EDO STATE UNIVERSITY UZAIRUE

FACULTY OF ENGINEERING
DEPARTMENT OF CHEMICAL ENGINEERING

UNDERGRADUATE ACADEMIC PROGRAMME

STUDENT HANDBOOK

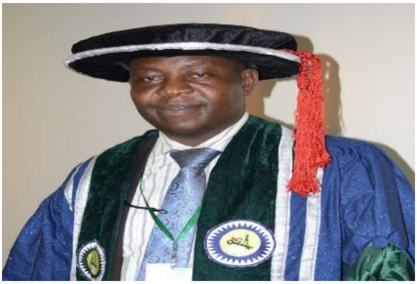
2023 - 2028

ADMINISTRATIVE BUILDING

University Administrative Building

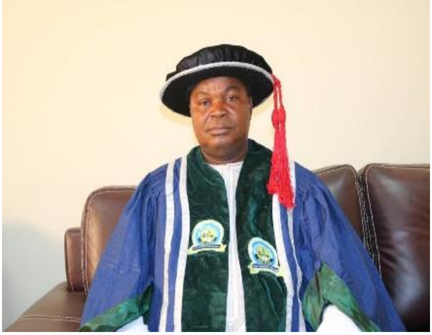
MANAGEMENT STAFF

Engr. Prof. Emmanuel O. Aluyor
Vice Chancellor



Prof. Stephen M. Omodia
Deputy Vice Chancellor
Administration

Engr. Prof. Vincent A. Balogun
Deputy Vice Chancellor
Academics



Mr. Habib I. Ikhelefo
Ag. Registrar

Mr. Osifo Osagie Uwagboe
Ag. Bursar

NOTES ON THE UNIVERSITY

The WHEEL represents technological and innovative advancement. It shows that the University is at the forefront of technological and innovative advancements.

The BEAKER and the TEST TUBE represent scientific expertise and laudable research. They reveal that Edo State University Uzairue is a centre for scientific expertise and laudable research

The COMPASS represents modern methods of educational delivery. It shows that at Edo State University, lectures are delivered using modern educational facilities.

The KEY represents the knowledge potential for future leadership. It reveals that Edo State University is poised to equip students with the knowledge and potential to be future leaders.

The BOOK represents quality education, research and ground breaking discoveries. It shows that Edo State University Uzairue is a centre for quality education, research and ground breaking discoveries, all for the development of humanity.

The University colours are Blue, Lemon Green and White. The Blue colour represents harmonizing industry and technology. Lemon green colour represents agriculture: the main occupation of the people of Edo State, especially, the Edo North. White represents peace, which is the hallmark of the Edo people.

Edo State University Uzairue Motto: Quality Education for Development

The motto "Quality Education for Development" positions Edo State University Uzairue as a citadel of learning where the search for truth and academic excellence are pursued for the advancement of man and his culture.

Vision: The vision of Edo State University is to become a centre of excellence in quality teaching, research, innovation and community development.

Mission: Through its teaching, research, and innovative activities, the University is poised to be a major contributor to the advancement of knowledge, wisdom and understanding for the benefit of the University in encouraging and promoting scholarship and will relate its activities to social, cultural and economic needs of the people of Edo State in particular and Nigeria in general.

FOREWORD

This edition of the students' handbook or course prospectus for the Department of Chemical Engineering, Edo State University, Uzairue, Edo State, has been designed to provide all the required information concerning course registration for each semester of an academic session, admission requirement, academic regulations and the departmental staff to whom any student could approach for necessary guidance or assistance. The handbook is also a fulfilment of the basic requirements of NUC/COREN accreditation, which the Department faces in order to keep abreast of the current curriculum development and updates. The students (fresh or old) are advised to make the book a necessary companion to avoid registering the wrong courses and/or having excess credit load. The University is endowed with many professional societies, e.g., Nigerian Society of Engineers (NSE) (student chapter), Nigerian society of Chemical Engineers (NSChE) (student chapter) and religious groups to which the students could find convenient to belong instead of belonging to banned secret cults or societies. The students are cordially invited to discuss their problems with their level academic advisers or the Head of Department to help them get useful solutions to their problems. This handbook should be read in conjunction with the University Student Handbook which contains the General and Academic Regulations of the University Information on certain services and functions of the University. These may be significant to you and described in details in the Handbook are: academic information, administrative information and University services.

Engr. Dr. A. O. FRANCIS
Lecturer-In-Charge

PREFACE

This edition of the students' handbook is written with the prospective undergraduate of Chemical Engineering Department in mind in order to provide a guide and reference point to his/her course registration for each semester of an academic session. It is necessitated by a number of developments: the NUC/COREN directive on programme structuring, positive change in the staff strength of the department and other issues that may arise. These developments have been addressed and included. Any other changes occurring thereafter will be reflected in future editions. I recommend this handbook to all who are interested in Chemical Engineering education and other related fields such as Petroleum Engineering and Food Technology. I wish you a wonderful and fulfilled academic session.

Engr. Dr. A. O. FRANCIS
Lecturer-In-Charge

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LIST OF STAFF

S/N	NAME OF STAFF	QUALIFICATIONS	RANK/ DESIGNATION
1.	Engr. Prof. E. O. Aluyor	PhD, M.Eng., B.Eng.	Professor
2.	Engr. Prof. S. K. Otoikhian	PhD, M.Eng., B.Eng.	Professor
3.	Engr. Dr. K. K. Adama	PhD, M.Eng., B.Eng.	Senior Lecturer
4.	Engr. Dr. A. O. Francis	Ph.D., M.Eng., PGD., HND	Lecturer I/ Lecturer-In-Charge
5.	Engr. P. M. O. Ikhazuangbe	M.Eng., B.Eng. PGD., HND	Lecturer I
6.	Mr. O. A. Amune	M.Eng., B.Eng.	Lecturer II

1.0 HISTORY AND PHILOSOPHY OF THE DEPARTMENT

1.1 Brief History

The Department was established in November, 2016 among other Departments in the Faculty of Engineering namely Chemical Engineering, Civil Engineering, Computer Engineering and Mechanical Engineering through the very effort of Engr. Prof M. J. E. Evbogbai, who groomed the Department in readiness for take-off through the first admission of students into the Department in 2017 in which the students came in through the Joint Admission and Matriculations Board (JAMB) Entrance Examination. The first admission exercise and the matriculation ceremony for the programme took place in 2017 with 10 students admitted for the five-year Bachelor of Engineering (B.Eng.) Degree Programme. The second and third sets of students admitted were 15 and 17 in the year 2018 and 2019 respectively. The Department took off with its laboratories equipped, though the department had not grown to the level of carrying out practical in the Departmental laboratories. The students started Departmental practical in the 2018/2019 Academic Session when the first sets of students admitted were in their third year (300-level). The Department produced its first set of graduates in the 2020/2021 Academic Session.

In December 2017, Engr. Prof. Shegun Kevin Otoikhian was appointed as the Acting Head of the Department. He had hardworking academic, technical and non-academic staff.

1.1.1 Introduction

Chemical Engineering also known as Process Engineering is designed to introduce students to three basic principles namely: the principles of physical sciences; principles of economics together with the principles of human relations as applicable to process and process equipment in which matter /materials are treated to effect change in composition, state and energy content for the benefit of mankind. These materials are engineering materials which comprise of metals, ceramics and polymers.

The programme aims to achieve this through uncompromising approach towards knowledge acquisition for its teaching and technical staff and its systematic transfer to students coupled with the adoption of dynamic state-of-the-art methods of teaching, researching as well as procurement of the latest analytical and industrial standard equipment for training both the students and staff.

Also, an emerging trend in the Engineering industry is the development of new processes for producing specialty materials, such as plastics, lightweight metal alloys and Nano-materials, for a wide variety of industrial and consumer applications. It is noteworthy that every product, regardless of size, shape and/or area of use, is made of materials. These materials have properties which must be specified correctly; - first for the production and subsequently for service. The choice of materials must therefore ensure that the products will not fail in service.

This programme therefore covers these areas and is designed to provide the students with the skills for a successful career in the process, materials and related industries. As with most engineering courses, core engineering concepts are covered in earlier years of the two and three hundred levels. At four and five hundred levels, various fields/ specialized areas of Chemical Engineering and other related topics are being introduced. Some of these courses include polymer engineering, reaction engineering, chemical process industries, technology of fossil fuel processing, corrosion engineering, biotechnology, solid mineral processing, and environmental engineering.

1.1.2 Career opportunities

The graduates of this department have career prospects in the following areas:

i. Petroleum refineries
ii. Paints and plastics
iii. Food and pharmaceutical industries
iv. Petrochemical industries
v. Petroleum exploration and drilling industries
vi. Research and development organisations
vii. Chemical industries such as soap, detergents, fertilizer, cement and manufacturing industries
viii. Design and construction companies
ix. Solid mineral processing industries

1.1.3 Areas of specialisation and research activity

The following are the areas of specialization offered by the department. These areas correspond to those in which research activities are channelled in the department

i. Unit operations
ii. Chemical reaction engineering
iii. Chemical process development
iv. Separation processes
v. Simulation and optimisation
vi. Coal and energy conversion technology
vii. Biochemical engineering
viii. Nuclear chemical engineering
ix. Chemical engineering analysis
x. Petrochemical and polymer technology
xi. Project appraisal and evaluation
xii. Environmental pollution control

1.2 Philosophy, Mission Statement, Vision Statement, Aim and Objectives

1.2.1 Philosophy

Our programme philosophy is to provide necessary materials, facilities and relevant human resources for the effective training of high-level independent minded, self-reliant and competent Chemical Engineers, capable of engineering the technological development of our nation.

1.2.2 Mission Statement

The mission of the Programme is to educate Nigerians in modern engineering principles so as to prepare them for lifelong professional growth in a dynamic range of careers, to engage in multi-disciplinary research programmes aimed primarily at benefiting the process industries thereby constituting a centre of excellence in education and research in Nigeria, Africa and the World at large.

1.2.3 Vision Statement

To be the leading Programme of Chemical Engineering in Nigeria where the fundamentals and principles of science and technology are integrated into multi-disciplinary teaching and research programmes aimed at producing internationally competitive research for the process industries as well as high-calibre, self-reliant graduates.

1.2.4 Aim

The Chemical Engineering Programme is established to provide an outstanding chemical engineering education and value directed at training students with the state of-the- art- equipment and teaching methods that will enrich them with the scientific and technical/practical skills in an emerging knowledge-based society. We are committed to maintaining world class standard of academic excellence and to preserving our core values of scholarship, professionalism and integrity. We strive to maintain an ethos founded on harmony, equity and a working environment where creativity and diversity are cherished. We firmly believe that our Programme will continue to find ways to improve the quality of life of all Nigerians and the society at large.

1.2.5 The specific objectives and goals

The Programme of Chemical Engineering intends to achieve the above mission and vision through the following objectives:

- To review course contents from time to time in order to meet minimum academic standards that can compete with international standards.
- To strengthen the quality of teaching staff.
- To give projects of quality with professional theoretical and practical preparation, this will depict the level of work undergone by the student throughout his career.
- To train Chemical Engineers so as to meet the national manpower requirement.
- To encourage external moderation which will avail the Department inputs and expertise of long serving senior academic in sister universities.

1.2.6 Learning Outcomes/Goals

- To produce highly trained graduates for the process and petroleum industries as well as for specialist technological firms, business and service sectors;
- To be the preferred provider of research for our stakeholders by conducting multidisciplinary research programmes within an integrated research portfolio;
- To employ top quality staff who will reflect the diversity of the profession;
- To provide first class facilities for Chemical Engineering education and research.

1.2.7 Students Welfare

Prompt attention is given to every student's complaint. All academic grievances from students are usually documented and handed over to the appropriate committee through either the Head of Department or the Dean of Faculty. The most common types of academic grievances handled in the past years, included correction of wrong grades, errors in computation of students CGPA and omitted results or grades.
The students also have the right to petition the School Board or Senate when they are not satisfied with the decision of the Departmental Board or Faculty Board.

2.0 ADMISSION REQUIREMENTS

2.1 UTME Requirements

Five credit passes at SSCE or GCE O' level or its equivalent which must include English Language, Mathematics, Chemistry, Physics and any other Science subject in not more than two sittings. It is desirable and an added advantage for candidates to have Further Mathematics and Technical Drawing at credit pass levels.

2.2 Direct Entry Requirements

a. GCE A' level, IJMB, HSC or its equivalent with credit passes in Mathematics, Physics and Chemistry in addition to O' level pass at credit level in English Language.

b. OND or HND with minimum of credit pass in addition to O' level passes at credit levels as in (1.1.3.1) above.

NOTE: It should be generally noted that for entry into various Departments/Programmes in the Faculty of Engineering, 100 level is the qualifying year. At this level, engineering students take courses in Mathematics, Physics, Chemistry and General Studies which are being run by the Faculty of Science, Faculty of Humanities and Social Sciences.
For students to proceed from 100 level to 200 level and to remain in the Faculty, a Cumulative Grade Point Average (CGPA) of at least 2.0 is required. In addition, the student must obtain 12 credits of Mathematics, 10 credits of Physics including at least two theory courses, 8 credits of Chemistry. He/she must also obtain 10 credits of General Studies. Note also that all the 200 level students of the Faculty offer the same common courses while at 300 level, students will begin to offer core courses and elective courses peculiar to their various Departments/Programmes.

2.3 Inter/Intra-University Transfer Mode

Students can transfer into 200-Level courses provided they have the relevant qualifications and have passed all their courses in 100 Level.

3.0 DURATION AND REQUIREMENTS FOR GRADUATION

3.1 Duration of the Programme

The Bachelor of Engineering degree in the Chemical Engineering programme is designed to last for a minimum of five (5) years for UMTE (100 – 500 levels) candidates; four (4) years for DE (A' level, IJMB and ND) candidates; and three (3) years for HND candidates. The counting of the duration for graduation begins immediately after matriculation.

3.2 Matriculation

This is the formal admission of a student to the membership of a University after registration and signing by the student of the Declaration of Obedience. Note, only matriculated students are entitled to become candidates for degrees. No student can be admitted to a first degree programme until he or she has completed full-time attendance for at least three University sessions. Exceptions may be made in specified circumstances on the authority of the EUI Senate.

3.3 Requirements for Graduation

To graduate from the Faculty of Engineering of EUI, the students must meet the minimum requirement as stipulated by the student's Department in addition to passing all the required Faculty Common Engineering courses from 100 – 500 levels.

3.4 Programme Structure for Graduation

The programme structure includes Period of Formal Studies in the University; Industrial Training; Planned Visit and Projects. This structure is made up of four parts namely

(i) **100 – 200 Levels:** General Studies, Basic Sciences and General Engineering and Technology Courses. General Studies and Basic Science Courses are normally taught by Lecturers from other Faculties.
(ii) **300 – 500 Levels:** Core Programme Courses/Elective Courses
(a) Students Work Experience Scheme (SIWES I) – 9 WEEKS
(b) Students Work Experience Scheme (SIWES II) – 12 WEEKS
(b) Students Work Experience Scheme (SIWES III) – 24 WEEKS

Note: SIWES I, II and III are required and graded for used in computation of final degree result.
The student is expected to go for forty five (45) weeks training which is an integral part of the five-year degree programme. This is made up of nine (9) weeks of Students Work Experience Scheme (SIWES I) at the end of 200 level, twelve (12) weeks of Students Work Experience Scheme (SIWES II) at the end of 300 level twenty four (24) weeks of Students Work Experience Scheme (SIWES III) during the second semester 400 level, i.e., at the end of the student's first semester 400 level examinations. However, an academically weak student may be advised to defer SIWES until he/she clears all his/her carry-over (failed) courses and such student must satisfy the SIWES requirements before proceeding to 500 level.

4.0 EXAMINATION/ACADEMIC REGULATIONS

The setting, conduct, evaluation schemes, moderation schemes - internal and external for degree examination and the issuance of results are as in the "Approved Senate Regulations governing the conduct of examinations" and the "General Academic Regulations for degree courses". The relevant details are set out below:

A. General Academic Regulations for Degree Course

(i) The unit of a course shall be the semester, one semester unit being when a class meets one hour every week for the semester or three or four hours every week in the laboratory for the semester or the equivalent in workshop or field work time. The size of a course shall, as much as possible, be a maximum of three units and its duration shall be one semester except for projects and design courses which may carry more than three units and may last more than one semester.

(ii) A core course (C) is one which must be registered for and passed by a student to get its degree and is counted toward the classification of his/her degree.

(iii) An elective course (E) is either compulsory or optional. All elective courses taken are used in final computation for the degree classification. There are compulsory elective courses, which implies that every student must offer the course before graduation; and the optional elective implies that a student may or may not offer the course provided such a student has taken the required units of elective courses for graduation.

(iv) A University required course (R) is a compulsory course prescribed by the University which must be passed before a student can graduate. It would also be counted toward the computation and classification of the student's degree.

(v) An audited course (A) is one which the student attends without writing the examination in it.

(vi) Pre-requisite course (P) is one in which the students must pass before proceeding to the higher course

(vii) Co-prerequisite course (CP) is one which may be taken in parallel with the course for which it is specified.

B. Students Work Load:

Maximum numbers of units a student can register for is 24 units per semester. The minimum numbers of units a student can register for is 16 units per semester.

C. Computation of Results:

The following terminologies and abbreviations are commonly used in the computation of Grade Point Average (GPA)

(i) **Total Load Units (TLU):** This is the total numbers of course units carried by a student in a particular semester. It is the summation of the load units on all courses carried during the semester. Take for example, a student who is taking 6 courses of 3 units each has a TLU of 18 for the semester.

(ii) **Cumulative Load Unit (CLU):** This is the summation of the total load units over all the semester from the beginning to date. Student who is prone to repeating courses will finish (if he/she does not drop out) with a higher CLU than his non-repeating colleagues, and will most likely require a longer time to complete the requirements for the award of a degree.

(iii) **Total Credit Points (TCP):** These are the sum of the product of course units and rating in each course for the entire semester. Take for example, a student who took four (4) courses of 3 units each. Suppose the grades he obtained in the four courses are A, B, C, and D, respectively. The TCP of the student is calculated as (3 x 5.0) + (3 x 4.0) + (3 x 3.0) + (3 x 2.0) = 15 + 12 + 9 + 6 = 42.

(iv) **Cumulative Credit Point (CCP):** This is the summation of the Total Credit Points over all semesters from the beginning to date.

(v) **Grade Point Average (GPA):** This is the Total Credit Points (TCP) divided by the Total Load Units (TLU). Take for example, consider the student's score referred to in section C (iii). His TCP is 42.0 and his TLU is 12, his GPA is therefore 42/12 = 3.50. The highest possible GPA that can be earned is 5.0 and that is when a student has earned a grade of "A" in every course during the semester. The lowest GPA obtainable is 2.0 to remain and graduate in any engineering programme.

(vi) **Cumulative Grade Point Average (CGPA):** The Cumulative Grade Point Average (CGPA) of a student can be determined by the addition of the Grade Point (GP) at each level taking into consideration the weighting percentage. To calculate the final class of degree for students, the following weighting system shall apply as shown in the table below.

S/N	LEVEL	5 YEARS (UTME)	4 YEARS (DIRECT ENTRY)
1.	100	10%	-
2.	200	15%	20%
3.	300	20%	25%
4.	400	25%	25%
5.	500	30%	30%

5.0 WITHDRAWAL FROM THE UNIIVERSITY

5.1 Voluntary Withdrawal

Students who wish to withdraw from the university shall notify the Registrar in writing through the Deans of the Faculty and Head of Department. The period of withdrawal shall not exceed one academic year and shall be subject to approval by the Senate.

- For fresh students, the written notice of withdrawal shall be given not later than two weeks after matriculation. For old (continuing) students, the notice shall be given not later than four weeks after the beginning of the semester.
- Any student from the university shall be required to complete a form giving a brief statement of the reason(s) and effective date of leaving. The form shall be obtained from the Registrar.
- In the case of such voluntary withdrawal, the refund of fees in excess of the period spent in the university will be made by the Bursar's office.
- Such a student may retain grades carried for the semester examinations preceding the date of voluntary withdrawal.

- A student who so withdraws from the University shall, in order to be readmitted, be required to send a formal application to the registrar through his/her Head of Department/Dean of faculty and receive official clearance from the Registrar.
- Senate may prescribe conditions, which shall be fulfilled before a student may resume his/her programme of studies after a period of withdrawal.

5.2 Unauthorized Withdrawal

A student who withdraws from the university without authority for one academic year may not be reconsidered for readmission until his/her case has been considered on its merit by the Department/faculty Board and approved by Senate.

5.3 Withdrawal for Academic Reasons

(i) For a student to proceed from 100 Level to 200 Level, the student should not fail more than 9 credit units, consequently any student at 100 Level who fails more than 9 credits units at the end of the Academic Session will be advised to withdraw from the Faculty of Engineering.

(ii) From 200-300 Level, a student is expected to pass at least 24 credit units of the total credit units registered for that Academic Session, while for 400 Level, the student must pass at least 12 credit units before he/she can proceed to the next level.

(iii) Any student who fails to accumulate 24 credit units at the end of any Academic Session except 400 Level or 12 credit units for the 400 Level Academic session shall be on probation.

(iv) Any student who fails to accumulate up to 12 credit units at the end of any Academic Session except at the 400 Level Academic Session or 6 credit units for the 400 Level Academic Session shall be advised to withdraw from the Department Faculty of Engineering

5.4 Withdrawal on Health Reasons

A student may withdraw or be asked to withdraw on health reasons certified by the Director of Health Services of the University. Such a student shall be readmitted into the University on production of a valid medical report from an approved Medical Officer and certified by the Director of Health Services.

5.5 Withdrawal Based on Disciplinary Action

A student who is suspended on disciplinary grounds may not be readmitted unless with express permission of the Senate.

5.6 Financial Obligation after Withdrawal

Student who withdraws from the University for any reason whatsoever shall be required to clear any outstanding debts before they may be reconsidered for readmission.

6.0 COURSE CREDIT SYSTEM (CCS)

At EDSU, we practice Course Credit System; therefore, all Engineering Programmes shall be run on a Course Credit System, that is, a modularized system commonly referred to as Course Unit System. Going by this system, therefore, all courses should 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. In that case, credit weights should be attached to each course. Note, one credit is equivalent to one hour per week per semester of 15 weeks of lectures or 2 hours of tutorials or 3 hours per week of laboratory/studio work per semester of 15 weeks.

7.0 EXAMINATION MALPRACTICE

7.1 Definition of examination malpractice

Examination malpractice shall be defined as all forms of cheating, which directly or indirectly falsify the ability of the students. These shall include cheating within an examination hall, cheating outside an examination hall any involvement in all examination related offences.

7.2 Cheating within and Examination Hall/Room

1. Copying from one another or exchanging questions/answer sheets

2. Bringing in prepared answers, copying from textbooks, notebooks, laboratory specimens and any other instructional aids smuggled into the hall
3. Collaboration with invigilator/lecturer, where it involves, the lecturer-invigilator providing written/oral answer to a student in the examination hall
4. Oral/written communication between and among students
5. Bringing in prepared answer written on any part of the body
6. Receiving information whether written or oral from any person(s) outside an examination hall
7. Refusal to stop writing at the end within half a minute in an examination
8. Illegal removal of answer scripts from the examination hall. Non-submission of answer scripts at the end of the examination. A check-off system of students who have actually submitted answer scripts should be devised.

7.3 Another form of Examination Malpractice

Plagiarism is a form of examination malpractice and should be investigated and punished in the same way as cheating in the examination hall/room. Plagiarism is the use of another person's work (I.e. in writing term papers, final year project, seminar presentation, etc) without appropriate acknowledgement both in the text and in the refences at the end.

7.4 Punishment for Examination Malpractice

Any student found guilty of examination malpractice after due process shall be dismissed from the University. This decision shall be pasted on all notice boards throughout the University and shall be contained in each Faculty prospectus so as to give it the widest possible publicity.

8.0 GRADING SYSTEM (GS)

Edo University Iyamho, Edo State, Nigeria, operates a five (5) point grading system. Examination carries 70 percent while the continuous assessment (which is made up of class attendance/quiz/test/assignment/mini-project) all at the discretion of the course lecturer carries 30 percent giving a total of 100 percent.
Apparently, a student must have at least 75 percent attendance in lectures before he/she is qualified to sit for any examination in the faculty. The overall grading system and the class of graduation degree are as given in the tables below.

Overall Grading System

Grade	Point	Range of Score (%)	Remark
A	5.0	70 and above	Excellent Pass
B	4.0	60 – 69	Distinction Pass
C	3.0	50 – 59	Credit Pass
D	2.0	45 – 49	Pass
F	0.0	0 – 44	Failed

Class of Graduation Degree

S/N	Class of Degree	CGPA
1.	First Class	4.50 – 5.0
2.	Second Class Upper Division	3.50 – 4.49
3.	Second Class Lower Division	2.40 – 3.49
4.	Third Class	1.50 – 2.39
5.	Failure (withdrawal)	Less than 1.50

9.0 OUTLINE OF COURSES

100 LEVEL

Course Code	Course Title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian People and Culture	2	C	30	-
GET 101	Engineer in Society	1	C	15	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
TCH 101	Introduction to Chemical Engineering	2	C	30	-
EDSU-TCH 103	Elementary Mathematics III	3	C	45	-
EDSU-TCH 104	Elementary Statistics	2	C	30	-
	Total	**30**			

Note: For a student to proceed from 100 Level to 200 Level, the student should not fail more than 9 credit units, consequently any student at 100 Level who fails more than 9 credits units at the end of

the Academic Session will be advised to withdraw from the Faculty of Engineering.

200 LEVEL

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 204	Students Workshop Experience	2	C	-	90
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
TCH 201	Chemical Engineering Fundamentals	3	C	45	-
TCH 202	Material Science	3	E	45	-
TCH 206	Statistics for Chemical Engineers	2	C	30	-
GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
EDSU-TCH 226	Strength of Materials	2	C	15	45
	Total	**31**			

300 LEVEL

Course Code	Course Title	Units	Status	LH	PH
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture and creation	2	C	15	45
GET 304	Technical Writing and Communication	3	C	45	-
GET 306	Renewable Energy Systems and Technologies	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	2	C	30	-
TCH 301	Transfer Processes I	2	C	15	-
TCH 302	Chemical Engineering Thermodynamics	2	C	30	-
TCH 303	Separation Processes I	2	E	30	-
TCH 304	Process Instrumentation	2	E	30	-
TCH 305	Chemical Engineering Laboratories I	1	C	-	45
TCH 307	Biochemical Engineering	2	C	30	-
TCH 308	Numerical Methods in Chemical Engineering	2	C	30	-
GET 399	SIWES II: Students Work Experience Scheme	4	C	12 Weeks	
EDSU-TCH 315	Chemical Engineering Analysis	2	C	30	-
EDSU-TCH 316	Chemical Reaction Kinetics	2	C	30	-
EDSU-TCH 317	Transport Phenomenon II	2	C	30	-
EDSU-ENT 321	Entrepreneurial Skills (Practical course)	1	C	-	45
	Total	**32**			

400 LEVEL

Course Code	Course Title	Units	Status	LH	PH
TCH 401	Chemical Product Design	3	C	15	90
TCH 402	Chemical Reaction Engineering I	3	E	45	-
TCH 404	Plant Design and Economics	3	E	45	90
TCH 405	Process Control	2	E	30	-
TCH 406	Process Modelling and Simulation	2	C	30	-
GET 499	SIWES III: Students Work Experience Scheme	8	C	24 Weeks	
EDSU-TCH 410	Chemical Engineering Laboratory II	2	C	-	60
EDSU-TCH 411	Transport Phenomena III	3	C	45	-
EDSU-TCH 412	Chemical Engineering Thermodynamics II	3	C	45	-
EDSU-TCH 413	Separation Process II	3	C	45	-
EDSU-TCH 414	Particle Technology	2	C	30	-
EDSU-ENT 421	Entrepreneurship Development	1	C	15	-
	Total	**27**			

500 LEVEL

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
TCH 501	Plant Design II	4	C	15	135
TCH 555	Chemical Engineering	4	C	-	180

	Research Project				
EDSU-TCH 511	Environmental Engineering	2	C	30	-
EDSU-TCH 512	Process Optimization	2	C	30	-
EDSU-TCH 513	Technology of Glass Production	2	C	30	-
EDSU-TCH 514	Separation Process III	2	C	30	-
EDSU-TCH 515	Reservoir Engineering	2	E	30	-
EDSU-TCH 517	Biotechnology	2	C	30	-
EDSU-TCH 523	Solid Mineral Processing	2	E	30	-
EDSU- TCH 524	Chemical Process Industries (Sugar, Detergent, Pulp & Paper, Paint, Petrochemical & Cement)	3	C	45	-
EDSU-TCH 525	Corrosion Engineering	2	E	30	-
EDSU-TCH 526	Polymer Engineering	2	E	30	-
EDSU- TCH 529	Technology of Fossil Fuel Processing	2	C	30	45
	Total	**30**			

NOTE: TCH 555 – Chemical Engineering Research Project shall be taken/taught over the two semesters of the final year.

10.0 COURSE CONTENTS AND LEARNING OUTCOMES

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

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

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

Course Contents

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

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

History, evolution and philosophy of science. engineering and technology. The 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.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;

3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

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

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

Learning Outcomes

At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point,
test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which
could be acidic/basic/ neutral organic compounds.

Course Contents

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

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

Learning Outcomes

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

1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents

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

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes

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

1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

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

Learning Outcomes

At the end of the course, students should be able to:
1. solve some vectors in addition and multiplication;
2. calculate force and momentum; and
3. solve differentiation and integration of vectors.

Course Contents

(Pre-requisite –MTH 101)

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

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

Learning Outcomes

On completion, the students should be able to:
1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;

5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

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

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

Learning Outcomes

On completion, the students should be able to:
1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and

6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

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

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

Learning Outcomes

On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

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

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

Learning Outcomes

On completion, the student should be able to:

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

Course Contents

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

TCH 101: Introduction to Chemical Engineering (2 Units C: LH 30)

Learning Outcomes

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

1. appreciate the role of the chemical engineer in the industry and society;
2. be able to use basic engineering units in both SI and imperial systems in solving problems;
3. develop problem solving skills and engage more effectively in solving different types of problems;
4. formulate and solve basic steady state material balances for single units; and
5. perform stoichiometry analysis for chemical conversions and apply it to material balance.

Course Contents

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.

EDSU-TCH 103: Elementary Mathematics III (Vectors, Coordinate Geometry & Dynamics) (3 Units C: LH 45)

Senate-approved relevance

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

Overview

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

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

Objectives

The objectives of the course are to:

1. explain types of vectors, geometrical representation of vectors, components of vectors
2. illustrate linear dependence of vectors and its simple application

3. demonstrate dimensional coordinates systems,
4. analyze equation of circle, tangent and normal to a circle.
5. describe the properties of parabola, ellipse, hyperbola, straight lines and planes in space;
6. describe the components of velocity and acceleration of a particle moving in a plane.
7. describe force, momentum, laws of motion under gravity, projectiles, resisted vertical motion, angular momentum and simple harmonic motion
8. describe elastic string, simple pendulum, impulse.
9. explain the impact of two smooth spheres and of a sphere on a smooth surface

Learning outcomes

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

1. list at least two types of vectors, geometrical representation of vectors, components of vectors
2. explain linear dependence of vectors and its simple applications
3. describe dimensional coordinates systems,
4. explain equation of circle, tangent and normal to a circle.
5. explain the properties of parabola, ellipse, hyperbola, straight lines and planes in space;
6. describe the components of velocity and acceleration of a particle moving in a plane.
7. explain force, momentum, laws of motion under gravity, projectiles, resisted vertical motion, angular momentum and simple harmonic motion
8. explain elastic string, simple pendulum, impulse.
9. describe the impact of two smooth spheres and of a sphere on a smooth surface

Course contents

Types of vectors: points, line and relative vectors. Geometrical representation of vectors in 1-3 dimension. Addition of vectors. Multiplication of vector by a scalar. Components of vectors in 1-3 dimensions. Direction cosines. Linear independence of vectors. Point of division of a line. Scalar product of two vectors. Vector products of two vectors. Simple applications of scalar and vector products of two vectors. Two-dimensional coordinate geometry. Straight lines and angle between two lines. Distance between points. Equation of circle, tangent and normal to a circle. Properties of parabola ellipse. Properties of hyperbola straight lines. Properties of planes in space. Direction cosines. Angle between lines and planes. Distance of a point from a plane. Components of velocity and acceleration of a particle moving in a plane. Force. Momentum. Laws of motion under gravity. Projectiles. Resisted vertical motion. Angular momentum. Simple harmonic motion. Elastic string. Simple pendulum and impulse. Impact of two smooth spheres. Impact of a sphere on a smooth surface.

EDSU-TCH 104: Elementary Statistics (2 Units C: LH 30)

Senate-approved relevance

Training of high-quality graduates that are well skilled and knowledgeable in handling and analysing statistical data is in line with EDSU's mission to address African developmental challenges in producing graduates in chemical engineering.

Overview

Elementary statistics is a vital approach used in handling data obtained from different processes, operations and experiment in chemical engineering. It is designed to introduce and expose students to various statistical tools required in computing and analysing data. Also, to build the capacity of students in the area of data analysis formulating reinforced glass materials in the midst of abundance of untapped raw materials.

The importance of the course lies in meeting the need in achieving sustainable development goals (SDGs) numbers 1 and 2 in the areas of reducing poverty and zero hunger respectively. The objectives of the course, learning outcomes, and contents are provided to address this need.

Objectives

The objectives of the course are to:

1. explain measures of location and dispersion in simple and group data
2. explain exponential and elements of probability distribution
3. explain normal, binomial, Poisson, geometrics and negatives binomial

distributions
4. describe estimate and tests hypothesis concerning the parameters of distributions.
5. describe regression, correlation, and analysis of variable contingency table non-parametric inference.

Learning outcomes

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

1. describe measure of location and dispersion in simple and group data
2. analyze exponential and elements of probability distribution
3. describe normal, binomial, Poisson, geometrics and negatives binomial distributions
4. evaluate estimate and tests hypothesis concerning the parameters of distributions.
5. analyze regression, correlation, and analysis of variable contingency table non-parametric inference.

Course contents

Measures of location in simple data. Measures of location in group data. Dispersion in simply data. Dispersion in group data. Exponential probability distribution. Normal probability distribution. Binomial probability distribution. Poisson probability distribution. Geometrics. Negatives binomial distributions. Estimations. Tests of hypothesis. Regression. Correlation. Analysis of variables. Contingency table. Non-parametric inference

200 Level

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

Learning Outcomes

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

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;

4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

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

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

Learning Outcomes

At the end of this course, students should be able to:
1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

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

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

Learning Outcomes

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

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

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

Course Contents

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

Learning Outcomes

At the end of this course, the students should be able to:
1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs, etc;

6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications

Course Contents

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

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes

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

1. describe basic concepts of thermodynamics, quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e., evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e., organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e., describe steady-flow open system, apply the first law of thermodynamics to

the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

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

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

Learning Outcomes

At the end of the course, the students should be able to:
1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;

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

Course Contents

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

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

Learning Outcomes

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

7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

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

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

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

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and

6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents

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

Learning Outcomes

SIWES I should provide opportunity for the students to:

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

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, (8-10 weeks during the long vacation following 200 level).

TCH 201: Chemical Engineering Fundamentals (3 Units C: LH 45)

Learning Outcomes

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

1. formulate and solve closed steady state material balances on multi-stage systems with and without a recycle and purge;
2. formulate and solve closed steady state Material balances on multi-stage systems that include single and multiple chemical reactions;
3. formulate and solve closed steady state material balances on multi-stage systems that include complete and incomplete conversions;
4. formulate and solve problems involving species and elements for reacting and non-reacting systems;
5. formulate and solve energy balances; and
6. formulate and solve combined material and energy balances.

Course Contents

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 202: Material Science (3 Units E: LH 45)

Learning outcome

On completion students should be able to:

1. explain the basic concepts and mechanism of atomic structure, configuration, inter-atomic bonding, crystals and microstructure;
2. explain/discuss the relationship between structure and properties of materials;

3. explain the characteristics of phase diagrams and phase transformations of solid solutions (alloys);
4. determine the components and compositions of phase diagrams and phase transformations of solid solutions (alloys);
5. discuss the different types, causes and effects of corrosion and methods of its prevention and mitigation; and
6. discuss the basic principles of nanotechnology, nanomaterials and engineering applications.

Course Contents

Introduction to electronic configuration, atomic structures, inter-atomic bonding mechanisms, crystal and microstructure. Relationships between structure and properties of metals, alloys, ceramics and plastics. 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, nanomaterials and engineering applications.

TCH 206: Statistics for Chemical Engineers (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
1. construct appropriate graphical displays of data and understand the role of such displays in data analysis;
2. perform statistical inference tasks using software and understand the calculations involved in such tasks and be aware of assumptions necessary for the validity of results;
3. use and interpret statistical software package such as MINITAB, Design Expert to summarise and analyse industry data;
4. make appropriate conclusions based on experimental results;
5. plan and execute an experimental program to determine the performance of a chemical engineering system;
6. evaluate the accuracy of the measurements taken; and
7. communicate the results of the investigation in a number of ways.

Course Contents

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.

EDSU-TCH 226: Strength of Materials (2 Units C: LH 15; PH 45)

Senate-approved relevance

Training of high-quality graduates that are well skilled and knowledgeable in the strength of materials to be used for any engineering operation in Nigeria is in line with EDSU's mission to address African developmental challenges in producing graduates in chemical engineering.

Overview

Strength of material is a vital approach used to decrease and reduce the rate at which material and infrastructural development, fails. Manufacturing, production and Housing sectors need materials with known and reliable strength to be used in their facility. This highlights the importance of preparing students in chemical engineering with the knowledge and skills on how to harness the knowledge of strength of materials to all production sectors.

Therefore, this course is designed to introduce and expose students to various segments of strength of materials and to educate them on how to design and analysis the strength of various production facilities. The importance of the course lies in meeting the need in achieving sustainable development goals (SDGs) numbers 1 and 2 in the areas of reducing poverty and zero hunger respectively. The objectives of the course, learning outcomes, and contents are provided to address this need.

Objectives

The objectives of the course are to:

1. describe forces of equilibrium via free body diagram in a given structural member
2. explain the notion of stress – normal stress/strain, shear stress/strain and bearing stresses.
3. distinguish between axial, uniaxial, biaxial, plane stress and strain, principal stresses/strain and maximum shear stress.
4. analyze the deformation of axially loaded members, composite bars, and indeterminate structural member.
5. explain different application of torsion in engineering.

Learning outcomes

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

1. explain forces of equilibrium via free body diagram in a given structural member
2. describe the notion of stress – normal stress/strain, shear stress/strain and bearing stresses.
3. explain the difference between axial, uniaxial, biaxial, plane stress and strain, principal stresses/strain and maximum shear stress.
4. describe the deformation of axially loaded members, composite bars, and indeterminate structural member.
5. describe at least five different applications of torsion in engineering.

Course contents

Force equilibrium. Free body diagrams. Stress. Strain. Tensile test. Young modulus. Strength factors. Axially loaded bars. Composite bars. Temperature stresses. Simple indeterminate problems. Hoop stresses in cylinders. Hoop stresses in rings. Bending moment. Shear force for simple cases. Axial force for simple cases. Simple torsion and application

300 Level

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

Learning Outcomes

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

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

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active 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 306: Renewable Energy Systems and Technology (3 units C: LH 30 PH 45)

Learning Outcomes

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

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

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, 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; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

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

Learning Outcomes

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

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

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and 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 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes

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

1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

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

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e., 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3

months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits
include:

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

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solid works: software capabilities, design methodologies and applications. Basics part modelling: sketching with 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 301: Transfer Processes I (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of the course, students should be able to:
1. derive the heat diffusion equation and use it to predict temperature profiles across solid bodies transferring heat by conduction;
2. derive equations of heat transfer by convection and use them to predict the rate of heat loss under steady state natural and forced convection;

3. derive the equations of heat loss by radiation, and use them to predict the rate of heat loss under steady state conditions;
4. perform a procedural design of a heat exchanger for defined process requirements;
5. derive equations of mass transfer by molecular diffusion and use these to predict the flow rates and composition of output streams from a mass transfer operation under steady state conditions;
6. determine the performance and size of a given heat exchanger using different methods; and
7. perform pressure drop calculations and procedural design of different heat exchangers according to defined process requirements.

Course Contents

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. Kirchoff'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 Multi-pass 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 302: Chemical Engineering Thermodynamics I (2 Units C: LH 30)

Learning outcomes

At the end of this course, the students should be able to:
1. perform calculations for various heat effects on industrial reactions as functions of temperature and with or without phase change;
2. use enthalpy-concentration and related diagrams in the analysis of heat effect on industrial reactions;
3. perform calculations of equilibrium constants of reversible reactions; and

4. perform calculations on the effect of temperature and pressure on equilibrium constants and conversions for gas phase, liquid phase and heterogeneous reactions.

Course Contents

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 303: Separation Processes I (2 Units E: LH 15; PH 45)

Learning outcomes

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

1. identify, analyze and solve engineering problems involving phase separation;
2. estimate stage requirements for absorption, stripping, and liquid-liquid extraction systems; and
3. estimate the number of stages, feed plate, product rates, reflux ratios for binary distillation systems using Mccabe-Thiele, Ponchon-Savarit methods.

Course Contents

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 304: Process Instrumentation (2 Units E: LH 30)

Learning Outcomes

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

1. explain the principles of various flow, temperature, pressure and liquid level measurements;
2. explain the principles of some analytical instruments use in physical and chemical characterisation of materials;
3. identify appropriate instruments applicable for particular characterisation; and
4. interpret and analyse data obtained from analytical instruments.

Course Contents

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 305: Chemical Engineering Laboratory I (1 Unit C: PH 45)

Learning Outcomes

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

1. locate (or identify) relevant literature sources to support/contradict theoretical arguments, and to find data;
2. demonstrate theoretical principles by means of experiments;
3. propose theoretical models of experimental data; or
4. evaluate the accuracy of prescribed theoretical models; and
5. communicate (or describe) technical information and arguments in a professional manner.

Course Contents

Laboratory experiments in transport phenomena. Kinetics and separation process

TCH 307: Biochemical Engineering (2 Units C: LH 30)

Learning outcomes

At the end of this course, the students should be able to:
1. explain the basic concepts of macromolecules and their building blocks, and their relevance to chemical engineering;
2. interpret the fundamental of microbial growth, the principles of enzyme and cell kinetics;
3. calculate cell growth, and enzyme kinetics; and
4. perform mass balance on cell and enzyme systems

Course Contents

Introduction to microbiology and biochemistry. Classification and growth characteristics of micro-organisms. Enzymes Engineering: including enzyme kinetics, aerobic and anaerobic respirations, metabolic pathways, cell growth kinetics and models

TCH 308: Numerical Methods in Chemical Engineering (2 Units C: LH 30)

Learning outcomes

At the end of this course, the students should be able to:
1. apply numerical method techniques to solve problems arising from heat and mass transfer, chemical reactions, thermodynamics, fluid mechanics and molecular simulations;
2. apply numerical method techniques to solve different categories of mathematical equations;
3. apply numerical methods such as Navier-Stokes, Runge Kutta, Newton-Raphson, Taylor's series etc to solve ODES and PDES; and
4. perform numerical integrations and differentiation.

Course Contents

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.

EDSU-TCH 315: Chemical Engineering Analysis (2 Units C: LH 30)

Senate-approved relevance

This course trains EDSU chemical engineering students to apply mathematical principles to chemical engineering problems derived from material and energy balance. Relevance is seen in the EDSU graduates being able to interpret real-life chemical engineering and production data problems and convert them into simple mathematical representations solvable using appropriate mathematical steps and essential mathematical software. This will help to link their theoretical mathematical knowledge to practical issues while expanding their understanding of chemical engineering problems.

Overview

Material and Energy Balances form the foundation for nearly all future chemical engineering courses and analyses. Accounting for mass and energy is akin to "chemical accounting." In this course, we will learn how to solve the balances that govern practical systems in which mass and energy are exchanged. This analysis includes experimental designs and reactive and nonreactive chemical engineering systems. Overall, this course will introduce the principles and calculation techniques used in the field of Chemical Engineering and give exposure to the various areas and facets of current Chemical Engineering research.

This comprehensive practical-based course contains many current engineering examples from all engineering disciplines. The focus is on critical considerations in analyzing a chemical engineering problem, designing a data-based experiment, generating model equations for the problem, and solving the problems using several means. We will examine how engineering activities can positively and negatively impact the environment. This course is also highly team-based, with homework and projects.

Objectives

The objectives of the course are to:

1. explain differential equations; O.D.E., P.D.E. and Higher order differentials
2. describe basic Ordinary and Partial D.E. questions
3. develop differential equations and chemical models from real-life problems
4. describe the use Matlab for solving differential equations and ANOVA for statistical solutions to data problems
5. develop efficient methods of experimental design through exercise problems and taught experiments

Learning outcomes

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

1. describe differential equations; O.D.E., P.D.E. and Higher order differentials
2. explain basic Ordinary and Partial D.E. questions.
3. apply the development of differential equations and chemical models to real-life problems
4. apply MATLAB for solving differential equations and ANOVA for statistical solutions to data problems
5. apply efficient methods of experimental design through exercise problems and taught experiments.

Course contents

Introduction to ordinary differential equations. and Introduction to partial differential equations. Linear differential equations. Non-Linear differential equations. Homogenous equations. Bernoulli differential equation. Formulation of mathematical equations for Chemical Engineering operations. Formulation of mathematical equations and their numerical solutions in Chemical Engineering. Applied ordinary differential equations. Applied partial differential equations. Introduction to finite difference method. Solution of differential equations using MATLAB. Types of observations in statistics. Analysis of variance. Tests of significance. Regression analysis. Design of experiments.

EDSU-TCH 316: Chemical Reaction Kinetics (2 Units C: LH 30)

Senate-approved relevance

This course trains EDSU chemical engineering students to design chemical reactors. Relevance is seen in the EDSU graduates' ability to identify essential chemical reactions used in the chemical industry., determine the rate of reactions and provide sustainable catalysts usable for cheaper and sustainable productions. Reaction and catalysis are critical technology in the sustainable chemical process industry, energy production, and environmental processes, and this course would solidify students' seamless transition into the industry.

Overview

Chemical reactions occur in different phases, including the gas phase, in solutions with various solvents, between interfaces including gas-solid and liquid-solid, and other interfaces in solid and liquid states. Chemical reaction kinetics includes investigations of how experimental conditions influence the speed of a chemical reaction and yield information about the reaction's mechanism and transition states, as well as the construction of mathematical models that can describe a chemical reaction's characteristics. Therefore, this course aims to establish fundamental chemical engineering knowledge in reaction kinetics for students. The system introduces essential principles and methods of heterogeneous and homogeneous reactions and catalysis.

Objectives

The objectives of this course are to:

1. explain chemical reactions and the types of reactions
2. describe reaction rates under varying conditions of concentration and time
3. classify reactions into homogenous and heterogenous with their peculiar characteristics
4. derive rate law and generate rate expressions in their different orders and units
5. explain reaction cycles in homogeneous transition metal complex catalysis

6. describe chemisorption and kinetic data in the calculation of reaction rates and specific reaction rate
7. explain graphical methods in solving chemical kinetics problems relating to the influencing factors.

Learning outcomes

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

1. describe chemical reactions and mention two types of reactions
2. explain reaction rates under varying conditions of concentration and time
3. describe the classification of reactions into homogenous and heterogenous with their peculiar characteristics
4. apply rate law and generate rate expressions in their different orders and units
5. describe reaction cycles in homogeneous transition metal complex catalysis
6. apply chemisorption and kinetic data to calculate reaction rates and specific reaction rate
7. apply graphical methods in solving chemical kinetics problems relating to the influencing factors.

Course contents

Classification and types of chemical reactions. Chemical reaction rate. Rate expressions. Analysis of experimental kinetics data. Integral analysis. Differential analysis. Elementary homogeneous reactions. Non-elementary homogeneous reactions. Molecularity. Reaction order. Rate constant. Temperature dependency theories. Activation energy. Interpretation of batch reactor data. Graphical treatment of complex kinetics. Constant volume batch reactor. Catalysis. Chain reactions. Kinetics of homogeneous catalytic reactions. Kinetics of fluid–solid (heterogeneous) catalytic reactions. Interpretation of batch reaction data. Photochemistry. Absorption of gases on solids. Application to gas chromatography.

EDSU-TCH 317: Transport Phenomenon II (2 Units C: LH 30)

Senate-approved relevance

This course trains EDSU chemical engineering students to understand, predict and determine the movement of fluids and other quantities in pipes and conduits within the industry. Relevance is seen in the EDSU graduates' ability to anticipate and solve transportation problems within any production industry while quickly analyzing and determining the cause of underlying issues.

Overview

Transportation phenomena is divided into three parts: the transfer of mass, momentum, and heat. Fluid dynamics involve the transport of momentum, heat transfer deals with energy transport, and mass transfer is concerned with the mass transport of various chemical species. This transfer occurs in all life spheres, from household activities to industrial processes.

This course advances the fundamentals of material, momentum and energy transfer. Emphasis is placed on the theory and analysis of diffusion, convection and interphase transport of material in laminar and turbulent streams and their similarities. Chemical engineering applications are found in engineering and environmental transport processes, and the modelling of complex processes is considered.

Objectives

The objectives of this course are to:

1. explain different types of fluids, their nature, and properties
2. describe compressible flow of materials and energy under varying surfaces
3. explain the velocity distribution of fluids under the variable condition of materials and surfaces
4. explain the derivation of mathematical correlations (Reynolds, Prandtl, Nusselt, etc.) and analogies in transfer processes
5. describe heat, mass, and momentum transfer using mathematical formulas and differential equations
6. describe heat exchangers
7. explain the diffusion of materials in solids, liquids, and gases.

Learning outcomes

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

1. describe at least two types of fluids, their nature, and properties
2. explain compressible flow of materials and energy under varying surfaces
3. describe velocity distribution of fluids under the variable condition of materials and surfaces
4. describe mathematical correlations (Reynolds, Prandtl, Nusselt, etc.) and analogies in transfer processes
5. explain heat, mass, and momentum transfer using mathematical formulas and differential equations
6. explain heat exchangers
7. describe the diffusion of materials in solids, liquids, and gases.

Course contents

Compressible flow. Non-Newtonian Fluids. Velocity distributions with single independent variables. Velocity distributions with multiple independent variables. Concepts of heat transfer by convection. Natural convection. Forced convection. Analogies between the transfer of momentum and heat. Reynold's analogy. Prandtl analogy. Colburn's analogy. Radiation. Mechanism of radiative heat transfer. Heat exchange between radiating surfaces. Unsteady state conduction. Free convection heat transfer. Forced convection heat transfer. Determination of heat transfer coefficient. Application to the design of heat exchangers. Mass transfer coefficient. Diffusion in solids.

EDSU-ENT 321: Entrepreneurial Skills (1 Unit C: PH 45)

Senate- approved relevance

The training of high-quality graduates who are equipped with the knowledge of channelling their creativity into creating productive and innovative things that can contribute significantly to the current competitive world at large and particularly Nigeria is of immense relevance to Edo State University. This is important as it will lead to the production of graduates with innovative, analytical, and logical reasoning.

Overview

Entrepreneurial skills experiments are a research method by which students create controllable environments to test hypotheses.

This course advances the practical aspects of Soap/Detergent, Toothbrush, and Toothpaste making. Photography. Brick making. Rope making. Brewing. Glassware production/Ceramic production. Paper production. Water treatment/conditioning/packaging. Food processing/preservation/packaging. Metal fabrication. Tanning industry. Vegetable oil extraction. Farming; Fisheries/aquaculture. Plastic making. Refrigeration/Air-conditioning. Carving. Weaving. Bakery. Tailoring. Printing. Carpentry. Interior Decoration. Animal husbandry

Learning objectives

The learning objectives of this course are to:

1. define the concepts and profitability of entrepreneurial skills.
2. develop high entrepreneurial potential in students.
3. describe the key requirements for entrepreneurial skills
4. analyze the various possible business ideas open to students.
5. engage in practical activities on various entrepreneurial skills

Learning Outcomes:

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

1. explain at least two concepts and profitability of entrepreneurial skills
2. apply the entrepreneurial potential in setting up a business
3. outline five key requirements for the entrepreneurial skills
4. explain one possible business idea.
5. showcase the product from the practical activities their various entrepreneurial skills for exhibition

Course Contents

Soap/Detergent, Toothbrush, and Toothpaste making. Photography. Brick making. Rope making. Brewing. Glassware production/Ceramic production. Paper production. Water treatment/conditioning/packaging. Food processing/preservation/packaging. Metal fabrication. Tanning industry. Vegetable oil extraction. Farming; Fisheries/aquaculture. Plastic making. Refrigeration/Air-conditioning. Carving. Weaving. Bakery.

Tailoring. Printing. Carpentry. Interior Decoration. Animal husbandry. Case Study Methodology applied to the development and administration of Cases that bring out key issues of the business environment, start-up, pains and gains of growth of businesses, etc. with particular reference to Nigerian businesses. Experience sharing by business actors in the economy with students during Case presentations.

400 Level

TCH 401: Chemical Product Design (3 Units C: LH 15; PH 90)

Learning Outcomes

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

1. identify a chemical process or product that is of relevance and of value that will involve application of student knowledge of chemical engineering principles;
2. develop a strategy for the design and production of this process/product including milestones;
3. develop the project budget and market analysis of the process/product;
4. write a proposal for the development/production of the process or product;
5. apply principles of starting up a chemical engineering business successfully;
6. Package the product for market where possible; and
7. Present process orally and in writing.

Course Contents

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 startups.

TCH 402: Chemical Reaction Engineering I (3 Units E: LH 45)

Learning Outcomes

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

1. calculate conversion in batch and flow systems;
2. size single batch, continuous-stirred tank, and plug flow reactors;
3. size real reactors in different flow regimes, packed bed reactors catalytic reactors and unsteady state reactors;
4. identify and determine the parameters in kinetic rate expressions for homogeneous reactions;
5. maximise product selectivity for systems involving multiple reactions;
6. use residence time distributions to find conversions for non-ideal mixing; and
7. use computer software packages to assist in sizing reactors.

Course Contents

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 404: Plant Design and Economics (3 Units E: LH 45)

Learning Outcomes

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

1. calculate stream data and present on a process flow-sheet from process descriptions;
2. explain the general principles of design, the techniques specific to particular products and processes and the characteristics of engineering materials and components;
3. prepare and present findings of engineering design tasks;
4. plan and produce process flow sheet for a specified industry or product;
5. perform mechanical design of process units and piping;

6. perform basic costing and economic evaluation of process units and systems; and
7. use CAD software to perform design activities.

Course Contents

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 405: Process Control (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be albe to:
1. explain the importance of process control in chemical engineering industry and classify chemical process variables;
2. solve first order and second order ODE's analytically and using Laplace transform;
3. determine the transfer function of chemical processes; and
4. determine the stability of chemical processes from their transfer function.

Course Contents

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

TCH 405: Process Modelling and Simulation (2 Units C: LH 30)

Learning Outcomes

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

1. generate and solve mathematical models involving chemical process systems such as transfer processes, separation processes, chemical reactions and thermodynamics;
2. use appropriate software to simulate various aspects of process systems including but not limited to flow sheets, vessels, piping, instrumentations, etc.;
3. use appropriate software to simulate material and energy balances for process plants; and
4. use appropriate software to simulate and solve process models.

Course Contents

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.

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:
1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly, and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On the job experience in industry chosen for practical working experience but not necessarily limited to the student's major (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 an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

EDSU-TCH 410: Chemical Engineering Laboratory II (2 Units C: PH 60)

Senate-approved relevance

This course trains EDSU chemical engineering students to perform primary fundamental separation, transport phenomena, and thermodynamics experiments. Relevance is seen in the chemical engineering graduates' ability to design experimental studies, follow procedures, achieve experimental results, interpret them, and compare them with industry-acceptable standards.

Overview

Chemical Engineering Laboratory experiments are a research method by which students create controllable environments to test hypotheses. This course advances the practical aspects of thermodynamics, separation process, and transportation phenomena. Chemical engineering applications are found in industrial manufacturing processes, refining, water treatment, and other chemical-related industries.

Objectives

The objectives of this course are to:

1. describe laboratory etiquettes and experimental conditions
2. explain the balance between theoretical courses (transport phenomenon, separation process, and thermodynamics) and practical processes
3. describe experimental procedures
4. describe experimental results with support
5. explain technical report writing, suitable referencing styles, and the use of referencing software

Learning outcomes

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

1. identify laboratory etiquettes and experimental conditions
2. describe the balance between theoretical courses (transport phenomenon, separation process, and thermodynamics) and practical processes
3. apply experimental procedures
4. explain experimental results with support
5. apply technical report writing skills, suitable referencing styles, and referencing software

Course contents

Determination of particle Size distribution. Studies of the settling rate of solid (sedimentation). Experimental studies of fluidization of solid and determination of minimum fluidization. Liquid – Liquid Equilibrium studies for the system of Ethanol, Benzene and Water. Determination of overall heat transfer coefficient and area of a shell and tube heat exchanger. Determination of overall heat transfer coefficient of a tubular heat exchanger. Determination of drying characteristics of solid in batch dryer. Studies of the diffusivity of acetone in air. Determination of the drag coefficient for Spheres. Determination of the mean values of solid sampling. Determination of heat transfer area and heat coefficient of liquid. Determination of filtration area of a filter press and the constant. Determination of the isotherm of adsorption of acetic acid from water onto charcoal. Determination of the heat of solution of benzoic acid in water from solubility measurements. Kinetic studies of the hydrolysis of methyl acetate catalyzed by hydrochloric acid. Determination of the rate constant of the hydrolysis of ethyl acetate with sodium hydroxide.

Determination of the saponification value of a given sample of oil. Determination of velocity constant of a batch first order reaction. Determination of velocity constant of a batch second order reaction. Determination of the velocity constant of a pseudo first-order reaction of potassium persulphate and potassium iodide. Kinetic studies of the saponification of ethyl acetate and sodium hydroxide in a combined reactor in series.

EDSU-TCH 411: Transport Phenomena III (3 Units C: LH 45)

Senate-approved relevance

This course trains EDSU chemical engineering students to understand the simultaneous diffusion of fluids and matter within an environment. It teaches the use of software in the development of heat, mass, and momentum transfer operations. Relevance will be seen in the chemical engineering graduates' ability to use their understanding of the simultaneous transfer process to maximize the movement of materials across boundaries within a household or an industry.

Overview

Transportation phenomena can be studied at the microscopic and macroscopic levels involving transport problems at wall boundaries. Also, the movement of heat, mass, and momentum never occurs individually; instead, they almost always co-occur. This transfer, which occurs both in the home and in the open, can be studied to processes.

This course advances the fundamentals of material, momentum and energy transfer. Emphasis is placed on the analysis of material diffusion with chemical reactions and the use of software to generate and solve mathematical models.

Objectives

The objectives of this study are to:

1. describe the flow of fluids (Newtonian and non-Newtonian) fluids at solid boundaries using the boundary layer theory
2. explain boundary conditions using the Navier-Stokes equation and the Euler equation

3. describe the mass transfer problems taking place within a chemical reaction (across several films, i.e., from the liquid phases to the bulk liquids and/or gas)
4. explain the macroscopic considerations in simultaneous diffusional processes (simultaneous heat and mass transfer equations)
5. describe the use of ANSYS to model heat, mass, and momentum transfer conditions.

Learning outcomes

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

1. explain the flow of fluids (Newtonian and non-Newtonian) fluids at solid boundaries using the boundary layer theory;
2. describe boundary conditions using the Navier-Stokes equation and the Euler equation;
3. explain mass transfer problems taking place within a chemical reaction (across several films, i.e., from the liquid phases to the bulk liquids and/or gas);
4. describe the macroscopic considerations in simultaneous diffusional processes (simultaneous heat and mass transfer equations);
5. apply ANSYS to model heat, mass, and momentum transfer conditions.

Course contents

Boundary layer theory. Turbulent fluid flow. Navier-Stokes equations. Universal velocity profile. Condensation. Boiling. Eddy diffusion. Theories of mass transfer. Mass transfer with chemical reaction. Simultaneous mass transfer. Simultaneous heat transfer. Interphase mass transfer. Description of ANSYS fluent software. Application of ANSYS fluent software for modelling heat transfer. Application of ANSYS fluent software for modelling momentum transfer. Application of ANSYS fluent software for modelling mass transfer. Application of ANSYS fluent software for simulation of momentum, heat and mass transport.

EDSU-TCH 412: Chemical Engineering Thermodynamics II (3 Units C: LH 45)

Senate-approved relevance

This course trains EDSU chemical engineering students in the applications of thermodynamics as related to unit operations and unit processes. Relevance will be seen in the chemical engineering graduates' ability to utilize their knowledge of phases, chemical potential, fugacity, and phase equilibria to design or interpret thermodynamic models in individual unit operations used in industries within the university's locality and in Nigeria.

Overview

In chemical thermodynamics, when matter changes form (e.g., solid to liquids and to gas), a phase change is said to have occurred. These changes, which are a function of temperature, pressure, or composition of the components in a system, are best described using a Phase diagram. At certain times two phases can coexist under certain conditions called an equilibrium, and some laws guide the understanding of these particular phase systems.

Therefore, this course extends the basic thermodynamic principles of single phase closed systems to study open systems involving fluid mixtures. Topics covered would play a central role in unit operations and chemical reactor design.

Objectives

The objectives of this course are to:

1. explain the thermal dynamics of a solute and solvent dissolution (Solution thermodynamics)
2. describe phase changes and phases in equilibrium
3. explain Raoult's law and Henry's law as they relate to partial pressures of phase mixtures;
4. describe the concept of fugacity and the fugacity coefficient
5. explain the difference between a real system and an ideal system of gases and the laws guiding the relationship between both systems
6. explain the Vapour–Liquid Equilibrium (V.L.E.) data, interpret the necessary concept from the diagram, and solve problems relating to V.L.E

7. explain chemical potential related to chemical or electrochemical reactions and Gibbs free energy

Learning outcomes

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

1. describe thermal dynamics of a solute and solvent dissolution (Solution thermodynamics)
2. identify phase changes and phases in equilibrium
3. describe Raoult's law and Henry's law as they relate to partial pressures of phase mixtures;
4. explain the concept of fugacity and the fugacity coefficient
5. describe the difference between a real system and an ideal system of gases and the laws guiding the relationship between both systems
6. describe Vapour–Liquid Equilibrium (V.L.E.) data
7. describe chemical potential related to chemical or electrochemical reactions and Gibbs free energy

Course contents

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 and composition relationship of Fugacity. 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.

EDSU-TCH 413: Separation Process II (3 Units C: LH 45)

Senate-approved relevance

This course trains EDSU chemical engineering students to identify and solve separation problems relating to close temperature mixtures and liquid extraction and perform stage-wise separations as required in all industries.

Relevance is seen in the chemical engineering graduates' ability to use their professional understanding of the separation process to separate two or more essential mixtures without losing any material. Other relevance is found in industrial separations relevant to S.D.G. 6 and 11 within localities.

Overview

Separation processes are a core part of global chemical engineering, making up a large proportion of capital investment in plants, and are vital to economically producing valuable and safe products. A separation principle is usually based on a difference in component characteristics in a mixture which might involve only physical methods. However, many industrial separations involve difficult-to-identify differences, usually the basis of such separations.

This course builds on Separation process I and covers the principles and design of large-scale diffusional separation processes in equilibrium-stage, azeotropic mixtures, and mass transfer continuous-contact operations. Throughout, emphasis is placed on developing quantitative problem-solving skills essential to practicing graduates.

Objectives

The objectives of this course are to:

1. describe properties of mixture components
2. explain leaching, solvent extraction, azeotropic distillation, and gas absorption
3. describe at least three separation methodologies
4. explain stage-wise and continuous contact operations
5. describe at least three recent separation technologies

Learning outcomes

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

1. identify at least five properties of mixture components
2. explain leaching, solvent extraction, azeotropic distillation, and gas absorption
3. identify at least three separation methodologies
4. describe stage-wise and continuous contact operations
5. identify at least three recent separation technologies

Course contents

Physical mechanism of drying. Drying equilibria. Drying rate curve. Calculation of drying time from drying rate data. Classification of drying equipment. Meaning of evaporation. Theory of evaporation. Evaporation equilibrium. Application of evaporation. Single effect evaporation. Multiple effect evaporation. Crystallization: meaning. Solid-Liquid phase equilibrium in crystallization. Nucleation and crystal growth. Crystal size distribution. Batch crystallization. Melt crystallization. Humidification: meaning. Terminology and definition. Adiabatic saturation and wet bulb temperatures. Psychrometric chart and its use. Cooling tower distillation and calculation. Ion exchange. Reverse osmosis.

EDSU-TCH 414: Particle Technology (2 Units C: LH 30)

Senate-approved relevance

This course trains EDSU chemical engineering students to develop technologies for the flow, handling, and processing of particle systems critical to established and emerging sectors and then to transfer these technologies to industrial businesses within Nigeria. Relevance will be seen in the chemical engineering graduates' ability to conduct primary experimental research and train other industry professionals in the principles and expectations of materials being dealt with in their industries. Other relevance is found in industrial separations relevant to S.D.G. 3, 7, 11, 12, and 17 within localities.

Overview

Knowledge of the science of particulate materials (particle or powder technology) is indispensable to the process industries. During the design phase, problems with handling or processing powders are often ignored or overlooked. As a result, powder-related issues cause a lot of production stoppages. However, a simple understanding of this particle behaviour can reduce these processing issues, reducing downtime, quality control, and environmental emissions.

Therefore, this course provides a thorough introduction to particle technology and covers particle characterization, fluid mechanics, and the physics of particle flow. Throughout, emphasis is placed on developing quantitative problem-solving skills essential to practicing graduates.

Objectives

The objectives of this course are to:

1. explain at least five properties of particles and techniques to characterize particles
2. explain single and multi-scale particles and their effect on the particle properties
3. describe Newton and Stokes's law for modelling particle settling velocity
4. identify the fundamental particle and rheological properties affecting a manufacturing process in different industries.
5. describe analytical and computational methods to model and analyze particle processes in the industry.

Learning outcomes

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

1. describe at least three properties of particles and techniques to characterize particles
2. describe single and multi-scale particles and their effect on the particle properties
3. explain Newton and Stokes's law for modelling particle settling velocity
4. describe fundamental particles and rheological properties affecting a manufacturing process in different industries.
5. apply analytical and computational methods to model and analyze particle processes in the industry.

Course contents

Physical properties of particles. Particles in industrial processing. Theory of particle separation and grinding. Nanoparticles and principles of developing nanotechnology. Motion of particles in a fluid. Stoke's and Newton's Laws. Particles size reduction techniques. Screening and classification of particles. Modern methods of particle size measurement (microscopic, coutler-counter, X-ray etc). Flow of single fluid through packed beds. Calculation of pressure drop. Counter-current and co-current flow of fluid through packed columns. Flooding and loading rates. Filtration. Constant rate and constant-pressure filtration. Washing and drying of cakes. Selection of equipment. Fluidization: meaning. Types of fluidization. Calculation, factors influencing fluidization characteristics. Behaviours of bubbles. Heat and energy transfer. Chemical reactions in fluidized beds. Solid transport: meaning. Sedimentation. Flocculation. Introduction to powder technology.

EDSU-ENT 421: Entrepreneurship Development (1 Unit C: LH 15)

Senate- approved relevance

There is no market for vision, and turning the vision into a solution makes a real entrepreneur. One of the greatest challenges of entrepreneurs is staring-up. Having trained and equipped graduates with creative, productive, and innovative knowledge, a key to achieving the vision of Edo State University of graduating competitive graduates is the provision of the opportunity to put the knowledge to practice. One of the channels of achieving this is through entrepreneurial competition which is the main content of this course. This is important as it will help the students to take the step of putting their vision into solution provision, and source of capital for the winner.

Overview

Entrepreneurial development is a research method by which students create controllable environments to test hypotheses.

This course advances the practical aspects of models of wealth creation, requirements in preparing an innovative business plan, sustainability strategies, managing business growth, time, and self-management, Students are to prepare and defend a competitive business idea/plan where the winner gets an award.

Learning objectives

The learning objectives of this course are to:

1. explain the various models of wealth creation
2. analyze a profitable and innovative business idea.
3. examine the capacity of the student to develop a business plan to start a business.
4. demonstrate the preparation of a proposal on a remarkable and innovative business idea/plan in different fields of study.

Learning Outcomes:

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

1. explain at least one model of wealth creation
2. prepare a profitable and innovative business idea.
3. develop one business plan to start a business.
4. prepare a proposal on a remarkable and innovative business idea/plan in their field of study

Course Contents

Models of wealth creation. Requirements in preparing an innovative business plan. Sustainability strategies. Managing business growth. Managing business time. Self-management. Students are to prepare and defend a competitive business idea/plan where the winner gets an award.

500 Level

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

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

TCH 501: Plant Design II (4 Units C: LH 15; PH 135)

Learning Outcomes

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

1. analyse existing process and carry-out process retrofitting;
2. perform flowsheet of the operating principles of reacting, pumping & piping, plant control, and utilities systems and execute the design of the systems;
3. analyse product/process design options and produce flow diagrams to obtain most suitable option;
4. perform process design of some units;
5. plan, produce and implement process calculations using software;
6. prepare and present findings of engineering design tasks;
7. perform process economics and determine process profitability, carry-out safety and environmental studies; and
8. present final design orally and in writing.

Course Contents

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 555: Chemical Engineering Research Project (4 Units C: PH 180)

Learning Outcomes

Students will be able to:

1. identify the problem or hypothesis to research or tests;
2. identify resources and constraints;
3. identify the best option (Research method, process);
4. carry out research;
5. present data and conclusions according to the nature of research;
6. evaluate techniques and outcomes and suggest improvements; and
7. present the final report (orally and in writing).

Course Contents

Individual research projects under the supervision of an academic staff. Projects should focus on national and state industrial problems.

EDSU-TCH 511: Environmental Engineering (2 Units C: LH 30)

Senate-approved relevance

Training of high-quality graduates that are well skilled and knowledgeable in environmental pollution analysis and control for any engineering operation in Nigeria is in line with EDSU's mission to address African developmental challenges in producing graduates in chemical engineering.

Overview

Environmental Engineering is concerned with natural resource management, the use of water, environmental pollution and human health. It is the study of problems associated with soil, air and water pollution. An environmental engineer is responsible for improving the quality of the environment, and public health and developing solutions to minimize the degradation of natural resources. They devise ways to control pollution, treat wastewater, distribute safe drinking water, manage hazardous waste, etc.

Therefore, this course is developed to ensure that societal development and the use of water, land and air resources are sustainable. This will be achieved by managing these resources so that environmental pollution and degradation is minimized in line with sustainable development goals (SDGs) number 6

Objectives

The objectives of this course are to:

1. describe pollution and the environment
2. identify various types of air, water and land pollution and their effects on the environment
3. describe legislation relating to air, water and land pollution
4. explain the methods of controlling air, water and land pollutions in the environment
5. identify other types of pollution, like noise, thermal and nuclear and their treatment methods

Learning outcomes

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

1. explain pollution and the environment
2. describe at least three various types of air, water and land pollution and their effects on the environment
3. explain legislation relating to air, water and land pollution
4. describe at least three methods of controlling air, water and land pollutions in the environment
5. explain other types of pollution, like noise, thermal and nuclear and their treatment methods

Course contents

Pollution and the environment: definitions and inter-relationship. Natural and man-made pollution. Economics of pollution. Air pollution. Gaseous and particulate pollutions and their sources. Effects on weather vegetation materials and human health. Legislation relating to air pollution. Methods of control of gaseous emission and destruction. Cyclones. Inertia separators. Electrostatic precipitator bag filters. Wet washers. Dispersal from chimneys. Method of calculating chimney height. Flare stacks. Water pollution. River pollution by industrial effluent. Legislation and standards for effluent discharge. Impurities in natural water and their effects. Brief survey of ecology and the effects of effluent on the ecosystems. Treatment processes including precipitation flocculation coagulation, sedimentation, clarification and colour removal. Principles of biological treatment processes. Cost of treatment. Treatment for water re-use. Ion exchange cooling water treatment. Land pollution. Disposal of solid wastes by incinerator and dumping. Possible future trends including conversion of solid wastes into useful material or energy. Treatment of other types of pollution: noise, thermal and nuclear pollution.

EDSU-TCH 512: Process Optimization (2 Units C: LH 30)

Senate-approved relevance

Training of high-quality graduates that are well skilled and knowledgeable in Chemical Engineering process optimization and its relationship chemical process industries in Nigeria is in line with EDSU's mission to address African developmental challenges in producing graduates in chemical engineering.

Overview

This course is to introduce optimization techniques to chemical engineering students, with an emphasis on problems arising in Chemical Engineering applications. The course includes both linear and nonlinear programming problems.

The first portion of the course introduces maxima of functions through the use of calculus. The second portion describes unconstrained peak seeking methods. Other aspect of the course includes numerical optimization and constrained optimization techniques.

Objectives

The objectives of this course are to:

1. explain maxima of functions problems using calculus
2. describe unconstrained peak seeking methods for solving problems
3. describe single and multi-variable search techniques for solving problems
4. describe problem solving using constrained optimization techniques
5. describe linear programming problems
6. describe numerical optimization problems

Learning outcomes

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

1. apply calculus to solving maxima of functions problems
2. apply unconstrained peak seeking methods for solving problems
3. apply single and multi-variable search techniques for solving problems
4. apply constrained optimization techniques go solving problems
5. explain linear programming problems
6. explain numerical optimization problems

Course contents

Definition. Terminologies. Mathematical representation. Formulation of objective function. Static versus dynamic optimization. Unimodality. Convexity. Concavity. Characterization of stationary points. Contour plots. Equality and inequality constraints. Problems encountered in optimization. Maxima of functions through the use of calculus. Review of matrices and matrix algebra. Analytical techniques. Classical optimization theory. Necessary and sufficient conditions. Hessian matrix; determinant and eigenvalue analyses of Hessian matrix. Unconstrained one-dimensional optimization numerical methods. Interval of uncertainty. Line-Search Without Using Derivatives: Region-elimination methods. Sequential search. Dichotomous search. Golden-Section search. Fibonacci search. Polynomial approximation methods. Line-Search Using Derivatives: bisecting search; Newton, QuasiNewton, and Secant methods. Unconstrained multivariable optimization: use of line search in multidimensional search. Search using Derivatives: steepest descent; Newton, Quasi-Newton, Marquardt-Levenberg, and Broyden methods; Methods Using Conjugate Directions: method of Fletcher. Reeves constrained multivariable optimization. Linear

Programming (LP). Graphical solution. Slack and artificial variables. Simplex method. Sensitivity analysis. Duality in LP. Penalty Function Techniques. Lagrange Multiplier Method. Kuhn-Tucker conditions Optimization of staged and discrete processes. Dynamic Programming. Integer (IP) and Mixed Integer Programming (MIP: MILP, MINLP). Parameter estimation: Linear/Nonlinear Regression Use of optimization software; GAMS, MATLAB, PYTHON, Maple etc.

EDSU-TCH 513: Technology of Glass Production (2 Units C: LH 30)

Senate-approved relevance

Training of high-quality graduates that are well skilled and knowledgeable in the processing of dolomite, production of glass and reinforced glass materials in Nigeria is in line with EDSU's mission to address African developmental challenges in producing graduates in chemical engineering.

Overview

Glass process engineering is a vital approach used to increase and improve the material and infrastructural deficit for sustainable development. The major raw material for the production of glass is dolomite which is reading mined in Ikpeshi, a community around EDSU. Though, the ashes and small particles from the crushing do fly, but this can be curtailed by using appropriate methods. Glass is used for the following non-exhaustive list of products: Packaging (jars for food, bottles for drinks, flacon for cosmetics and pharmaceuticals), Tableware (drinking glasses, plate, cups, bowls), Housing and buildings (windows, facades, conservatory, insulation, reinforcement structures). This highlights the importance of preparing students in chemical engineering with the knowledge and skills on how to harness the abundant dolomite for the production of different glasses.

Therefore, this course is designed to introduce and expose students to various segments of glass production and utilization and to educate them on how to design, process and characterized different glass systems. Also, to build the capacity of students in the area of addressing inadequate infrastructures, by formulating reinforced glass materials in the midst of abundance of untapped raw materials.

The importance of the course lies in meeting the need in achieving sustainable development goals (SDGs) numbers 1, 2, and 11 in the areas of reducing poverty, zero hunger and sustainable communities/cities respectively. The objectives of the course, learning outcomes, and contents are provided to address this need.

Objectives

The objectives of this course are to:

1. explain the origin, sources and compositions of raw materials for glass production
2. describe the methods of processing raw materials and the different glass type
3. conduct different analysis on glass and the raw materials
4. conduct practical exercises on the factors that determine the performances of dolomite for glass production
5. describe the formulation, melting and characteristics of glasses
6. explain Nigeria's glass potential.
7. explain the prospects and challenges of glass production in Nigeria.
8. describe the future application of reinforced glass material.

Learning outcomes

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

1. describe the origin, sources and compositions of raw materials for glass production
2. explain at least two methods of processing raw materials and the different glass type
3. analyze glass and its raw materials
4. identify at least five factors that determine the performances of dolomite for glass production
5. explain the formulation, melting and characteristics of glasses
6. discuss Nigeria's glass potential.
7. describe the prospects and challenges of glass production in Nigeria.
8. explain the future application of reinforced glass material.

Course contents

Atomic-level structure of oxide glasses. Composition of glass forming systems. Properties of glass forming systems. Structure of glass forming systems. Relationship between compositions, properties, and structures of glass forming systems. Simple chemical rate processes. Temperaturedependent properties. Development of various glass types. Manufacturing methods of types of glass. Application and properties of flat purpose glass. Application and properties of fibre purpose glass. Application and properties of container purpose glass. Application and properties of chemical purpose glass. Application and properties of special purpose glass. Composition of glasses. Properties of glasses. Composition/property relationships of glasses. Nucleation-crystallization processes for glass-ceramics.

Minimum Academic Standards

Glass Blowing Laboratory; Ovens; Furnaces; Gas cylinders; Glass lathe; Crushers

EDSU-TCH 514: Separation Process III (2 Units C: LH 30)

Senate-approved relevance

Training of high-quality graduates that are well skilled and knowledgeable in chemical engineering separation processes in Nigeria is in line with EDSU's mission to address African developmental challenges in producing graduates in chemical engineering.

Overview

This course will empower the students with the fundamentals of separation processes in Chemical Engineering.

The course covers solvent extraction design aspect of separation process equipment such as distillation, absorption and membrane filtration.

Objectives

The objectives of this course are to:

1. describe equilibrium among phases
2. explain equilibrium stage concept, cascade of stages and stage efficiency
3. explain separation of components by binary distillation, absorption, stripping, extraction and leaching
4. explain the theory of mass transfer diffusion
5. explain absorption, extraction and adsorption of real problems

Learning outcomes

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

1. explain equilibrium among phases
2. describe equilibrium stage concept, cascade of stages and stage efficiency
3. describe separation of components by binary distillation, absorption, stripping, extraction and leaching
4. describe the theory of mass transfer diffusion
5. describe absorption, extraction and adsorption of real problems

Course contents

Solvent extraction. Extractive and azeotropic distillation. Multi-component gas absorption. Distillation of multi-component mixtures. Novel separation process: membrane filtration. Pattern of changes and computational approaches. Energy requirements of separation processes. Solution of separation processes. Optimal design of separation process. Operation of separation process. Leaching: meaning. Solid-liquid equilibria. Leaching equipment for batch operations. Leaching equipment for continuous operations. Calculation of number of stages. Leaching by percolation through stationary solid beds. Moving bed leaching. Counter current multiple contact (shank's system). Equipment for leaching operation. Multi stage continuous cross current leaching. Multi stage continuous counter current leaching. Stage calculations. Stage efficiency

EDSU-TCH 515: Reservoir Engineering (2 Units E: LH 30)

Senate-approved relevance

Training of high-quality graduates that are well skilled and knowledgeable in reservoir engineering in exploring and exploiting crude oil and natural gas in Nigeria is in line with EDSU's mission to address African developmental challenges in producing graduates in chemical engineering.

Overview

Reservoir engineering is a vital approach used to increase and improve the material and infrastructural deficit for sustainable development. This will prepare the students for the exploration and exploitation of crude oil and

natural gas. This highlights the importance of preparing students in chemical engineering with the knowledge and skills on how to harness the knowledge of oil and gas sectors of this country.
This course is designed to introduce and expose students to various segments reservoir engineering and to educate them on how to identify, explore, exploit and control the pollution of crude oil and gas deposit. The importance of the course lies in meeting the need in achieving sustainable development goals (SDGs) numbers 1, 2, 11 in 13 in the areas of poverty reduction, zero hunger, sustainable communities/cities, and climate action issues respectively. The objectives of the course, learning outcomes, and contents are provided to address this need.

Objectives

The objectives of this course are to:

1. explain reservoir engineering and petroleum geology
2. describe petroleum exploration and exploitation
3. explain physical principles of reservoir engineering. The appraisal of oil and gas fields.
4. interpret PVT fluid properties of oil. Calculation of stock Tank Oil. Initially in Place (STOIIP) Feed Utilization and equity determination of oil Initially in Place (OIIP).
5. evaluate recoverable resources: Moveable oil and calculation of Gas initially in place (GIIP). Pressure – depth plotting. Repeat Formation Tester (RFT). Appraisal testers
6. analyse material balance applied to oil field.
7. describe enhanced oil recovery by water/gas injection. Oil and gas well testing. Field development planning and executive.

Learning outcomes

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

1. describe reservoir engineering. petroleum geology
2. explain petroleum exploration and exploitation.
3. describe physical principles of reservoir engineering. The appraisal of oil and gas fields.

4. describe PVT fluid properties of oil. Calculation of stock Tank Oil. Initially in Place (STOIIP) Feed Utilization and equity determination of oil Initially in Place (OIIP).
5. interpret recoverable resources. Moveable oil. Calculation of Gas Initially in place (GIIP). Pressure – depth plotting. Repeat Formation Tester (RFT). Appraisal testers
6. describe material balance applied to oil field. The use of commercial software (Schlumberger Eclipse, Feteke, Petroleum Expert) for the computation of material balance
7. interpret enhanced oil recovery by water/gas injection. Oil and gas well testing. Field development planning and executive.

Course contents

Introduction to reservoir engineering. Petroleum geology. Petroleum exploration. Crude oil production. Pollution control. Natural gas production. Technical responsibilities of the reservoir engineering. Physical principles of reservoir engineering. Appraisal of oil and gas fields: meaning. PVT fluid properties of oil. Calculation of stock Tank Oil. Initially in Place (STOIIP). Feed Utilization of oil Initially in Place (STOIIP). Equity determination of oil initially in Place (STOIIP). Recoverable resources. Moveable oil. Calculation of Gas Initially in place (GIIP). Pressure – depth plotting. Repeat Formation Tester (RFT). Appraisal testers. Material Balance applied to oil field. Use of commercial software (Schlumberger Eclipse, Feteke, Petroleum Expert) for the computation of material balance. Enhanced oil recovery by water/gas injection. Oil and gas well testing. Field Development planning and executive.

EDSU-TCH 517: Biotechnology (2 Units C: LH 30)

Senate-approved relevance

Training of high-quality graduates that are well skilled and knowledgeable in biotechnological processes in Nigeria is in line with EDSU's mission to address African developmental challenges in producing graduates in chemical engineering.

Overview

Biotechnology is designed to immerse the student in the techniques, applications and societal issues that focus on Genetic Engineering, DNA Technology, and Cellular Engineering. The course will emphasize recombinant DNA technology and present numerous examples of products produced through biotechnology.

Nevertheless, where feasible, the students will be presented with a product and through lectures and open discussion, develop the science behind the product.

Objectives

The objectives of this course are to:

1. explain the basic concepts of molecular biology and methods used in the manipulation of nucleic acids to isolate and characterize genes.
2. describe how molecular tools are used to modify an organism.
3. identify the numerous benefits of molecular biology and its utilization in basic and applied sciences.
4. identify the regulatory and social issues surrounding biotechnology.
5. describe the application of biotechnology in fermentation: malting and brewing, and wine making enzymes in fermentation

Learning outcomes

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

1. describe the basic concepts of molecular biology and methods used in the manipulation of nucleic acids to isolate and characterize genes.
2. interpret how molecular tools are used to modify an organism.
3. explain at least five benefits of molecular biology and its utilization in basic and applied sciences.
4. interpret the regulatory and social issues surrounding biotechnology
5. explain the application of biotechnology in fermentation: malting and brewing, and wine making enzymes in fermentation

Course contents

Introductory Biotechnology. Introductory microbiology. Introduction to biochemistry. Definition and principles of biotechnology. Areas of application in biotechnology. Methods of genetic modification of prokaryotic organism to optimize biochemical characteristics and to stabilize cellular. Methods of genetic modification of eukaryotic organisms, to optimize biochemical characteristics and to stabilize cellular. Structure transformation transduction. Conjugation and protoplasm fusion. Natural DNA recombination. Advantages and method of induced phage virus bacterial plasmid or vector DNA mapping techniques. Present and future prospect of utilization of created gene pools is selected topics of application areas. Microbial enzyme technology. Bioreactor design. Practice of post-harvest technology. Agricultural waste recycling. Biotechnology application in fermentation processes. Substrates. The fermentation processes. Batch fermentation. Continuous fermentation. Malting and brewing. Wine making Enzymes in fermentation.

EDSU-TCH 523: Solid Mineral Processing (2 Units E: LH 30)

Senate-approved relevance

Training of high-quality graduates that are well skilled and knowledgeable in the processing of industrial solid minerals in Nigeria is in line with EDSU's mission to address African developmental challenges in producing graduates in chemical engineering.

Overview

An increasing demand for metals and other mineral products in today's growing global economy is being met with decreasing ore grades, requiring more efficient mineral extraction and recovery techniques. This course reviews the fundamental principles, conventions, and terminology of mineral processing and metallurgy. At the start of the course, students will learn how to assess the mineral properties utilized in separation of ore from gangue. The stages of processing are then examined in detail from initial classification, crushing, and grinding to dewatering and tailings disposal. The student is presented with an introduction to current operating issues and circuit design considerations, as well as the efficiency of different concentration approaches.

Students will gain understanding of the suitability of processing techniques for particular deposit types and individual commodities. The environmental implications and sustainability issues surrounding individual processing techniques will be discussed, as well as specific safety requirements.

Objectives

The objectives of this course are to:

1. explain the implications of mineralogical characteristics for mineral processing requirements
2. identify key sustainability issues in mineral processing
3. describe major classes of mineral processing equipment
4. describe basic flowsheets for physical separation processes of various industrial minerals and ore
5. describe froth flotation testing, crushing, grinding, screening and classification, and particle size analysis
6. describe how ore grade and recovery are calculated

Learning outcomes

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

1. describe the implications of mineralogical characteristics for mineral processing requirements
2. interpret key sustainability issues in mineral processing
3. interpret major classes of mineral processing equipment
4. explain basic flowsheets for physical separation processes of various industrial minerals and ore
5. demonstrate froth flotation testing, crushing, grinding, screening and classification, and particle size analysis
6. interpret ore grade and recovery calculation

Course contents

An overview of Nigeria mineral deposit. Introduction to mineral processing. Ore transportation. Ore storage. Methods of particle size measurement. Shape classification. Principles of comminution. Comminution theory. Crushing equipment. Grinding equipment. Screening. Classification. Principles of gravity concentration. Types of gravity concentration. Dense medium separation. Principles of froth flotation. Solid-liquid separation by thickening. Filtration. Drying. Solid-liquid separation equipment. Principles of magnetic separation. Principles of electrostatic separation. Hydrometallurgy. Methods of tailing disposal.

Contaminant control. Industrial minerals. Ore accounting. Ore control and simulation.

Minimum Academic Standards

Mineral analysis Laboratory: Crushing and milling equipment; sizing equipment; Concentration equipment

EDSU-TCH 524: Chemical Process Industries (Sugar, Detergent, Pulp & Paper, Paint, Petrochemical and Cement) (3 Units C: LH 45)

Senate-approved relevance

Training of high-quality graduates that are well skilled and knowledgeable in chemical process industries in Nigeria is in line with EDSU's mission to address African developmental challenges in producing graduates in chemical engineering.

Overview

Chemical process industries, is a course whose vital approach is used to increase and improve access to products of sugarcane, linear alkylbenzene, gypsum, petrochemical for sustainable development. The raw materials deposit can be found within and around Edo state. The importance of the products of sugarcane, linear alkylbenzene, limestone and gypsum etc. cannot be overemphasized in our everyday life. This highlights the importance of preparing students in chemical engineering with the knowledge and skills on how to harness the abundance raw material deposits in this region. Therefore, this course is designed to introduce and expose students to various sugar, petrochemical, cement, pulp and paper, and paint industries, their process and products.

Furthermore, this course will build the capacity of students in the area of sequestering CO_2, and addressing environmental pollution that may arise. The importance of the course lies in addressing the sustainable development goals (SDGs) numbers 1, 2, 11 and 13 which bothers on poverty reduction, zero hunger, sustainable communities/cities, and climate action issues, respectively.

Objectives

The objectives of this course are to:

1. describe the equipment and considerations of the process and operations involve in the manufacture of refined sugar from cane.
2. explain energy recovery.
3. describe production of detergents, paints, pulp and paper. Properties of their raw materials.
4. explain petroleum oil industry and its relevance to the petrochemical industry, Petrochemical precursors and products
5. explain the chemistry of cement and raw materials for the production of cement
6. explain sintering and the chemistry of sintering, justify the technology of the production of clinker and cement and identify the types of cement
7. explain hydration of cement and how it can be carried out
8. explain the technology of organic processes, hydrogenation, alkylation
9. identify requirements for optimum yields, production of paraffins; olefins and aromatics from petroleum, separation and purification techniques of reaction products from reactors,
10. explain the manufacture of styrene, alkylbenzene sulphonate and sodium alkylene sulphonate as detergent

Learning outcomes

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

1. identify the equipment and considerations of the process and operations involve in the manufacture of refined sugar from cane
2. describe energy recovery
3. explain production of detergents, paints, pulp and paper. Properties of their raw materials.
4. describe petroleum oil industry and its relevance to the petrochemical industry, Petrochemical precursors and products.
5. describe the chemistry of cement and raw materials for the production of cement
6. describe sintering and the chemistry of sintering, justify the technology of the production of clinker and cement and identify the types of cement
7. describe hydration of cement and how it can be carried out

8. describe the technology of organic processes, hydrogenation, alkylation
9. interpret at least five requirements for optimum yields, production of paraffins; olefins and aromatics from petroleum, separation and purification techniques of reaction products from reactors,
10. describe the manufacture of styrene, alkylbenzene sulphonate and sodium alkylene sulphonate as detergent

Course contents

Description of the equipment in the manufacture of refined sugar from cane. Considerations of the process and operations involve in the manufacture of refined sugar from cane. Utilization of the by-products of the refining operation. Safety. Economics. Environmental considerations. Energy recovery. Historical outline. Types of detergents. Mechanism of detergency. Oil and fats. Manufacture of non-soap base by direct saponification of oils and fats. Manufacture of fatty acids. Production of detergents and paints. Properties of their raw materials. Preparation of pulpwood. Pulping processes. Energy recovery. Bleaching of pulps and stock preparation. Utilization of by-products. Economics and ecological aspects of paper manufacture. 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. Reactions of cement with gases, liquids and solids. Production of blended cement and area of utilization. Role of cement in carbon sequestration. Petroleum oil industry and its relevance to the petrochemical industry, Petrochemical precursors. Operations in the petrochemical industries. Feedstocks and products.

EDSU-TCH 525: Corrosion Engineering (2 Units E: LH 30)

Senate-approved relevance

Training of high-quality graduates that are well skilled and knowledgeable in corrosion engineering and proffer solutions to corrosion problems in any engineering operation in Nigeria is in line with EDSU's mission to address African developmental challenges in producing graduates in chemical engineering.

Overview

Corrosion engineering is a vital approach used to sustain and prolong the lifespan of material and infrastructural development. This highlights the importance of preparing students in chemical engineering with the knowledge and skills on how to harness the knowledge of corrosion science and technology in protecting materials and infrastructure in all production sectors. This course is designed to introduce and expose students to various segments of corrosion engineering and to educate them on how to design corrosion protection measures, analysis and protect critical infrastructure from corrosion.

The importance of the course lies in meeting the need in achieving sustainable development goals (SDGs) numbers 1, 2 and 11 in the areas of reducing poverty, zero hunger and sustainable communities/cities respectively. The objectives of the course, learning outcomes, and contents are provided to address this need.

Objectives

The objectives of this course are to:

1. explain corrosion, cost of corrosion, electrochemical mechanisms involved in corrosion,
2. identify aqueous corrosion: recognizing the various forms of aqueous corrosion and understanding their basic mechanisms
3. describe high-temperature (hot) corrosion: hot gases, liquid metals, thermal fatigue.
4. explain corrosion control
5. describe at least five properties and performance of metals, alloys and non-metals

Learning outcomes

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

1. describe corrosion, cost of corrosion, electrochemical mechanisms involved in corrosion
2. describe aqueous corrosion
3. interpret high-temperature (hot) corrosion: hot gases, liquid metals, thermal fatigue
4. describe corrosion control

5. explain at least three properties and performance of metals, alloys and non-metals

Course contents

Definitions of corrosion. Cost of corrosion. Electrochemical mechanisms involved in corrosion. Aqueous corrosion: meaning. Recognizing the various forms of aqueous corrosion and understanding their basic mechanisms. High-temperature (hot) corrosion: meaning. Hot gases. liquid metals. Thermal fatigue. Equipment selection for corrosive service: meaning. Materials (alloy) selection. Economics. Codes and standards. Design aspects. Corrosion control: meaning. Changing materials. Surface coatings. Changing operating conditions. Applying cathodic and anodic protection. Changing design. Corrosion testing: meaning. Laboratory testing. Field testing. Plant testing. Corrosion monitoring. Materials: meaning. Properties and performance of metals. Properties and performance of alloys. Properties and performance of non-metals. Corrosion issues in specific industries: meaning. Power generation. Chemical processing. Oil and gas. Marine.

EDSU-TCH 526: Polymer Engineering (2 Units E: LH 30)

Senate-approved relevance

Training of high-quality graduates that are well skilled and knowledgeable in Polymer materials to be used for any engineering operation in Nigeria is in line with EDSU's mission to address African developmental challenges in producing graduates in chemical engineering.

Overview

Polymer engineering is a vital approach used to increase and improve the material and infrastructural deficit for sustainable development. The major raw material for the polymer sector comes from the petrochemical sector. This highlights the importance of preparing students in chemical engineering with the knowledge and skills on how to harness the knowledge of polymer engineering in designing producing different polymers. This course is designed to introduce and expose students to various segments of polymer science and technology, and to educate them on how to design and process various polymer materials.

The importance of the course lies in meeting the need in achieving sustainable development goals (SDGs) numbers 1 and 2 in the areas of reducing poverty and zero hunger respectively. The objectives of the course, learning outcomes, and contents are provided to address this need.

Objectives

The objectives of this course are to:

1. explain polymer and their characteristics
2. describe the source of monomers, structure and physical properties of polymers
3. describe William Landel Ferry Equation, Polymerisation reactions and manufacturing methods; Ziegler Natta catalysis
4. describe processing and technology of polymers
5. explain the chemistry of polymer manufacture, the molecular structure of polymers, and the structure-property relationships for thermoplastic and thermosetting polymers.

Learning outcomes

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

1. describe polymer and their characteristics
2. explain the source of monomers, structure and physical properties of polymers
3. explain William Landel Ferry Equation, Polymerisation reactions and manufacturing methods; Ziegler Natta catalysis
4. explain processing and technology of polymers
5. describe the chemistry of polymer manufacture, the molecular structure of polymers, and the structure-property relationships for thermoplastic and thermosetting polymers.

Course contents

Introduction to polymer. Characteristics of polymer. Source of monomers. Structure and physical properties of polymers: meaning. Rheology. Solubility. Molecular weights. Plasticity. Elasticity. William Landel Ferry Equation. Polymerisation reactions. Manufacturing methods. Ziegler Natta catalysis. Processing of polymer. Technology of Polymers. Introduction to the manufacture of organic polymeric materials. Processing of organic polymeric materials. Applications of organic polymeric materials. Chemistry of polymer manufacture. Molecular structure of polymers. Structure-property relationships for thermoplastic. Structure-property relationships for thermosetting polymers.

EDSU-TCH 529: Technology of Fossil Fuel Processing (2 Units C: LH 30)

Senate-approved relevance

Training of high-quality graduates that are well skilled and knowledgeable in in the processing of crude oil, natural gas, coal and tar sand in Nigeria is in line with EDSU's mission to address African developmental challenges in producing graduates in chemical engineering.

Overview

Technology of fossil fuels processing is a vital approach used to increase and improve access to products of crude oil, natural gas and coal for sustainable development. The raw materials deposit can be found within and around Edo state. The importance of the products of crude oil, natural gas and coal cannot be overemphasized in our everyday life. This highlights the importance of preparing students in chemical engineering with the knowledge and skills on how to harness the abundant crude oil, natural gas and coal deposits in this region.

This course is designed to introduce and expose students to various crude oil, natural gas and coal processing and utilization and to educate them on how to design, process and characterized different the various products. Also, to build the capacity of students in the area of sequestering CO_2, and addressing environmental pollution that may arise.

The importance of the course lies in meeting the need in achieving sustainable development goals (SDGs) numbers 1, 2, 11 and 13 in the areas of poverty reduction, zero hunger, sustainable communities/cities, and climate action issues respectively. The objectives of the course, learning outcomes, and contents are provided to address this need.

Objectives

The objectives of this course are to:

1. describe source, availability and characterisation of fossil fuel
2. explain modern processing technology
3. explain choice of product lines and products
4. explain carbonisation of coal, combustion of coal, gasification of coal, liquefaction of coal
5. identify environmental aspects of coal utilisation
6. explain petroleum processing equipment and storage tank
7. describe preliminary processing, thermal processes
8. explain catalytic processes

Learning outcomes

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

1. explain source, availability and characterisation of fossil fuel
2. describe modern processing technology.
3. identify choice of product lines and products
4. describe carbonisation of coal, combustion of coal, gasification of coal, liquefaction of coal.
5. Interpret environmental aspects of coal utilisation
6. describe petroleum processing equipment and storage tanks
7. explain preliminary processing, thermal processes; thermal cracking; coking; pyrolysis.
8. describe catalytic processes

Course contents

Source of fossil fuel. Availability and characterization of fossil fuel (Petroleum, Natural gas, tar sands, coal). Modern processing technology. Choice of product lines and products. Alternative product lines and products. Product specification. Introduction to coal formation. Physical and chemical properties of coal. Carbonization of coal. Combustion of coal. Gasification of coal. Liquefaction of coal. Environmental aspects of coal utilization. Petroleum refining technology: meaning. Preliminary processing. Thermal cracking. Coking. Pyrolysis. Catalytic cracking. Catalytic reforming. Hydrogenation. Hydrogen cracking.

Equipment

Pilot Plants

1. Continuous distillation pilot plant –
2. Liquid-liquid extraction pilot plant
3. Reaction pilot plant -
4. Multi-stage evaporation unit

Laboratory Scale Teaching Units

1. Shell and tube heat exchanger
2. Heat conduction and radiation apparatus – heat transfer
3. Unit operation lab: rotary, tray, fluidized bed and pneumatic dryers
4. Drying ovens and furnace, incubators, fridges, freezers
5. Chemical Reactors – CSTR, plug flow, batch reactors
6. Refrigeration experimentation units
7. Multifunction Process Control Teaching System
8. Cooling tower for humidification and heat transfer studies
9. Absorption column
10. Flooding and loading bench apparatus
11. Vapour-liquid equilibrium measurement apparatus
12. Adsorption columns
13. Rheometer for rheological investigation of non-Newtonian fluids in fluid mechanics
14. Sieve shakers and a set of sieve plates

General Apparatus

Assorted glasswares, balances, water baths,

Utilities

Boiler, compressor and vacuum pump

Analytical Equipment

Gas chromatograph, HPLC (High Performance Liquid Chromatograph), bomb calorimeter, spectrophotometer, centrifuges.

Computer Laboratories with Enough Computers dedicated to the Program and Available to Students

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalent of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practicals and supervision of projects.

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

Academic Support Personnel

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

Administrative Support Staff

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

Technical Support Personnel

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

Minimum Number of Staff

Subject to the general standards specified by NUC:

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

Student/Staff Ratio

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

Library

Each course should be supported by at least 2 prescribed textbooks and 3 recommended textbooks which must be available in the library.

Below is a list of some useful textbooks. These are some of the textbooks commonly found in Chemical Engineering Library.

Most of these books and a whole lot more are available in electronic library. Most of the popular and international journals are available in the electronic library. Institutions are advised to subscribe to at least 3 databases that host these textbooks and journals.

List of Textbooks

1. Unit operations by McCabe & Smith
2. Introduction to Chemical Engineering by Badger & Banchero Unit Processes by Groggins
3. Chemical Technology by Dryden
4. Chemical Process Industries by Foust et al.
5. Chemical Engineering Thermodynamics by Dodge
6. Introduction to Chemical Engineering by Thompson & Ceckler
7. Mass Trasfer Operations by Treyball
8. Chemical Reactions Engineering by Levenspiel
9. Perry's Chemical Engineer's Handbook11
10. Coulson and Richardson (Vol.-1 to Vol.-6)
11. Transport Processes and unit operations by Christie Geankoplis
12. Introduction to Chemical Engineering Thermodynamics by J.M. Smith
13. Heat transfer principles by B.K. Dutta
14. Basic Principles and Calculations in Chemical Engineering by David M Himmelblau

15. Introduction to Material and Energy Balances by G.V. Reklaitis
16. Bioprocess Engineering by Michael L Shuler and Fikret Kargi

Academic and Non-Academic Spaces

The NUC recommends the following physical space requirement:

Academic	**m2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Accommodation

S/N	**Office**	**No in Room**	**Facilities**
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet,

			bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves.

LIST OF REVIEWERS

Title	Surname	First Name	Institution	Programme
Prof.	FABORODE	Michael O.	Obafemi Awolowo University, Ile-Ife	**Discipline Chairman**
Prof.	OLOCHE	O. B	University of Abuja, Abuja	Mechanical Engineering
Prof.	EKECHUKWU	Onyemaechi Valentine	University of Nigeria, Nsukka	Mechanical Engineering
Engr.	ALI	Kashim	COREN	Mechanical Engineering & General Discipline
Prof.	OLORUNMAIYE	Adesiji	University of Ilorin,	
Lt. Col. Dr.	IMAM	A. S	Nigerian Defence Academy, Kaduna	Mechatronics Engineering
Prof.	ASERE	Abraham	Elizade University, IlaraMokin.	Automotive Engineering
Prof.	EDOKPAI	Raph	University of Benin, Benin-City	Industrial and Production Engineering
Prof.	FUBARA-MANUEL	Isoteim	Rivers State University of Science and Technology, Port Harcourt	Marine Engineering
Prof.	FAKINLEDE	O. A	University of Lagos,	Systems Engineering

			Lagos	
Prof.	OGBONNA	Chibueze Achimba	Babcock University, Ilishan Remo	Computer Engineering
Prof.	BOYI	Jimoh	Ahmadu Bello University, Zaria	Electrical Engineering
Prof.	ADEDIRAN	Yinusa Ademola	University of Ilorin	Electrical and Electronics Engineering
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