculture and allied professions;
8. To promote and emphasize teaching, research and extension of agricultural knowledge including agriculture extension services and out-reach programmes, in-service training, continuing education, and on-farm adaptive research;
9. To offer academic programme in relation to the training of manpower for agriculture in Nigeria;
10. To organize research relevant to training in agriculture with emphasis on small scale farming;
11. To organize extension services and outreach programmes for technology transfer;
12. To establish institutional linkages in other to foster collaboration and integration of training, research and extension activities; and
13. To undertake any other activities appropriate for Universities of Agriculture

In view of the above stated mission and objectives, and while fully aware of its national responsibilities, the University will ensure that its research and extension activities are responsive to the needs of the farmers in the agro-ecological zone in which it is located. Specifically the University will adopt the bottom-to-up approach in the planning and implementation of research, and in development and transfer of technology to the farmers. Hence, the immediate enhancement of the well-being of the farmers is the focal point of the University.

COLLEGE OF ENGINEERING AND ENGINEERING TECHNOLOGY (CEET)

CEET's PHILOSOPHY
The College of Engineering and Engineering Technology (CEET) is committed to entrepreneurial and transformational education, responsible research and community services for advancing national development through self-sufficiency in food/fibre production and innovative solutions to real-world challenges.

CEET's VISION
To lead in tech-manpower development and impactful research for sustainable agriculture and industrialization

CEET's MISSION
To provide high-quality engineering education that stimulates trainees' ingenuity and originality to become highly proficient, self-reliant professionals capable of driving positive societal change through technological innovations for equitable future.

CEET's CORE VALUES
Excellence, Honesty, Lifelong learning and Societal Impact

CEET's GOALS
Our goals are to:

- Produce highly skilled and industry-relevant engineering professionals equipped to lead sustainable development efforts across agro-industrial and allied sectors.
- Promote interdisciplinary research that drives innovation and technological advancement
- Stimulate impactful partnerships and collaborations that translate research outcomes into scalable entrepreneurial solutions for societal needs.

CEET's OBJECTIVES
The outlined goals will be achieved through the following:

- Creating inclusive and challenging academic environment conducive for positive teacher-student relationships and interactive learning experiences.
- Delivering training with outcome-based curricula for driving the advancement of national development policies and strategies.
- Stimulating trainees' ingenuity, originality, lifelong learning. leadership and team capabilities
- Collaborating with industry partners and agricultural organizations to translate research into market-ready solutions and ventures for addressing societal challenges and achieving a sustainable future.
- Championing staff and students' internship and community service engagement.

DEPARTMENT OF CHEMICAL ENGINEERING

History

In May 1992, Decree No. 48 of the Federal Government of Nigeria established the Michael Okpara University of Agriculture, Umudike. Over time, it became evident that the institution's mission could not be fully realized, nor could agriculture be effectively developed and leveraged for national industrialization and sustainability, without the establishment of - College of Engineering. Consequently, in the 2001/2002 academic session, the College of Engineering and Engineering Technology was founded. The Department of Agricultural Engineering was first established, followed by that of Civil Engineering, Mechanical Engineering, and Electrical/Electronics Engineering during the 2003/2004 academic session. Realizing the key role chemical engineering plays in agro-processing, the Department of Chemical Engineering was established and commenced operations in the 2011/2012 academic session, with Dr. Kayode Feyisetan Adekunle serving as the pioneer Head of Department (HOD). The department offers a five-year Bachelor of Engineering (B.Eng) degree programme, and postgraduate degrees (Master's and Ph.D.) in Chemical Engineering.

Philosophy

To develop skilled chemical engineers equipped with the knowledge and expertise to design, optimize, innovate chemical processes, and drive industrial growth, environmental sustainability, and national development.

Mission statement

To develop competent chemical engineers with scientific knowledge and skills to address real-world challenges in energy, manufacturing, healthcare, and environmental

Vision statement

To be a center of excellence in chemical engineering education, research, innovation, and development, and produce highly skilled professionals for sustainable industrial development and technological advancement of Nigeria and the world.

To realize this goal, the Department operates an academic curriculum for the undergraduate programme, culminating in award of a Bachellor of Engineering (B.Eng.) degree. The program spans five academic sessions for the undergraduate students admitted through the Unified Tertiary Matriculation Examination (UTME), and four for those by direct entry (DE) admission. The Department commenced postgraduate programmes (M.Eng., and Ph.D.) in year 2016 in core research areas of Process and Product Development, Polymer processing and composites development and Process Systems Engineering

Staff List of the Department

S/No.	Name	Rank	Status And Qualification	Area of Specialization
1.	E.O. Oke	Reader & Ag. Head of Department	B.Tech., M. Tech., Ph. D (LAUTECH, Ogbomoso); R.Eng. (Nigeria)	Process System Engineering, Process and Product Development
2.	B.I. Okolo	Reader	B.Sc., M.Eng., (ESUT), Ph.D. (UNIZIK); R.Eng. (Nigeria)	Environmental Engineering, Separation Processes
3.	P.C. Nnaji	Reader	B.Sc., (ESUT) M.Sc. (FUTO); Ph.D (COOU); R.Eng. (Nigeria)	Environmental Engineering, Separation Processes
4.	O. Adeyi	Senior Lecturer	B.Sc. (LAUTECH); M.Sc. (UI); Ph.D (South Africa); R.Eng. (Nigeria)	Process System Engineering, Process and Product Development
5.	C. Ugwuodo	Senior Lecturer	B.Sc. (ESUT); M.Eng., Ph.D (UNIBEN) R.Eng. (Nigeria)	Process Design, process and product development
6.	G. Okoronkwo	Senior Lecturer	B. Sc, M.Sc, Ph.D (COOU)	Polymer and composite synthesis
7.	C.N. Ude	Senior Lecturer	B.Sc., M.Sc., Ph.D. (UNIZIK); R.Eng. (Nigeria)	Sustainable process engineering and catalysis
8.	K. Nwosu-obieogu	Senior Lecturer	B.Eng., M.Eng (ESUT), Ph.D. (COOU); R.Eng. (Nigeria)	Sustainable Process Engineering and catalysis, Process and Product Development
9.	F.O. Aguele	Senior Lecturer	B.Eng., M.Eng (FUTO); Ph.D. (MOUAU); R.Eng. (Nig.)	Polymer synthesis, processing and Nanotechnology
10.	B.I. Ugwu	Lecturer 1	B.Eng(ESUT), M.Eng (ABU) R.Eng. (Nigeria)	Catalysis and energy

11.	T. U. Apugo-Nwosu	Lecturer I	B.Eng., M.Sc. (ABU, Zaria); . (Nigeria)	Process and Product development
12.	E.O. Anike	Lecturer I	B.Eng., M.Eng. (ESUT) R.Eng. (Nigeria)	Biofuel, Chemical Reaction Engineering and Process synthesis
13.	G. W. Dzarma	Lecturer I	B.Eng (FUT, Yola) M.Sc (UNIPORT); R.Engr. (COREN)	Process and Product Development, Process system engineering
14.	N. C. Ogunaobi	Research Fellow 2	B.Eng., M.Eng (UNIZIK) R.Engr. (COREN)	Environmental Engineering, Separation Processes
15.	K. N. Akatobi	Assistant Research Fellow	B.Eng. (ESUT); M.Eng (MOUAU), R.Engr. (COREN)	Environmental Engineering, Separation Processes
	Technical Staff			
16.	G. Ohabuike	Senior Technologist	B.Eng (FUTO), R.Engr. (COREN)	
17.	O. Ige	Senior Technologist	OND. ; HND. (Effurun)	
18.	O. Ogueri	Senior Engineer	B.Eng (FUTO)	
19.	M. Nwankwo	Senior Engineer	B. Eng (FUTO)	
20.	U. Anyakudo	Principal Technical officer	O.N.D, H.N.D (I.M.T)	
21.	M. Egwu-Kelechi	Senior Technical officer	O.N.D, H.N.D (Imo Poly)	
	Administrative Staff			
22.	Ogbueghu Kingsley Obinna	Adminstrative officer	M.Sc, B. Agric	
23.	Ndugbu Cynthia Uchechi	Administrative officer	B.Sc Statistics	

24.	Onwubali Anthonia Amaka	Confidential Secretary I	HND	
25	Onyeukwu Patricia ijeoma	Senior clerical officer	NABTEB	
26	Irole Uchenna	Clerical officer	NABTEB	

Chemical Engineering Core Curriculum and Minimum Academic Standards (CCMAS)

Overview

The B.Eng. Chemical Engineering Core Curriculum and Minimum Academic Standards (CCMAS) is the new curriculum approved by the National Universities Commission (NUC) for use in all Nigerian universities for the educational and training of chemical engineers. CCMAS is the outcome of the efforts of all the universities in Nigeria and experts who worked together to develop it. It is an improvement over the B.Eng. Chemical engineering Benchmark Minimum Academic Standards (BMAS), which has been in use from 2007 until the approval of the present CCMAS. The B.Eng. Chemical Engineering CCMAS compares significantly well with any B.Eng. as this CCMAS provides a unique basis upon which specialization and uniqueness of individual institution can be built.

The aim is to produce graduates that meet the needs of today's process industries by providing a thorough understanding of the subject, technical competence, and transferable skills required for the 21st Century knowledge-based and digital economy. The B.Eng. Chemical Engineering CCMAS contains 105 Units of the core courses in Basic Sciences, General Engineering and Chemical Engineering Sciences. The course content for all the courses as well as learning outcomes for individual courses in the CCMAS are outlined as a guide for content delivery. The balance of the 150 units required for graduation are to be designed by the University to suit its purpose. The aim is to produce Chemical Engineers with generic skills, competencies and attitudes fit for the 21st Century and the 4th Industrial Revolution.

Philosophy

The general philosophy of the Chemical Engineering CCMAS is to produce graduates with high academic and soft skills competence, capable to adequately participate, transform, impact on the engineering and allied industries in consonance with National and Global community values, including National Policy on Industrialization and Self-Reliance.

Chemical Engineering is a very diverse profession that finds application in many knowledge areas such as science, technology, finance, management and ICT. In Science, there are applications in areas from Biology to Chemistry and Mathematics and Engineering Science. The skills needed in process industries even in cutting edge ones such as Environment, Biotechnology, Nanotechnology, etc. are found in chemical engineers. These industries depend on chemical engineers to make their products and processes a reality. Hence an appropriate CCMAS must

establish a broad knowledge based upon which the required skills can be built. This begins with foundational knowledge in chemistry, biology, physics, and mathematics. From this foundation, a core expertise in engineering is developed in areas such as thermodynamics, mass and heat transfer and separation processes, chemical reaction, process modelling and simulation. To be equipped for the challenges of the 21st Century complex and real-national and world problems, chemical engineers must develop engineering problem-solving skills, strong synthetic and analytical skills. The modern-day chemical engineer must thus find relevance in the application of these knowledge and skills to create innovative solutions to the 21st Century industrial and societal problems in areas such as environmental responsibilities, clean energy sources, sustainable system, and discovery, processing and production of new materials and products.

Objectives

The objectives of the programme are, amongst others, to:

1. Apply knowledge of Science, Technology, Engineering and Mathematics (STEM) fundamentals to the solution of Chemical Engineering related problems;
2. Design solutions for Chemical Engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, environmental and other ethical considerations;
3. Conduct investigations of complex problems using research-based knowledge and research methods, including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions;
4. Create, select, and apply appropriate techniques, resources and modern engineering and IT tools: including prediction and modeling, to complex engineering activities, with an understanding of the limitations;
5. Function effectively both as an individual and as a team member or leader in diverse and in multi-disciplinary settings;
6. Communicate effectively on complex engineering activities with the engineering community and with society at large;
7. Apply the knowledge and understanding of engineering and management principles in managing multi-disciplinary projects;

8. Create awareness and understanding of the moral, ethical, legal, and professional obligations needed to function as part of a professional enterprise while protecting human health and welfare and the environment in a global society; and
9. Develop entrepreneurial skills and knowledge, in addition to adequate training in human and organizational with a spirit of self-reliance, so that they can set up their own businesses.

Features of the Programme

There are a number of unique features that characterize the CCMAS curriculum:

1. More student-directed learning;
2. Limitation of classroom contact time by minimizing student work load;
3. Increased application of computer and computer software in both teaching and learning;
4. Early introduction into Engineering discipline and Chemical Engineering;
5. Development of creative and innovative skills;
6. Development of entrepreneurial skill;
7. Specialization to define uniqueness of programme; and
8. Provision for combination with emerging and cutting-edge technologies.

Employability Skills

A Chemical Engineer to be able to function adequately in the 21st century, national and global industrial, economic and societal environment, must possess certain skills such as:

1. Application of Fundamental and Specialist knowledge;
2. Engineering Design;
3. Investigations, experiments and data analysis;
4. Engineering methods, skills, tools and information technology;
5. Professional and technical communication;
6. Impact of Engineering activity;
7. Individual, team and multi-disciplinary working attitude;
8. Independent learning ability;
9. Responsibility for Decisions;
10. Management of Engineering Activities;
11. Professionalism; and
12. Effective Communication.

21st Century Skills

The B.Eng. Chemical Engineering CCMAS has the capability of inculcating into the graduate engineers' skills essential for the 4th industrial revolution such as:

1. Problem solving skills;
2. Computing and data management skills;
3. Modelling and simulation skills;
4. Information and Communication skills;
5. Self-reliance and ability to take initiative;
6. Critical, innovative and creative thinking abilities;
7. **C**ollaborative and team-working skills;
8. Leadership skills and responsibility; and
9. The analysis, interpretation and synthesis of information.

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 propgramme, 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 IJMB 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 an 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 chemical engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct Entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters.
3. Candidates admitted through the Direct Entry mode at 300-Level shall have registered for a minimum of 90 and a maximum of 120 units of courses during a 3–year engineering degree programme. Such candidates shall have spent a minimum of 6 academic semesters;
4. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
5. A student shall have completed and passed all the courses registered for, including all compulsory courses and such elective and optional courses as may be specified by the university/faculty or department and obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
6. A student shall also have earned the 15 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.

The CGPA shall be used in the determination of the class of degree awarded, as summarized in Table 1. 2. It is important to note that the CGPA shall be calculated and expressed correctly to two decimal places.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students who entered at 200-Level and 11 semesters in the case of Direct Entry students who entered at 300-Level.

Course System

All Engineering and Technology programmes shall be run on a modularized system, commonly referred to as Course Unit System. All courses are therefore be sub-divided into more or less self-sufficient and logically consistent packages that are taught within a semester and examined at the end of that particular semester. Credits are weights attached to a course. One credit is equivalent to one hour per week per semester of 15 weeks of lectures or three hours of laboratory/studio/workshop work per week per semester of 15 weeks.

Definition of Course System

This should be understood to mean a quantitative system of organization of the curriculum in which subject areas are broken down into unit courses which are examinable and for which students earn credit(s) if passed. The courses are arranged in levels of academic progress. There shall be five levels of courses numbered 101-199, 201-299, 301-399, 401-499 and 501- 599. For ease of identification, course numbers can be prefixed by a three-character programme/subject code. Thus, the course code is in the form: DEP LNJ (where the three-letter code DEP identifies the programme, ‘L’ in LNJ represents the level of the course (1 or 2 or 3 or 4 or 5 for all undergraduate courses), N represents the sub-subject area while J represent the semester the course is offered some hierarchical code. Thus, for example, MEE 207 is a 200-Level course with number 0 say for labs and 7 indicating 1st semester, offered in the mechanical engineering programme.

The second aspect of the system is that courses are assigned weights allied to Units. Units: Consist of specified number of student-teacher contact hours per week per semester. Units are used in two complementary ways: one, as a measure of course weighting, and the other, as an indicator of student work load:

1. As a measure of course weighting for each unit course e.g. the credit unit to be earned for satisfactorily completing the course is specified; thus a 2-credit unit course may mean two 1-hour lecture per week per semester or one 1-hour lecture plus 3-hour practical per week per semester.

2. As a measure of work load, "One Credit Unit" means one hour of lecture or one hour of tutorial per week per semester. For other forms of teaching requiring student teacher contact, the following equivalents may apply: two hours of seminar: three hours of laboratory or field work, Clinical practice/practicum, studio practice or stadium sporting activity, six hours of teaching practice; four weeks of industrial attachment where applicable.

Normally, in the Course Credit System, courses are mounted all year round, thus enabling students to participate in examinations in which they are unsuccessful or unable to participate on account of ill health or for other genuine reasons. In such a system, no special provisions are made for re-sit examinations.

The minimum number of credit units for the award of a degree in engineering and technology is 150 units, for a 5-year programme subject to the usual Department and Faculty requirements. A student shall therefore qualify for the award of a degree when he/she has met the conditions. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.

For the purpose of calculating a student's cumulative GPA (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. Pre - requisite courses must be taken and passed before a particular course at a higher level.

Grading of Courses

Grading of courses shall be done by a combination of percentage marks and letter grades translated into a graduated system of Grade Point as shown in Table 1.1.

Table 1.1: Grade Point System

Percentage Mark (%)	Letter Grade	Grade Point
70 – 100	A	5
60 – 69	B	4
50 – 59	C	3
45 – 49	D	2
40 – 44	E	1
<40	F	0

Grade Point Average and Cumulative Grade Point Average

For the purpose of determining a student's standing at the end of every semester, the Grade Point Average (GPA) system shall be used. The GPA is computed by dividing total of the product of number of Units and Grade Point (TUGP) by the total number of Units (TNU) for all the courses taken in the semester as illustrated in Table 1.2. The Cumulative Grade Point Average (CGPA) over a period of semesters is calculated in the same manner as the GPA by using the grade points of all the courses taken during the period.

Table 1.2: Calculation of GPA or CGPA

Course	**Units**	**Grade Point**	**Unit x Grade Point (UGP)**
C_1	U_1	GP_1	U_1 x GP_1
C_2	U_2	GP_2	U_2 x GP_2
-	-	-	-
-	-	-	-
C_i	U_i	GP_i	U_i x GP_i
-	-	-	-
-	-	-	-
C_n	U_n	GP_n	U_n x GP_n
TOTAL	TNU		TUGP

$$\boldsymbol{TNU = \sum_{i=1}^{n} U_i} \qquad \boldsymbol{TUGP = \sum_{i=1}^{n} U_i * GP_i} \qquad \boldsymbol{CGPA = \frac{TUGP}{TNU}}$$

Table 1.3: Classification of Degree

Cumulative Grade Point Average (CGPA)	Class of Degree
4.50 – 5.00	First Class Honours
3.50 – 4.49	Second Class Honours (Upper Division)
2.40 – 3.49	Second Class Honours (Lower Division)
1.50 – 2.39	Third Class Honours
1.00 – 1.49	Pass

Students who transfer from other departments/programmes or universities shall be credited with only those courses deemed relevant to the programme, which they have already passed prior to their transfer. Such students shall however be required to pass the minimum number of units specified for graduation for the number of sessions he/she has spent in the Faculty; provided that no student shall spend less than two sessions (4 semesters) in order to earn a degree. Students who transfer from another programme within the faculty or other faculties for any approved reason shall be credited with those units passed that are within the curriculum of the Chemical Engineering Programme. Appropriate decisions on transfer cases shall be subjected to the approval of Senate on the recommendation of the Faculty.

Probation

A student whose Cumulative Grade Point Average (CGPA) is below 1.00 at the end of any particular year of study, shall earn a period of probation for one academic session. A student on probation is allowed to register for courses at the next higher level in addition to his/her probation level courses provided that:

1. The regulation in respect of student work-load is complied with; and

2. The pre-requisite courses for the higher-level courses have been passed.

Withdrawal

A candidate whose Cumulative Grade Point Average (CGPA) is below 1.0 at the end of a particular year of probation shall be required to withdraw from the programme. However, in order to minimize waste of human resources, consideration shall be given to withdrawal from programme of study and possible transfer to other programmes within the same University.

Evaluation
Techniques of Student Assessment

Practicals

By the nature of the programmes in Engineering and Technology, laboratory practical works are very important in the training of students. To reflect the importance of practical work, a minimum of 9 hours per week or 135 hours per semester (equivalent to 3 units) should be spent on students' laboratory practical. Consequently, some of the courses have both theory and practical components. Thus, in the description of courses to be taken, the number of lecture hours (LH) and the number of practical hours (PH) per semester are indicated. The overall performance of students in such courses is to be based on the evaluation of the performance in written examination (which tests theory) and also the performance in the laboratory work (based on actual conduct of experiments and the reports). The experiments to achieve the practical~~'s~~ ,components of the courses must be designed in quality and quantity to enrich the grasp of the theoretical foundations of the courses. It is left for the department to organize all the experiments in the best way possible. One of the ways to achieve this is to lump all the laboratory practical works under a course, which the student must pass.

Tutorials

The timetable for courses shall be designed to make provision for tutorials of at least one hour for every four hours of lecture. Thus a 3-unit course of 45 hours per semester should attract about 10 hours of tutorials. Postgraduate students are normally employed to help in giving tutorials to undergraduate students. This is a veritable training ground for academic career.

Continuous Assessments

Continuous assessment shall be done through essays, tests and practical exercises.

1. Scores from continuous assessment shall normally constitute 30 per cent of the full marks for courses which are primarily theoretical.

2. For courses which are partly practical and partly theoretical, scores from continuous assessment shall constitute 40% of the final marks.

3. For courses that are entirely practical, continuous assessment shall be based on a student‘s practical work or reports and shall constitute 100% of the final marks.

Examinations

In addition to continuous assessment, final examinations should normally be given for every course at the end of each semester. All courses shall be graded out of a maximum of 100 marks comprising:

Final Examination: 60% –70%

Continuous assessment (Quizzes, Homework, Tests, Practical‘s): 30% - 40% Each course shall normally be completed and examined at the end of the semester in which it is offered.

External Examiner System

This system should be used only in the final year of the undergraduate programme to assess final year courses and projects, and to certify the overall performance of the graduating students, as well as the quality of facilities and teaching in the faculty.

SIWES Rating and Assessment

In engineering education, industrial attachment is very crucial. The minimum duration of the Students Industrial Work Experience Scheme (SIWES) should be 33 weeks accomplished in 3 modules.

SIWES I: (3 Units) 9 weeks during long vacation at the end of 200-Level session

SIWES II: (4 Units) 12 weeks during the long vacation at the end of the 300-Level

SIWES III: (4 Units) 12 weeks from second semester of 400-Level to the beginning of the following session.

SIWES is an important aspect of the education and training of engineering students in the universities organized for exposure to some elements of industrial art as articulated below under the Students Industrial Work Experience Scheme (SIWES) and the Technical Support Unit (TSU). This is being emphasized herein in view of the rather poor handling of SIWES, in particular, in most existing faculties of engineering and technology in the country. It should be noted that Industrial Training as a course involves the following: working successfully in the industry or an industrial setting for the specified period; submitting of a Work Report to the Industrial Training Coordinating Centre at the end of the training period; and presentation of seminar on the industrial training experience.

Faculties of Engineering in universities are expected to organize Students Industrial Work Experience Scheme (SIWES) or what most commonly refer to as Industrial Training. Universities are expected to establish a Unit to coordinate SIWES not only for engineering programmes, but also programmes in other faculties that have SIWES component. The SIWES Unit is to shoulder the following responsibilities: soliciting co-operative placements (jobs) in business, industry, government or service agencies depending upon the needs and qualifications of the student, and placing students on such training assignments after analysing the technical contents; need to establish firm strategy to ensure students get placements and options when they cannot get places; coordinating and supervising the cooperative employment of students in such a way that students have the opportunity of learning useful engineering and technological skills on real jobs and under actual working conditions; conducting follow-up activities regarding all placements by checking regularly each student's job performance through company visits and individual student's interview; assembling individual inventory records of students and employers for the purposes of placements and supervision in addition to maintaining functional departmental and personal records and reports; providing necessary advice to students as to the relevance of their chosen field to the industrial requirements of the country; organizing and conducting students' seminars on Work Reports; and Liaison with NUC, ITF, other agencies and industries on student industrial training programme of the University.

All the 11 experiential units of SIWES, the two units of GET 402: Engineering Project I and the two units of GET 404: Engineering Valuation will be credited towards the overall assessment for graduation/award of the degree. The Grading template for SIWES will be:

SIWES Supervision Continuous Assessment (from Industry)	25%
SIWES Supervision/Log Book Grading (by University Supervisor)	25%
SIWES Comprehensive Report	25%
Seminar: Oral presentation (defense) of SIWES activity	25%

(i) and (ii) will be scored for each SIWES upon completion and the weighted average for each student computed. However, the consolidated report for all industrial experience will be 10 submitted for seminar and assessment at the end of the 400-level SIWES. The overall grade will then be collated with the 400-level CGPA.

Performance Evaluation Criteria

The accreditation of the Engineering and Technology degree programme means a system of recognising educational institutions (universities and programmes offered by them) for a level of performance, integrity and quality which entitles them to the confidence of the educational and professional community, the public they serve, and employers of labour and services.

The objectives of the accreditation exercise are to:

1. Ensure that at least the provisions of the minimum academic benchmark statements are attained, maintained and enhanced;

2. Assure employers and other members of the community that graduates of these institutions have attained an acceptable level of competence in their areas of specialisation; and

3. Certify to the international community that the programmes offered in these universities are of high standards and that their graduates are adequate for employment and for further studies.

Engineering Design Project and Engineering Valuation

Engineering Project is mandatory for all engineering students, traditionally in their final year. However, under the CCMAS, the need for emphasis on hands-on practical engagements and industry collaboration ~~is~~ are reflected in the new paradigm to commence the project in the 2nd Semester of 400–Level to enable the student integrate the project with SIWES III and develop a project concept that has industry contribution in its conception and utility as part of the industrial immersion, thereby enriching the practical content, industrial/society relevance of the project. The

intent is to ingrain in the student real-life engineering practice in their project design, conception and management capabilities, as indicated in the course content. Hence, GET 402: Engineering Project I is now commenced in the 2nd Semester of 400-level, along with the hands-on 2-unit GET 404: Engineering Valuation, which is also taken simultaneously. Altogether, these innovations are to strengthen the professional and practical competence of the Nigerian engineering graduates, hence their capability in handling real-life challenges.

5. Global Course Structure COURSE OUTLINE

Year	GNS/GST	ENT	Basic Science	General Engineering (GET)	Chemical Engineering	SIWES & Engineering Valuation	Total
1	5	-	25	8	2	-	40
2	2	2	-	26	8	3*	38
3	2	2	-	11	18	4*	33
4	-	-	-	2	18	6*	20
5	-	-	-	5	30		35
Total	9	4	25	52	76	13*	166

100 LEVEL - FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 111	Engineer in Society	1	C	15	-
CHM 113	General Chemistry I	2	C	30	-
CHM 114	General Practical Chemistry I	1	C	-	45
MTH 112	Elementary Mathematics I	2	C	30	-
PHY 111	General Physics I	2	C	30	-
PHY 113	General Physics III	2	C	30	-
PHY 117	General Practical Physics I	1	C	-	45
STA 112	Probability I	3	C	45	-
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	-
IGB 111	Basic Igbo Literacy	1	C	15	-
LIB 116	Use of Library	1	C	15	-
FRE 114	Elementary French I	1	E	15	-
GER 115	Elementary German I	1	E	15	-
	Total	**20**		**255**	**135**
	100 LEVEL - SECOND SEMESTER				
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
TCH 121	Introduction to Chemical Engineering	2	C	30	-
GET 121	Design Thinking and Innovation	1	C	15	-
GET 122	Engineering Graphics & Solid Modeling I	2	C	15	45
GET 123	Engineering Laboratory I	1	C	-	45
CHM 121	General Chemistry II	2	C	30	
CHM 124	General Practical Chemistry II	1	C	-	45
MTH122	Elementary Mathematics II	2	C	30	-
MTH 123	Elementary Mathematics III	2	C	30	-
PHY 122	General Physics II	2	C	30	-
PHY124	General Physics IV	2	C	30	
PHY 127	General Practical Physics II	1	C	-	45
IGB 121	Readings and Practice in Igbo	1	C	15	-
ENG 121	Use of English	1	C	15	
FRE 124	Elementary French II	1	E	15	-
GER 125	Elementary German II	1	E	15	-
	Total	**20**		**240**	**180**

***E – Elective courses**

200 LEVEL - FIRST SEMESTER

Course Code	Course Title	Units	Status	LH	PH
GET 211	Applied Electricity I	3	C	30	45
GET 212	Engineering Graphics & Solid Modeling II	2	C	15	45
GET 213	Engineering Mathematics I	3	C	45	-
GET 214	Applied Mechanics	3	C	45	-
GET 215	Student Workshop Practice	2	C	15	45
GET 216	Fundamentals of Thermodynamics	3	C	45	-
ENT 211	Entrepreneurship and Innovation	2	C	30	
GST 217	Philosophy, Logic and Human Existence	2	C	30	-
	Total	**20**		**255**	**135**

200 LEVEL - SECOND SEMESTER

Course Code	Course Title	Units	Status	LH	PH
TCH 221	Chemical Engineering Fundamentals	3	C	45	-
TCH 222	Material Science	3	C	45	-
TCH 223	Statistics for Chemical Engineers	2	C	30	-
GET 221	Computing and Software Engineering	3	C	30	45
GET 223	Engineering Mathematics II	3	C	45	-
GET 225	Fundamentals of Fluid Mechanics	3	C	45	-
GET 226	Electrical and Electronic Engineering Laboratory	1	C	15	45
GET 227	Engineering Laboratory II	1	C	-	45
*GET 229	SIWES 1	3	C		135
	Total	**19**		**255**	**135**

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

300 LEVEL FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
TCH 311	Transfer Processes I	2	C	15	45
TCH 312	Separation Processes I	2	C	30	-
TCH 313	Chemical Engineering Laboratory I	1	C	-	45
TCH314	Chemical Kinetics and Catalysis	2	C	30	
TCH315	Biochemical Engineering	2	C	30	-
GET 312	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	
GET 313	Engineering Mathematics III	3	C	45	
GET 314	Engineering Laboratory III	1	C	-	45
ENT 312	Venture Creation	2	C	15	45
GST 312	Peace and Conflict Resolution	2	C	30	
	Total	**20**		**240**	**180**
300 LEVEL SECOND SEMESTER					
TCH 321	Chemical Engineering Thermodynamics I	2	C	30	-
TCH 322	Process Instrumentation	2	C	30	-
TCH 323	Chemical Engineering Laboratory II	1	C	-	45
TCH 324	Numerical Methods in Chemical Engineering	2	C	30	-
GET 321	Engineering Economics	3	C	45	
GET 322	Technical Writing and Communication	3	C	45	
GET 323	Engineering Mathematics IV	3	C	45	
GET 324	Renewable Energy Systems and Technology	3	C	30	45
GET 329	SIWES II	4	C	-	180
	Total	**19**		**255**	**90**

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

400 LEVEL FIRST SEMESTER						
Course Code	**Course Title**	**Preq**	**Units**	**Status**	**LH**	**PH**
TCH 411	Chemical Engineering Thermodynamics II	TCH 322	2	C	45	
TCH 412	Chemical Reaction Engineering I		3	C	45	-
TCH 413	Chemical Product Design		3	C	15	90
TCH 414	Plant Design and Economics		3	C	45	
TCH 415	Process Control		2	C	30	45
TCH 416	Process Modelling and Simulation		2	C	30	-
TCH 417	Transfer Processes II	TCH 311	2	C	30	-
TCH 418	Chemical Engineering Laboratory III		1	C		45
	Total		**18**		**240**	**180**
400 LEVEL SECOND SEMESTER						
GET 421	Engineering Project I		2	C	-	90
GET 422	Engineering Valuation and Costing		2	C	30	
TCH 421	Chemical Process Technology		1	C	-	45
GET 229	SIWES I		3	C	-	135
GET 329	SIWES II		4	C	-	180
GET 429	SIWES III		4	C	-	180
	Total		**16**		**30**	**630**

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

500 LEVEL FIRST SEMESTER						
Course Code	**Course Title**	**Preq**	**Unit**	**Status**	**LH**	**PH**
GET 511	Engineering Project Management		3	C	45	
GET 512	Engineering Law		2	C	30	
TCH 511	Plant Design II		4	C	30	135
TCH 512	Chemical Reaction Engineering II (Heterogeneous System)	TCH 412	2	C	30	
TCH 513	Chemical Process Optimization	TCH 416	3	C	45	
TCH 514	Separation Processes II (Multi component System)	TCH 313	2	C	30	
TCH 515	Pulp and Paper Technology		2	E	30	
TCH 516	Sugar Technology		2	E	30	
TCH 517	Polymer Science and Engineering		2	E	30	
TCH 518	Membrane Technology		2	E	30	
TCH 519	Process Integration		2	E	30	
**TCH 555	Chemical Engineering Research Project		4	C	-	180
	Total		**18**		**210**	**315**
***Choose at least one elective**						
500 LEVEL SECOND SEMESTER						
GET 521	Engineering Management		3	C	45	
TCH 521	Process Safety and Loss Prevention in Industries		3	C	30	
TCH 522	Environmental Pollution and Control		2	C	30	-
TCH 523	Coal Processing Technology		2	C	30	-
TCH 524	Petroleum Processing and Petrochemicals		2	C	30	
TCH 525	Bio Refinery Engineering		2	E	30	
TCH 526	Fermentation Technology		2	E	30	
TCH 527	Cement Technology		2	E	30	
**TCH 555	Chemical Engineering Research Project		4	C	-	180
	Total		**18**		**165**	**180**

****TCH 555 – Chemical Engineering Research Project should be taken/taught over the two semesters of the final year. The unit is considered in the second semester.**
***Choose at least one elective (E) course per semester of final year**

6. COURSE SYNOPSIS

GET 111: Engineer in Society (1 Unit C: LH 15)
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.

CHM 113: General Chemistry I (2 Units C: LH 30)
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 114: General Practical Chemistry I (1 Unit C: PH 45)
Laboratory experiments designed to reflect topics presented in courses CHM 113. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

MTH 112: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30) Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

PHY 111: General Physics I (Mechanics) (2 Units C: LH 30)
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 113: General Physics III (Behaviour of Matter) (2 Units C: LH 30)
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; Bernoulli's equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 117: General Practical Physics I (1 Unit C: PH 45)
This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY111and 113). 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: LH 45)
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.

GST 111: Communication in English (2 Units C: LH 15; PH 45) Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). Major word formation processes; the sentence in English (types: structural and functional). Grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalization 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, notemaking) 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)

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 self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related 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 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.

IGB 111: Basic Igbo Literacy (1 Unit C: LH 15)

Igbo alphabets, Parts of speech: Nouns and pronouns, Parts of speech: Preposition and conjunctions, Parts of speech: Adjectives, Adverbs and verbs, Interrogatives, numerals and exclamation, Phrases and tones, Clauses, Affixation, Punctuation marks, Sentence types, Morphemes, Igbo literature: Teaching of Igbo culture, Igbo songs and poetry.

LIB 116: Use of Library (1 Unit C: LH 15)

Introduction and Historical Background of Libraries: Evolution and significance of libraries, The role of libraries in education and research, The Michael Okpara University of Agriculture, Umudike Library system. Types of Libraries and Their Resources: Academic, public, special, and national libraries, Print and non-print materials, Digital and electronic resources. Library and Education: The relationship between libraries and academic success, Role of the library in self-directed learning, Enhancing research and innovation through libraries. Library Study Skills: Note-taking and summarization techniques, Effective reading and comprehension strategies, Time management for academic success. Library Resources and Organization: Structure of an academic library, Arrangement and classification of resources, The role of librarians in information management. Using Library Resources: Print and Electronic: Accessing

books, journals and reference materials, Digital libraries and online repositories, Utilizing institutional e-learning resources. Library Search, Cataloguing and Classification

Schemes: The Dewey decimal classification (DDC), The Library of Congress Classification (LCC), OPAC (Online Public Access Catalogue) and other search tools. Databases and Digital Research Tools: Introduction to academic databases (e.g., Google Scholar, JSTOR, ResearchGate, etc.), Open access journals and institutional repositories. Evaluating sources for credibility and reliability. Research Writing and Academic Techniques: Structuring academic papers and reports, Formulating research questions, Literature review techniques. Bibliographic Citation and Referencing Methods: APA, MLA, Chicago, and Harvard citation styles, Managing citations with software tools (e.g., Mendeley, Zotero, EndNote), The importance of proper referencing in academic writing. Plagiarism and Academic Integrity: Understanding plagiarism and its consequences, Techniques for paraphrasing and summarizing, Ethical considerations in research. Copyright Laws and Intellectual Property Rights: Understanding copyright regulations, Fair use policies and restrictions, Copyright implications in academic research. Conducting Internet and Web-Based Research: Effective internet search strategies, evaluating online sources for accuracy and reliability. The role of artificial intelligence and search engines in research.

FRE 114: Elementary French I **(1 Unit E: LH 15)**

French Culture and Civilization: Importance of French language in Nigeria, Overview of Francophone countries and their relationship with Nigeria. Knowledge of France: Introduction to France's history and major major cities, Contribution of France to Development of Science,

Technology and Agriculture; Medicine and biology; Physics, chemistry and engineering; Agriculture, clothing and Food processing; Mathematics; Arts, communication and Computers; Philosophy. AGRICULTURE (L'AGRICULTURE): Position of France in agricultural produce, Definition of some related agricutral terms, Quelques verbes utilisent dans L'agriculture (Some verbs used in agriculture), Les outils et machines agricols (Some agricultural tools and machines), Some Educational terms in English and French, Some French verbs associated with education,

Informatique et la technologie d'information, Verbs associated with ICT. ENGINEERING (GENIE): Genie Chimique (Chemical Engineering), Genie Electrique (Electrical Enginnering), Mechanical Engineering (Genie Mecanique), Génie Civile (Civil Engineering), Les sciences naturelles, Physiques et Appliques (Natural, Physical and Applied Sciences), La Santé et La Médicine (Health and medicine), L'Economie (Economics), Le Tourisme (Tourism). INTRODUCTION A LA PHONETIQUE (INTRODUCTION TO PHONETICS: The French Alphabet and accents, Spellings and pronunciation, Classroom pronunciation practice. LES

SALUTATIONS ET FORMULES DE POLITESSE (GREETINGS AND POLITE REMARKS:

Common greetings and self-introduction, Asking about Someone's wellbeing, Introduction of Self and others, (Metiers/Professions) Occupation/professsions, Introducing someone (Presenter quelqu'un), Nationality, Address, place and Date of birth, Countries and their nationals, (residential Address) Domicile, (Place of birth) lieu de naissance, Les nombres: cardinaux et ordinaux

(Numbers : cardinal and ordinal), (Telling time, Day, Month, Year, and date) Dire L'heure, Les jours, Les mois et les années). LES OBJETS UTILISESS DANS LA CLASSE, ARTICLES, GENRES, PREPOSITIONS (OBJECTS USED IN THE CLASSROOM, ARTICLES, GENDER AND PREPOSTIONS.

GER 115: Elementary German I (1 Unit E: LH 15)
Introduction to German Language, Pronunciation of German alphabets and special characters (ä, ö, ü, ß), Personal pronouns and auxiliary verbs (sein, haben, werden). Greetings and Personal Information, Common greetings and self-introduction, Asking and answering personal details (name, age, nationality, profession). Numbers, Dates and Time, Counting from 0 to 1 billion, Ordinal numbers and telling time, Days, months, seasons and their significance in agriculture. Articles, Nouns, and Cases, Definite and indefinite articles, Singular and plural forms, Basic introduction to nominative, accusative, dative and genitive cases.

TCH 121: Introduction to Chemical Engineering (2 Units C: LH 30)
The role of the chemical engineer. Units and dimensions. The mole unit. Conventions in the method of analysis and measurement. Temperature. Pressure. Physical and chemical properties and measurement. Techniques of solving problems. The chemical equation stoichiometry, material balances in single units, recycle, bypass, purge. This course will be supported with guest lectures from senior chemical engineers in industries, government and academia.

GET 121: Design Thinking and Innovation (1 Unit C: LH 15)
Introduction to Design and Problem Solving in Engineering. Principles of Teamwork and Collaboration in Design. Breaking down complex Engineering problems. The Engineering Design Process: From Need to Concept. Problem Definition and Stakeholder Analysis. Brainstorming,

Ideation and Concept Selection. Modeling and Prototyping Techniques (Sketching, CAD, Simulations). Team Presentations on Concept Development. Systems Thinking and Integration in Mechatronic Design. Design thinking suite of methods and techniques applied to project lifecycles with an emphasis on interdisciplinary practice. Ethical and Social Impact of Engineering Solutions. Final Project Work and Peer Feedback. Final Team Presentations and Design Review.

GET 122: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45) 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 work spaces. 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.

GET 123: Engineering Laboratory I (1 Unit C: PH 45)
Introduction to Laboratory Practices, Safety Procedures and Report Writing. Measurement Techniques and Error Analysis (Length, Mass, Volume, Time, Temperature). Use of Vernier Calipers, Micrometers, and Multimeters. Force, Equilibrium and Vector Analysis. Newton's Laws and Friction. Oscillations and Simple Harmonic Motion. Ohm's Law and Series/Parallel Circuits. Kirchhoff's Laws and Network Theorems. Basic Data Acquisition: Introduction to Sensors and Arduino. Arduino IDE installation and basics. Hydrostatic Pressure and Bernoulli's Principle. Stress-Strain Relationship. Thermal Conductivity and Heat Loss. Basic Signal Measurement: Oscilloscope and Signal Generator Use. Overview of robotics components. DC motor and servo motor control using motor drivers (e.g., L298N). Final Report Submission and Review.

CHM 121: General Chemistry II (2 Units C: LH 30)
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 124: General Practical Chemistry II (1 Unit C: PH 45)
Continuation of CHM 114. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 122: Elementary Mathematics II (Calculus) (2 Units C: LH 30)
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 123: Elementary Mathematics III (Vectors, Geometry and Dynamics) (2 Units C: LH 30) Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional coordinate 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 122: General Physics II (Electricity and Magnetism) (2 Units C: LH 30) Forces in nature. Electrostatics (electric charge and its properties, methods of charging). Coulomb‘s law and superposition. Electric field and potential. Gauss‘s law. Capacitance. Electric dipoles. Energy in electric fields. Conductors and insulators. DC circuits (current, voltage and resistance). Ohm‘s law. Resistor combinations. Analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère‘s laws. Magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz‘s laws. Step up and step down transformers. Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, and resistance.

PHY 124: General Physics IV (Vibration Waves and Optics) (2 Units C: LH 30) Simple harmonic motion (SHM). Energy in a vibrating system. Damped SHM. Resonance and transients. Coupled SHM. Q values and power response curves. Normal modes. Waves (types and properties of waves as applied to sound). Transverse and longitudinal waves (superposition, interference, diffraction, dispersion, polarization). Waves at interfaces (energy and power of waves). The wave equation. 2-D and 3-D wave equations. Wave energy and power. Phase and group velocities. Echo and beats. The Doppler-effect. Propagation of sound in gases, solids and liquids and their properties. Optics: Nature and propagation of light. Reflection and refraction. Internal reflection. Scattering of light. Reflection and refraction at plane and spherical surfaces. Thin lenses and optical instruments. Wave nature of light. Dispersion. Huygens’s principle (interference and diffraction).

PHY 127: **General Practical Physics II (1 Unit C: PH 45)** This practical course is a continuation of PHY 117 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the

basic physical techniques for observation, measurements, data collection, analysis and deduction.

IGB 121: Readings and Practice in Igbo (1 Unit C: LH 15)
Essay writing, Figures of speech, Traditional literature, Written literature, Translations and Dictionaries in Igbo, Test, Igbo indigenous knowledge, Speech writing, Comprehension, poetry or drama, Research in Igbo within the university, Using computer to write Igbo.

ENG 121: Use of English (1 Unit C: LH 15) Vocabulary Development: Exploring registers and levels of usage in different fields such as medicine, military, communication, marketing, Law, Literature, Agriculture and Sciences, Direct and indirect speech. Figures of speech: Understanding and application of smile, metaphor, personification, apostrophe, metonymy, synecdoche, hyperbole, climate, euphemism, irony, paradox and oxymoron. Writing Skills: Letter writing - formal, informal, semi- formal, Essay writing, Report writing, Article writing, letters to editors and speech writing techniques. Book Review: A literary book will be assigned at the beginning of the semester. Discussions and reviews to be guided by the instructor. Oral Communication: Introduction to Phonetics and Phonology. ii)Classification of speech sounds: vowels and consonants. Understanding syllables: mono- syllabic, di- syllabic and multi - syllabic words. Mastering stress and intonation patterns. This course is structured to provide students with essential English language skills necessary for academic success and professional communication in their respective disciplines.

FRE 124: Elementary French II (1 Unit E: LH 15)
LES VERBES ET LES ADVERBES FRANCAIS (FRENCH VERBS AND ADVERBS). CONSTRUCTION DES PHRASES FRANCAISES (FRENCH SENTENCE CONSTRUCTION).

Introduction to essential verbs (être, avoir, aller, aimer). Present tense conjugation and sentence construction. Sentence Formation and Communication. EXPRIMER LES ACTIVITES QUOTIDIEN (DAILY ACTIVITY EXPRESSIONS. -Sentence Formation and Communication. Using adjectives, pronouns, and common expressions. Everyday vocabulary and basic sentence structures. Engaging in basic conversations and describing daily activities. LES ADJECTIFS POSSESSIFS (POSSESSIVE ADJECTIVES).

GER 125: Elementary German II (1 Unit E: LH 15) Verbs – Modal, Separable and Inseparable. Modal verbs and their applications. Separable and inseparable verb prefixes. Family, Professions and Descriptive Adjectives. Vocabulary for family structures. Identifying professions and their gender forms. Adjective declension and sentence construction. The Human Body, Colors and Opposites. Naming

body parts and their functions. Understanding and using colors in different contexts. Common antonyms and contrasting words.

GET 211: Applied Electricity I (3 Units C: LH 30; PH 45)
Fundamental concepts: Electric fields, charges, magnetic fields. Current, B-H curves Kirchhoff's laws, superposition. Thevenin Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance and susceptance.

GET 212: Engineering Graphics and Solid Modeling II (2 Units C: LH 15; PH 45) 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 213: Engineering Mathematics I (3 Units C: LH 45)
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 214: Applied Mechanics (3 Units C: LH 45)
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 analyses.

GET 215: Students Workshop Practice (2 Units C: LH 15; PH 45)
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, press-tool work, spinning, etc.). Metal joining processes (welding, brazing and soldering). Heat treatment. Material removal processes. Machine tools and classification. Simple

theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines. Supervised identification, use and care of various electrical and electronic components 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 216: Fundamentals of Thermodynamics (3 Units C: LH 45)
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.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)
The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risktaking, 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.

GST 217: Philosophy, Logic and Human Existence (2 Units C: LH 30) 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.

TCH 221: Chemical Engineering Fundamentals (3 Units C: LH 45)

Analysis of material balances for multiple systems. Analysis of material balances problems with direct solutions. Material balances using algebraic techniques control surface and stage balances for open and closed system. Problems involving species and elements for reacting and non-reacting systems. Material balances in process flow sheets. Energy balances procedures; energy balances for reactive and non-reactive processes; combined mass and energy systems. Computer aided balance calculations.

TCH 222: Material Science (3 Units C: LH 45)

Introduction to electronic configuration, atomic structures, inter-atomic bonding mechanisms, crystal and microstructure. Relationships between structure and properties of metals, alloys, ceramics and polymers. Principles of the behaviour of materials in common environments. Phase diagrams and phase transformations of metal solutions. Effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Corrosion: types, causes and effects of corrosion, corrosion prevention and mitigation. Fabrication processes and applications. Basic nanotechnology, nano-materials and engineering applications.

TCH 223: Statistics for Chemical Engineers (2 Units C: LH 30)

Chemical engineers must have an appreciation of the accuracy and reliability of measurements. This course provides a broad introductory knowledge of statistical techniques used in data analysis. It also seeks to link the measurement of various quantities with statistics to enable the analysis of the accuracy of the measurements. Statistical inference intervals, tests hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Students to have weekly or fortnightly computer laboratory-based assignments.

GET 221: Computing and Software Engineering (3 Units C: LH 30; PH 45)

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 (IoT). Elements of software engineering.

GET 223: Engineering Mathematics II (3 Units C: LH 45)

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

equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 225: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

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 226: Electrical and Electronics Engineering Laboratory (1 Unit C: PH 45)

Resistance measurement; Condition for maximum power transfer; inductance and capacitance measurement; verification of network theorems; ac series circuits. Measurement of power and power factor, excitation of dc generator, load characteristics of a separately excited dc motor; open and short circuit tests for a transformer. Static characteristics of junction diode and transistor, Half and full wave rectification, determination of copper temperature coefficient by Wheatstone bridge, measurement of voltage, current and power in three phase star/delta connection, simple domestic installation practices.

GET 227: Engineering Laboratory II (1 Unit C: PH 45)

Crystal structure of selected specimen (BCC, FCC, HCP). Crystal imperfection. Determination of solidification curve of selected metals. Heat treatment processes (annealing, normalizing). Heat treatment processes hardening and tempering. Microstructural examination of mild steel. Commination devices. Pneumatic conveying system for solids. Use of cyclone to separate solids from air stream. Introduction to different types of screening equipment. Determination of the thermal conductivity of a metallic rod. Determination of the thermal conductivity of an insulating powder. Determination of the thermal conductivity of a solid by the guarded hot plate method. Verification of the Stefen-Boltzmann constant for thermal conductivity. Mechanical test: Impact test, Tensile test, Hardness test, Fatigue test, Creep and Non-destructive test of engineering materials, testing of magnetic materials e.g. transformer cores, testing of insulators, cables and transformers coil and verification of P-N junction characteristics. Tensile tests on bars.

Determination of young's modulus of rigidity of materials of close coiled helical spring and stiffness of spring. Radiation resistant spring. Proximate analysis and determination of the calorific value of coal and coke using Bomb Calorimeter. Composite materials, corrosion testing, entropy change during reversible and irreversible processes using heat exchanger.

GET 229: Students Industrial Work Experience I (3 Units C: PH 135)

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 handson 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).

TCH 311: Transfer Processes I (2 Units C: LH 15; PH 45)
Steady State Conduction. Forced and Natural Convection. Reynolds' Analogy. Heat Transfer Film Coefficient Correlations. LMTD Heat Transfer Design. Fouling Factors. Radiation; Blackbody Radiation, Emission from Real Surfaces. Kirchhoff's Law. Unsteady-State Conduction. 2-D Conduction. Fundamentals of Mass Transfer. Similarity of Momentum, Heat and Mass Transfer. Convective Mass Transfer. General, Molecular and Turbulent Diffusion Equations. Fick's Law for Diffusion. Molecular Diffusion in Gases, Liquids and Solids. Diffusion Coefficients in Gases. Liquids. Shell and Tube Heat Exchangers. LMTD Correction Factors. Heat Transfer and Pressure Drop Correlations. HX Design and Performance (Kern's and NTU Methods for Multipass and Cross-Flow HX). Compact Heat Exchangers. Plate Heat Exchangers. Operating Principles, Series and Parallel Combination, Use and Limitations. Comparison with Shell and Tube Heat Exchangers.

TCH 312: Separation Processes I (2 Units C: LH 15; PH 45)
Stage-wise and continuous contact equipment. Isothermal gas absorption. Binary distillation, flash distillation; distillation systems - types of condensers and reboilers, plate versus packed columns, reflux ratio, Distillation of binary mixture - McCabe Thiele method: rectifying and stripping section, feed plate; Ponchon-Savarit method.

TCH 313: Chemical Engineering Laboratory I (1 Unit C: PH 45)
Laboratory experiments in transport phenomena. Kinetics and separation process

TCH 314: Chemical Kinetics and Catalysis (2 Unit C: PH 30)
Introduction to chemical reactions. Classifications of chemical reactions. Definition of rates of a chemical reaction. Factors affecting the rate of chemical reactions. Identification of rate equations and constants. Arrhenius relationships in chemical reactions. Orders of chemical reactions. Activation energy and chemical reactions. Frequency factors and determinations in chemical reactions. Introduction to catalysis. Determination of the mechanism of reactions. Kinetics of homogenous non-catalytic reactions. Kinetics of heterogeneous non-catalytic reactions. Kinetics of catalytic homogenous reactions. Kinetics of catalytic heterogenous reactions. Deactivation of catalysts. Physicochemical characterization of catalyst deactivation. Construction of mathematical models.

TCH 315: Biochemical Engineering (2 Units C: LH 30) Introduction to microbiology and biochemistry. Classification and growth characteristics of microorganisms. Enzymes engineering: including enzyme kinetics, aerobic and anaerobic respirations, metabolic pathways, cell growth kinetics and models

GET 312: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)
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.

GET 313: Engineering Mathematics III (3 Units C: LH 45) 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 314: Engineering Laboratory III (1 Unit C: PH 45)
Introduction to IoT, AI and Data Analytics: Concepts and Trends. IoT Architecture and Protocols (MQTT, HTTP, CoAP). Sensors, Actuators and Embedded Platforms (Arduino, ESP32, Raspberry Pi). Data Acquisition, Signal Conditioning, and Streaming. Cloud and Edge Computing for IoT. Introduction to Machine Learning: Concepts and Tools (Python, Scikit-learn). Supervised Learning: Regression and Classification on IoT Data. Unsupervised Learning: Clustering, Anomaly Detection. Real-Time Analytics and Dashboarding (Node-RED, Grafana, Power BI). AI at the Edge: TinyML, TensorFlow Lite, Model Deployment on Microcontrollers. Case Studies: Smart Homes, Healthcare, Predictive Maintenance. IoT Security, Data Privacy and Ethical Considerations. Project Planning and System Design. Final Project Development and Testing. Final Project Presentation and Demonstration.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)
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 and 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 and Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies – artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy. Digital business and e-commerce strategies.

GST 312: Peace and Conflict Resolution (2 Units C: LH 30) 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 and Human Development. Approaches to Peace and Conflict Management (religious, government, community leaders).

Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive and 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, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union and Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs); the role of NGOs in post-conflict situations/crises.

TCH 321: Chemical Engineering Thermodynamics I (2 Units C: LH 30)
Heat Effects. Heat capacities as a function of temperature, specific heats of liquids and solids; Heat effects accompanying phase change Clasius-Clapeyron equation, standard heats of reaction, formation and combustion effect of temperature on heat reaction. Heat of mixing and solution, Enthalpy concentration diagrams for H_2SO_4, H_2O, etc., partial enthalpies. Chemical Reaction Equilibria; Standard free energy change and equilibrium constant, Evaluation of equilibrium constants. Effects of temperature and pressure on equilibrium constants; calculation of conversion; Gas phase reactions, Percentage conversion; Liquid phase reaction Heterogeneous reactions.

TCH 322: Process Instrumentation (2 Units C: LH 30)
Measuring instruments for level, pressure, flow, temperature and physical properties. Chemical composition analysers. Measurement. Gas chromatograph. Mass Spectrometer. Sampling systems. Description and use of current instrumentation such as atomic spectroscopy, infra-Red spectroscopy, High Performance Liquid Chromatography, Scanning Electron Microscope (SEM)

TCH 323: Chemical Engineering Laboratory II (1 Unit; C; PH 45)
Laboratory experiments in Separation processes, Batch sedimentation, fluid circuit system, fluid particle system, saponification in a batch reactor, Vortex tube, Double pipe heat exchanger, Efflux time determination, Screen analysis classification, Distribution coefficient of benzoic acid in Benzene, Terminal velocity, Investigating the effect of changes in hot and cold fluid flow rate on the temperature efficiencies, Overall heat transfer coefficient using shell and tube exchanger, laminar flow demonstration, Drying operation, Process parameters measurement.

TCH 324: Numerical Methods in Chemical Engineering (2 Units C: LH 30)
Numerical methods for solving problems arising in heat and mass transfer, fluid mechanics, chemical reaction engineering, and molecular simulation. Topics: numerical linear algebra, solution of nonlinear algebraic equations and ordinary differential equations, solution of partial differential equations (e.g., Navier-Stokes), numerical methods in molecular simulation (dynamics, geometry optimization). Runge Kutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation. All methods are presented within the context of chemical engineering problems.

GET 321: Engineering Economics (3 Units C: LH 45)
The nature and scope of economics. Basic concepts of engineering economy-Relationship between Science, Engineering, Technology and Economics. Theories of Maximization-Profit Maximization, Growth Maximization, Sales Revenue Maximization, Utility Maximization and Wealth Maximization. Theory of Demand-Demand schedule, Nature and characteristics of demand, Law of demand, Limitations to the law of demand, Elasticity of Demand: Price, Income and Cross elasticity. Demand Forecasting definition, factors determining demand forecasting, methods of demand forecasting. Cost Concepts-

Types of costs: Fixed cost, Variable cost, Average cost, Marginal cost, Real cost, Opportunity cost, Accounting and Economic cost. Cost - Volume profit analysis, Break - Even analysis, Operating leverage. Interest formulae, discounted cash flow, present worth, equivalent annual growth and rate of return comparisons. Replacement analysis. Benefit-cost analysis. Minimum acceptable rate of return. Accounting Concepts-Double Entry System, Journal, Ledger, Trail balance, Final Accounts Book Keeping System, DepreciationDefinition, functions, methods of depreciation; Straight line, Declining balance; Sum of years digits method. Judging attractiveness of proposed investment.

GET 322: Technical Writing and Communication (3 Units C: LH 45)

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, structure Fog and 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 323: Engineering Mathematics IV (3 Units C: LH 45)

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. Runge-Kutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 324: Renewable Energy Systems and Technology (3 Units C: LH 30; PH 45)]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; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Contents: 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; trans-esterification 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 329: Students Industrial Work Experience II (4 Units C: PH 180)

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 trouble-shooting, and wooden 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 PDMS 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: a. Design of machine components;

b. Product design and innovation;
c. Part modelling and drafting in SolidWorks; and
d. Technical report writing.

TCH 411: Chemical Engineering Thermodynamics II (2 Units; C: LH 45)
Phase Equilibria. Criteria of equilibrium. Fugacity of a pure component. General Fugacity relations for gases. Fugacity of gas mixtures. Effects of temperature and pressure of fugacity. pressure temperature composition relationship. Phase behaviour at low and elevated pressure. Raoult's law Henry's Law. Equilibrium constant. Activity coefficient. Gibbs-Duhem equation. Margueles and Van Leer equations Chemical Reaction Equilibria. Standard free energy change and equilibrium constant. Evaluation of equilibrium constants. Effects of temperature and pressure on equilibrium constants; conversion calculation. Gas phase reactions, Percentage conversion. Liquid phase reaction. Heterogeneous reactions

TCH 412: Chemical Reaction Engineering I (3 Units C: LH 45)
Introduction to chemical kinetics; concentration versus time equations for single, irreversible reactions; concentration versus time equations for reversible reaction; design of the ideal PFR, CSTR; batch and semi-batch reactors and CSTRs in series. Real tubular reactors in laminar flow; Real tubular reactors in turbulent flow; packed bed reactors; unsteady reactors; residence time distribution functions for non-ideal flow reactors.

TCH 413: Chemical Product Design (3 Units C: LH 15; PH 90)
Chemical Engineering open-ended problems/projects that require students to design a chemical process or product. Each team generates and filters ideas; identifies use cases and objectives; evaluates and selects a design strategy; develops a project budget; schedules milestones and tasks; and writes a proposal with supporting documentation. Each project must meet specified requirements for societal impact, budget, duration, person hours, environmental impact, safety, and ethics. Principles of chemical engineering business start-ups.

TCH 414: Plant Design and Economics (3 Units C: LH 45)
Presentation and discussion of real process design problems; sources of design data; process and engineering flow diagram; process outline charts incorporating method study and critical examination; mechanical design of process vessels and piping. Environmental considerations site considerations; process services. Costing of design Process. Formulation of feasibility report evaluation. Economics and safety consideration must be stresses. Computer aided Design; application of software packages in design.

TCH 415: Process Control (2 Units C: LH 30)

Process dynamics. Transfer functions. Frequency response analysis. Discrete events. Control system design. Cascade control. Feed forward and feedback control. Introduction to multi variable control. The control valves.

TCH 416: Process Modelling and Simulation (2 Units C: LH 30)
Use of computational tools to solve models and implicit equations covering transfer, separation, chemical reactions and thermodynamic systems involving steady and unsteady state. Process simulation using the HYSYS software or any other process simulation software, including ASPEN, MATLAB, Geogebra, Winplot, ESES.

TCH 417: Transfer Processes II (2 Units; Core; LH 30)
Basic Laws of mass momentum and energy transfer process and their relationship. Measurement calculations and prediction of transport coefficients. Viscosity and the Mechanisms of Momentum. Transport, shell momentum balances and velocity distributions in laminar flow. Velocity distributions in a turbulent flow. The equations of change for isothermal systems. The equation of continuity. The equation of motion. The equation of mechanical energy. The equation of angular momentum. The equations of change in terms of the substantial derivative. Use of the equations of change to solve flow problems. Shell momentum balances and velocity distributions in laminar flow. Shell momentum balances and boundary. Flow through a circular tube. Pressure drop for creeping flow in a condition. The flow of a falling film. Simple problems involving dimensionless groups, such as Re Sc Pr. Boundary layer theory and turbulence. Navier Stokes equation. Universal Velocity profile. Eddy diffusion. Theories of mass transfer. Mass transfer with chemical reaction. Interphase mass transfer.

TCH 418: Chemical Engineering Laboratory III (1 Units; Core; PH 45) Selected experiments in Heat Transfer. Thermodynamics. Chemical Reaction Engineering. Biochemical Engineering. Process Dynamics and control.

GET 421: Engineering Project I (2 Units C: PH 90)
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 422: Engineering Valuation and Costing (2 Units C: LH 30)
Objectives of valuation work/ valuer's primary duty and responsibility. Valuer's obligation to his or her client, to other valuers, and to the society. Valuation methods and practices.

Valuation reports. Expert witnessing. Ethics in valuation. Valuation standards. Price, cost and value. Depreciation and obsolescence. Valuation terminology. Real asset valuation; personal asset valuation. Machinery and equipment valuation. Oil and gas facilities valuation. Mines and quarries valuation. Appraisal reporting and review.

TCH 421: Chemical Process Technology (1 Unit; C PH 45)

Practical Production and application of Oils, Fats and Waxes: Extraction and reforming of vegetable oils. Hydrogenation. Trans-esterification. Soaps and Detergents production. Raw materials. Manufacture, properties and uses of glycerine.

Practical Production and application of Essential Oils, Fragrances and Flavours: Practical recovery of volatile oils. Synthetic and semi-synthetic essential oils use. Natural fruit concentrates. Perfume production: Synthesis and uses.

Practical Production and application of Cosmetics: A general study including the preparation of cosmetics and perfumes in terms of raw materials such as emulsifiers (natural, synthetic and finely dispersed solids). Lipid components (oils, waxes, fats). Humectants, colours (dyes and pigments). Preservatives and antioxidants. Cosmetics for skin (Types and problems of skin). Key ingredients of skin cleansing: Toners. Moisturizers, Nourishing. Protective. Talcum powder. Bleaching products. Hair care: Classification. Special additives for conditioning and scalp health. Hair colorants. The plant materials (herbs) used in hair cosmetics.

GET 429: Students Industrial Work Experience III (4 Units C: PH 180)

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 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 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 229, GET 329 and GET 429), on which a seminar will be presented to the Department for overall assessment.

GET 511: Engineering Project Management (3 Units C: LH 45)

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 512: Engineering Law (2 Units C: LH 30)

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.

TCH 511: Plant Design II (4 Units C: LH 15; PH 135)

A design problem involving the study of a process. It should consist of preparation of flow sheet and heat and mass balances of the process and a detailed design of plant or unit operation equipment used in the process. Due consideration must be given to economics and safety. Each student is expected to submit and orally defend a bound copy of technological/engineering design project. A design project should consist of introduction, literature review, process design, detailed design of some of the units of the process, specification of the equipment required, specification of materials of construction, basic mechanical design and drawings, inclusion of process control, modern drawings of the process equipment including a good flow chart, economic and environmental considerations.

TCH 512: Chemical Reaction Engineering II (2 Units, C, LH 30)

Non-catalytic Heterogeneous Reactions: Selection of model. Progressive Conversion model. Unreacted core model. Determination of controlling step. Design application. Catalysis and

Catalytic Reactors: Overview of solid catalysed reactions. Rate equations for surface kinetics. Mass transfer between the bulk fluid phase and external catalyst surface in isothermal reactors. Pore and film diffusion resistances. Deactivation and regeneration of catalysts. Porous catalyst particles. Deriving the global reaction rate expression. Determination of rate controlling step. Effectiveness factor for flat-plate. Cylindrical and spherical catalyst pellets. Performance equation for catalytic reactors with porous catalysts. Pressure drops in packed bed catalytic reactors. Heat effects in catalytic reactors. Adiabatic packed bed catalytic reactors.

TCH 513: Chemical Process Optimization (3 Units; C; LH 45)

Nature and organization of optimisation problems: Examples of chemical Engineering applications of optimisation. General procedure for solving optimisation problems. Developing models for optimisation: Classification of models. How to build a model. Selecting functions to fit empirical. Economic objective functions. Time value of money in objective functions and measures of profitability. Basic concepts of optimisation theory: Continuity of functions. Convexity, concavity and their applications. Necessary and sufficient conditions for an extremum of an unconstrained function. Optimisation of unconstrained functions: One-Dimensional Search Methods. Unconstrained multivariable optimization techniques. Linear programming. Quadratic programming. Successive quadratic programming. Using Non-linear programming software: MATLAB optimisation toolbox. Dynamics programming: optimization of the staged system. Applications in heat transfer.

TCH 514: Separation Processes II (2 Units; C; LH 30)

Drying mechanism. Rate of drying and estimation of drying periods. Industrial dryer design. Solvent extraction. Introduction to gas absorption. Evaporation. Evaporation equipment and operation methods. Multiple effect evaporation. Evaporator performance and efficiency. General problems of multicomponent systems. Approximate method for multicomponent multistage operation. Fenske Underwood and Gilliland's method for multistage, multicomponent separation. Kremser Method. Multicomponent gas absorption. Distillation of multicomponent mixtures. Introduction to membrane separation technology. Types of membrane separation processes. Gas permeation and various models for gas separation membrane process. Design of selected multicomponent separation equipment

TCH 515: Pulp and Paper Technology (2 Units; E; LH 30)

Present status of pulp and paper manufacture. Fibrous raw materials. Wood composition. Fibre chemistry. Overview of paper manufacturing. Paper Properties: Physical (optical, strength, and resistance). Chemical and electrical properties. Paper defects. Variables affecting paper properties.

Raw Material Preparation: Debarking. Chipping. Chip screening. Storage. Pulping: Chemical, Semi-chemical. Mechanical, Chemi-mechanical. Non-conventional, Secondary fibre pulping. Advances and recent trends in pulping. Chemical Recovery: Composition and properties of black liquor. Oxidation and desilication. Concentration of black liquor and its incineration. Causticizing and clarification. Sludge washing and burning. Bleaching: Objectives of bleaching. Bleachability measurement. Bleaching chemicals and their production. Single and multi-stage bleaching processes. Bleaching of chemical and mechanical pulp. Colour reversion of bleached pulp. Control procedures in bleaching. Biobleaching. Recent trends in bleaching technology. Water reuse and recycle in bleaching.

TCH 516: Sugar Technology (2 Units; E; LH 30)

Sugar industry in Nigeria. Sugar worldwide views. Sugarcane and Sugar Beet: Production quality. Indigenous Technology for Small-Scale Sugar Production. Raw Sugar Manufacturing: Unit operations. Juice extraction. Purification. Heating. Evaporation. Crystallization, crystallization in motion. Refining: Affination. Clarification. Decolourisation. Crystallization. Centrifugation. Drying. Bagging, Storage. Factors affecting sugar processing. Quality criteria: Raw and refined sugar. Specialty Sugar Products: Brown or soft sugar. Liquid sugar. Sugar industry by-products and their uses. Sugar Chemistry, Sucrose: Structure, physical & chemical properties. Uses of sucrose. Food applications. Feedstock for chemical synthesis. Fermentation feedstock. Pharmaceutical applications, nutrition & health aspects and metabolism of sucrose. Sugar Analysis: standards & definitions. Physical methods of sugar analysis. Polarimetry. Refractive index. Colourimetry methods. Enzymatic methods. Chromatographic methods. NIR, determination of other components. Moisture, ash & inorganic constituents. Particle size distribution, insoluble matter

TCH 517: Polymer Science and Engineering (2 Units; E; LH 30)

Application of engineering fundamentals to the preparation and processing of polymers with emphasis on the relationship between polymer structure and properties. Polymer synthesis techniques. Characterization of molecular weight. Crystallinity. Glass transition. Phase behaviour. Mechanical properties. Visco-elasticity. Survey of polymer processing operations with emphasis on the application of polymer rheology and transport phenomena to predict performance, including polymer rheology and constitutive equations, mixing, extrusion, film blowing, blow moulding, injection moulding, compression moulding, coating flows, fibre spinning, thermoforming and composites processing.

TCH 518: Membrane Technology (2 Units, E; LH: 30)

Introduction, classification, membrane processes, principle, theory, membranes and materials, membrane selectivity, modules, concentration polarization, membrane fouling and cleaning, applications. Mechanism of membrane transport, RO/UF transport, solution diffusion model, dual sorption model, free volume theory, pore flow model, resistance

model, boundary layer film model, membrane modules, flat, cartridge, spiral wound, tubular, hollow fiber, design equations, applications. Membrane preparation techniques-isotropic membranes, anisotropic membranes, metal membranes, ceramic membranes, liquid membranes and bio-membranes. Evaporation and gas separation, principle, theory, process design, applications, complete mixing model (binary and multi component) for gas separation, cross flow model, counter current flow model. Engineering aspects of membranes, cascade operation, examples of cascade operation, design of gaseous & liquid diffusion membrane module. Hybrid membrane techniques, membrane reactor, membrane distillation, membrane extraction and osmotic distillation, design equations, applications.

TCH 519: Process Integration (2 Units; E; LH 30)

Introduction to process integration. Role of thermodynamics in process design. Targeting of energy, area, number of units, and cost. Super targeting. Concept of pinch technology and its application. Heat exchanger networks analysis. Maximum Energy Recovery (MER) networks for multiple utilities and multiple pinches. Design of heat exchanger network. Heat integrated distillation columns. Evaporators. Dryers and reactors. Waste and waste water minimization. Flue gas emission targeting. Heat and power integration. Case studies. Maximizing the sustainability of industrial systems, the optimal exploitation of oil reserves, new approaches to the modelling of reservoirs.

GET 521: Engineering Management (3 Units C: LH 45)
Essence of management task. Patterns of leadership. Creating a viable organization. Productivity and motivation, organizing task. The span of control and the delegation of authority. Organizational theory and concepts. Industrial safety. Industrial relations. Technology innovation and sustainability: Change, Risk, Logistic and Supply Chain management. Application of industrial engineering tools to solve health care delivery problems focused on cost reduction and quality improvement by facility and process redesign and systems integration. Operational specialties integration in a project consulting firm. Group technology tasks involve designing, planning and implementing an engineering project to stimulate students' multidisciplinary teams' working ability or application of industrial engineering tools in evaluating and solving any practical organizational problem.

TCH 521: Process Safety and Loss Prevention in Industries (3 Units, C; LH 30)
Review of some major accidents in process industries. Hazard Identification. Hazard types. Assessment and Control. Introduction to Process Safety Engineering. Loss Prevention. Toxic Materials. Dose and Response Curves. Threshold Limit Values and Permissible Exposure Levels MSDS's. Monitoring of Volatile Toxicants. Toxic Release

and Dispersion Models -PasquillGifford Plume and Puff Models. Fires and Explosions. Flammability of liquids and vapours.

Explosions - Detonations and Deflagrations. Fire and Explosion Protection and PreventionInerting, Purging Static Electricity. Explosion Proof. Equipment Ventilation. Sprinklers. Hazard Identification Checklists. DOW Fire and Explosion Index. Hazard and Operability studies (HAZOP). The layer of protection Analysis. Risk Assessment - Probability Theory. Interactions between units. Event Trees. Fault Trees. Accident Investigations. Process Safety Management – FMA, CIMAH, SEVESO Directives, PSM.

TCH 522: Environmental Pollution and Control (2 Units; C; LH 30)

Sources of water. Introduction to water pollution. Types of water pollution. Sources of water pollution. Analysis of dispersed pollutants in water. Effects of water pollutants on the environment. Streams and effluent standards. Water treatment processes for domestic uses. Water treatment for industrial uses. Introduction to air pollution. Types of air pollution. Theory, principles and practices related to engineering control of particulate and gaseous emissions from natural, industrial, agricultural, commercial and municipal sources of atmospheric pollution. Effect of atmospheric pollution on the various forms of life. Atmospheric pollutant dispersal modelling. Solid waste collection. Solid waste management. Refuse processing, recovery and conversion to useful products. Functions of environmental regulatory bodies.

TCH 523: Coal Processing (2 Units; E; LH 30)

Origin and formation of coal. Constituents of coal. Important properties of coals. Classification of coal. Rank of coal. Coal processing: Fundamentals of coal carbonization. Combustion. Pyrolysis. Co-pyrolysis with biochar. Gasification and liquefaction. Separation. Catalyst/catalytic reactions. Coal utilization: Products from carbonization (solid and volatile products). Chemicals and fertilizers from coal. Environmental aspects: Fly ash, SOx and NOx control strategies during combustion and after combustion. Product gas cleaning and energy utilization. Removal of H_2S, NH_3, tar, and suspended particulate matter.

TCH 524: Petroleum Processing and Petrochemical (2 Units; E; LH 30)

Chemistry of petroleum. Crude oil distillation and primary refining. Catalytic and thermal cracking. Heavy oil processing. Oil Blending. Petrochemical feedstock. Products specification. Petrochemical process: Adipic acid, nylon, nylon-6-6. PVC. Polypropylene, polyethene, insecticides etc. The non-oil fossil fuel and their relevance to the petrochemical industry. Models of crude oil distillation. Refining. Planning the petrochemical industry for a developing country. Design and simulation of modular refinery. Economic and environmental impact of the petrochemical industry. Mitigation plans for environmental pollution. Processes for improving motor fuel yields: hydrocracking, reforming polymerization and isomerization

TCH 525: Bio Refinery Engineering (2 Units, E; LH: 30)
Cellulosic biomass pre-treatment: Hydrolyse, fermentation, chemical treatment. Lignin pretreatment: radical and chemical pre-treatments. Gasification of biomass – Syngas production and valorization. Biogas from waste, residual biomass, environmental issues

TCH 526: Fermentation Technology (2 units; E; LH: 30)
Introduction: Fermentation. Types of fermentations. Role of microorganisms and other conditions on fermentation. Raw Materials for fermentative production of alcohol: Molasses- Composition. Storage. Spontaneous combustion. Grades and classification of molasses. Clarification of molasses. Other Saccharine Materials: Cane juice. Beet] juice. Sweet sorghum. Manhua flowers. Fruits' juices. Starchy and Cellulosic Materials. Isolation and purification of cultures. Outline of alcohol production by batch fermentation process. Alcohol production by continuous fermentation process. Modern Techniques of Fermentation: Batch. Semi-continuous. Continuous (Biostil, Multicont or Cascade, Encillium). Melle- Bionet process of yeast Cell Recycling. Bacterial Fermentation & immobilised Cell Technique. etc. Production of industrial and power alcohol by azeotropic distillation. Membrane technology and molecular sieves. Production of grain spirit. Chemical control. Theoretical Yield. Fermentation & Distillation. Efficiency, etc. including calculation.

TCH 527: Cement Technology (2 Units; E; LH: 30)
Description of the equipment and considerations of the process and operations involve in the manufacture of cement. Energy recovery. Historical outline. Introduction to Cement chemistry. Raw materials for cement production. Composition of cement raw mix. Sintering and chemistry of sintering. Technology of production of clinker and cement. Types of cement. Hydration of cement.

TCH 555: Chemical Engineering Research Project (4 Units C: PH 180)
Individual research projects under the supervision of an academic staff. Projects should focus on national and state industrial problems