FEDERAL UNIVERSITY WUKARI

TARABA STATE

DEPARTMENT OF CHEMICAL ENGINEERING

STUDENTS HAND BOOK

2023

FORWARD

The Department of Chemical Engineering, Federal University Wukari was established in 2021 within the Faculty of Engineering along with the Department of Agricultural Engineering and Computer Engineering after being approved by the National University Commission to start the program. The Department of Chemical Engineering at Wukari Federal University aspires to train students to become good engineers with the knowledge and ability to succeed in a changing modern society.

The goals of the Chemical Engineering Department are to advance science and technology, provide students with the knowledge they need to become informed citizens and prepare them for the job market. To design and troubleshoot processes that produce chemicals, fuels, foods, pharmaceuticals, biologicals, and more. They must know the science of chemical engineering, often used by large industrial facilities to increase productivity and product quality while reducing costs. Our degree program provides students with many of the skills they need to pursue their goals, including working as engineers or starting their own businesses. Students are allowed to focus on specific areas of chemical engineering to ensure chemical engineering graduates are prepared for dynamic and rapidly changing technological applications.

The Bachelor of Engineering (B.Eng..) program at Federal University Wukari aims to produce a well-rounded graduate who will be equipped with the necessary skills to practice chemical engineering as industrialists, manufacturers and elsewhere. We train our graduates to proffer solutions to industrial needs various chemical engineering industries , including the petrochemical, chemical, polymer, and pharmaceutical industries; beverage production and food processing; pulp and paper processing; power production; textile production; detergent production; mining and metallurgy; public services; hospital and biomedical engineering; toilets and sewages; industrial standardization; and water resources, among others. The program includes lectures, laboratory works, practical trainings and industrial relevant projects to ensure that every student receives well rounded training. We also have well established quality assurance management system, and student mentorship

It is suggested that prospective and returning students of the department should read the students' handbook so as to familiarize themselves with the policies. put in place to help them sccueed. . Consequently, I would want to extend a warm welcome to you and wish you well in your academic endeavors.

Engr Dr. O. S. Onyekwere
Ag Head, Department of Chemical Engineering
July 2023

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FUW ANTHEM

Coming all the way long
Reaching for the utmost height
Building Character
Living in an excellent way
Serving humanity with integrity of heart
Lifting our nation high

Chorus:

We have all it takes
Great F.U.Wukari
Good character
Excellent living
Heart of service
To lift our nation high

Arise! Oh the great croc
Working as the ant would do
Building a varsity
The pride of our nation
Marching towards the mark
Never looking back
Lifting our nation high

Vision and Mission of the University

Vision of Federal University Wukari

To be a leader among world class public Universities by:

- Advancing knowledge through high quality ICT centric educational experiences for students.
- Encouraging entrepreneurship.
- Conducting leading edge research and scholarship in all areas that promotes an intellectual environment that is anchored on the tenets of open dialogue and inquiry,
- A deep and abiding appreciation of the entire spectrum of human experience.

Mission of Federal University Wukari

To be a student's centered and community engaged institution by providing an enabling environment that:

- Enhances intellectual growth a strong commitment to academic excellence, integrity and entrepreneurship.
- Creating new knowledge and using ICT and other enabling technologies to solve practical problems that benefit humanity.
- Preparing our students as well as professionals in our community for ethical leadership.
- Promoting service to community and enduring sense of global citizenship.

Programme Educational Objectives (PEOs) For Chemical Engineering, Federal University Wukari

i. Graduates obtain positions in fields requiring their technical knowledge and professional skills such as industries, government organizations, academic or other organizations.

ii. Graduates have continued the pursuit of professional development through graduate studies in chemical engineering or related field leading to advanced degrees, or through non-degree continuing education or informal study.

iii. Graduates have advanced to positions of increasing responsibility as individuals or member of a team, with some assuming leadership roles.

iv. Graduates excel in various areas of chemical engineering as entrepreneurs.

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Preliminary Introduction of Chemical Engineering Program in Federal University Wukari

1.0 Background Introduction

Chemical engineering is the branch of engineering which deals with changing the composition, energy content, and state of aggregation of materials. The programme encompasses the fundamental properties and nature of matter (chemistry), the forces that act on matter (physics), and the precise expressions of the relationships between them (mathematics). It therefore incorporates computer-based modelling techniques to handle the application of these sciences to engineering problems. The programme is designed to provide a broad technical basis with an emphasis on material and energy balances, separation processes, rate processes, unit operations, and process economics and design. This will serve as input into chemical-based manufacturing of a wide variety of products, such as:

Fuels (gasoline, natural gas)

- Petro-Chemicals (chemicals obtained from petroleum or natural gas)
- Agricultural Chemicals (fertilizers, pesticides)
- Industrial Chemicals (acids, alkalis, organics, salts)
- Plastics, Polymers and Fibers
- Paper and Paper Products
- Pharmaceuticals and Drugs
- Consumer Products (paints, soaps, household cleaners, etc.)
- Food Additives/Products
- Cement
- Advanced Materials (ceramics, electronic materials, composites, etc.).

The aim of running Chemical Engineering programme is to produce graduates who can play key roles in industries, mostly in the manufacturing field with their work area varying from petroleum and petrochemicals to food, materials, specialty chemicals, plastics, power production, environmental control, waste management, biotechnology and nanotechnology.

1.1 Brief History of the Faculty of Engineering

The Faculty of Engineering at Federal University Wukari was established on 1st October 2013, a year after the university was founded by the Federal Government of Nigeria. Initially, it consisted of four departments: Chemical Engineering, Mechanical Engineering, Electrical and Electronic Engineering, and Civil Engineering. However, student enrollment was delayed due to the lack of resources and facilities. Eventually, on 16th June 2016, during a regular sitting of the university senate, it was decided to suspend the program due to its failure to commence activities since its inception. Four years later, in January 2021, the senate re-established the faculty with three departments: Agricultural Engineering, Chemical Engineering, and Computer Engineering. This decision was made after acquiring the necessary personnel and facilities to support the program. Consequently, student enrollment began in the 2020/2021 academic session.

1.2 History of the Department of Chemical Engineering of Federal University Wukari

The Department of Chemical Engineering of Federal University Wukari is one of the three departments under the faculty of engineering established in 2019 academic session as part of the second phase of development.

The department runs a 5-year, 2-semester course units' systems in its curriculum program that leads to the awards of Bachelor of Engineering (B.Eng..) degree in Chemical Engineering. The 5-year duration is expected to progress from year-one (100 level) through year-five (500 level). Each year is divided into two semesters (first and second), each of 15 weeks long of lectures plus practical.

The department comply to the policy staff to student ratio for the realization of its philosophy and objectives through proper utilization of facilities and equipment for teaching and research in the laboratories.

1.3 Philosophy of Chemical Engineering Discipline

To achieve the goals and objectives of the National Policy on Industrialization and Self-Reliance, the Engineering and Technology education should be geared towards:

(i) The development of a thorough practice in engineering and technology training.
(ii) Broad–based training in general Engineering and Technology at the early stages of the programme.
(iii) Practical application of Engineering, Technology and Manufacturing Processes.
(iv) Adequate training in human and organizational behaviour and management.
(v) Introduction to entrepreneurial education and training.
(vi) Close association of the programme with industries in the country.

The general philosophy therefore is to produce graduates with high academic standard and adequate practical background for self-employment as well as being of immediate value to industry and the community in general.

1.4 Program Outcomes (POs)

The general goals and objectives of Engineering and Technology training is in consonance with the realisation of national needs and aspirations vis-à-vis industrial development and technological emancipation (Table 1). The graduates must therefore be resourceful, creative, knowledgeable and able to handle tasks as Engineering graduates (Table 1).

Table 1. Program Objectives (POs) the Department of Chemical Engineering

S/N	CHARACTERISTIC	PROGRAMME OUTCOME (ENGINEER GRADUATE PROFILE)

1	**Engineering Knowledge**: Breadth, depth and type of knowledge, both theoretical and practical	Apply knowledge of mathematics, natural science, computing and engineering fundamentals, and an engineering specialization to develop solutions to complex engineering problems
2	**Problem Analysis**, Complexity of analysis	Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences with holistic considerations for sustainable development
3	**Design/development of solutions**: Breadth and uniqueness of engineering problems i.e., the extent to which problems are original and to which solutions have not previously been identified or codified	Design creative solutions for complex engineering problems and design systems, components or processes to meet identified needs with appropriate consideration for public health and safety, whole-life cost, net zero carbon as well as resource, cultural, societal, and environmental considerations as required
4	**Investigation**: Breadth and depth of investigation and experimentation	Conduct investigations of complex engineering problems using research methods including research- based knowledge, design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions
5	**Tool Usage**: Level of understanding of the appropriateness of technologies and tools	Create, select and apply, and recognize limitations of appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems
6	**The Engineer and the World**: Level of knowledge and responsibility for sustainable development	When solving complex engineering problems, analyze and evaluate sustainable development impacts to: society, the economy, sustainability, health and safety, legal frameworks, and the environment
7	**Ethics**: Understanding and level of practice	Apply ethical principles and commit to professional ethics and norms of engineering practice and adhere to relevant national and international laws. Demonstrate an understanding of the need for diversity and inclusion

8	**Individual and Collaborative Team work**: Role in and diversity of Team	Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multi-disciplinary, face-to-face, remote and distributed settings
9	**Communication**: Level of communication according to type of activities performed	Communicate effectively and inclusively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, taking into account cultural, language, and learning differences.
10	**Project Management and Finance**: Level of management required for differing types of activity	Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
11	**Lifelong learning**: Duration and manner	Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change

1.5 Basic Admission Requirements and Expected Duration of the Programme

The basic admission requirements for Engineering and Technology disciplines shall be;

1.5.1 Admission Requirements for UTME

The minimum admission requirement for Chemical Engineering is passes at credit level in the Senior Secondary School final year examination or GCE 'O' Level in five subjects including Mathematics, English Language, Physics, Chemistry and Biology. Candidates are also required to have acceptable pass in UTME. It is also desirable for candidates to have Further Mathematics and Technical Drawing at credit levels. Such candidates shall have added advantage.

1.5.2 Admission Requirements for Direct Entry

For Direct Entry, candidates must have passes in Mathematics, Physics and Chemistry at GCE 'A' level or equivalent. Holders of OND and HND at minimum of upper credit level are eligible for consideration for admission into 200 and 300 levels respectively. In addition Direct Entry candidates must have passes at credit level in the Senior Secondary School final year examination or GCE 'O' Level in five subjects including Mathematics, English Language, Physics, Chemistry and Biology.

1.5.3 Minimum Duration

The minimum duration of Chemical Engineering programme is five academic sessions for UTME candidates who enter with Senior Secondary School Certificate or GCE 'O' Level qualifications. Direct Entry candidates with relevant passes in Mathematics, Physics and Chemistry at GCE 'A' Level or equivalent will spend a minimum of four academic sessions provided that they satisfy all the other University requirements.

1.6 Categories of Courses Taken at Undergraduate Level

Core/Compulsory Course

A course which every student must compulsorily take and pass in any particular programme at a particular level of study.

Required Course

A course that you take at a level of study and must be passed before graduation.

Elective Course

A course that students take within or outside the faculty. Students may graduate without passing the course provided the minimum credit unit for the course had been attained.

Optional Course

A course which students can take based on interest and may count towards the minimum credit unit required for graduation.

Pre-requisite Course

A course which student must take and pass before taking a particular course at a higher level.

1.7 Credit Load Per Semester/Course Credit System

1.7.1 Minimum Credit Load per Semester

The Minimum credit load per semester is 15.

1.7.2 Course Credit System

Chemical Engineering program shall be run on a modularized system, commonly referred to as Course Unit System. All courses would therefore be sub-divided into self-sufficient and logically consistent packages that are taught within a semester and examined at the end of that semester. Credit weights would be attached to each course. 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.

1.7.3 Course Credit Unit System

This should be understood to mean a quantitative system of organization of the curriculum in which subject areas are broken down into unit courses which are examinable and for which students earn credit(s) if passed'. The courses are arranged in progressive order of difficulty or in levels of academic progress, e.g., Level or year 1 courses are 100, 101 etc. and Level II or Year II courses are 200, 202 etc. The second aspect of the system is that courses are assigned weights allied Credit Units.

B. Eng. Chemical Engineering Courses

2.0 100 Level Courses

FIRST SEMESTER

S/N	**Course Code**	**Course Title**	**Credits**	**Status**
1.	GST 101	Communication in English I	2	C
2.	GST 107	Use of Library, Study Skills and Information Communication Technology (ICT)	2	C
3.	CHM 101	General Chemistry I (Physical & Inorganic Chemistry)	3	C
4.	CHM 107	Practical Chemistry I	1	C
5.	MTH 101	General Mathematics I	3	C
6.	PHY 101	General Physics I	3	C
7.	PHY 103	General Physics III	2	C
8.	PHY 107	Practical Physics I	1	C
9.	CSC 101	Introduction to Computer Science	3	C
10.	GEN 101	Introduction to Engineering Statistics	2	C
		TOTAL	**22**	

SECOND SEMESTER

S/N	**Course Code**	**Course Title**	**Credits**	**Status**
1.	GST 102	Communication in English II	2	C
2.	GST 108	Communication in French	2	E
3.	GST 110	Communication in Arabic	2	E
4.	CHM 102	General Organic Chemistry	2	C
5.	CHM 104	Inorganic Chemistry I	2	C
6.	CHM 108	Practical Chemistry II	1	C
7.	MTH 102	General Mathematics II	3	C
8.	MTH 104	Elementary Vectors, Geometry and Mechanics	3	C
9.	PHY 102	Electricity and Magnetism	3	C
10.	PHY 108	Practical Physics II	1	C
11.	CSC 104	Computer Programming I	2	C
		TOTAL	**21**	

2.1 200 Level Courses

FIRST SEMESTER

S/N	Course Code	Course Title	Credits	Status
1.	GST 201	Philosophy, Logic and Human Existence	2	R
2.	GST 203	Nigerian Peoples, Culture and Citizenship	2	R
3.	GEN 201	Engineer in Society	1	C
4.	CHM 201	Physical Chemistry II	3	R
5.	EMA 201	Engineering Mathematics I	3	R
6.	CIE 201	Strength of Materials	3	C
7.	MEE 209	Engineering Drawing I	2	C
8.	MEE 203	Students Workshop Experience I	1	C
9.	MEE 205	Applied Mechanics I	3	C
10.	MEE 207	Engineering Materials	3	C
		TOTAL	**23**	

SECOND SEMESTER

S/N	Course Code	Course Title	Credits	Status
1.	GST 204	History and Philosophy of Science	2	R
2.	GST 206	Peace Studies and Conflict Resolutions	2	R
3.	GEN 204	Basic Engineering Laboratory II	2	R
4.	CHM 232	Organic Chemistry II	3	R
5.	EMA 202	Engineering Mathematics II	3	R
6.	MEE 212	Engineering Drawing II	2	C
7.	MEE 214	Fundamentals of Fluid Mechanics	3	C
8.	MEE 218	Engineering Thermodynamics I	3	C
9.	CHE 202	Chemical Engineering Concept	1	C
10.	CHE 200	SWEP I	2	C
		TOTAL	**23**	

2.2 300 Level Courses

FIRST SEMESTER

S/N	**Course Code**	**Course Title**	**Units**	**Status**
1.	GST 301	Introduction to Entrepreneurship Studies	2	R
2.	GEN 301	Engineering Statistics	2	C
3.	EMA 301	Engineering Mathematics III	3	R
4.	EEE 203	Applied Electricity I	2	C
5.	CHE 301	Transport Phenomena I	3	C
6.	CHE 303	Separation Processes I	3	C
7.	CHE 305	Biochemical Engineering I	3	C
8.	CHE 307	Polymer Process Engineering	3	R
9.	CHE 309	Process Modelling and Simulation	2	C
		TOTAL	23	

SECOND SEMESTER

S/N	**Course Code**	**Course Title**	**Units**	**Status**
1.	GST 302	Introduction to Entrepreneurial Skills	2	R
2	GEN 302	Engineering Communication	2	R
3	EMA 302	Engineering Mathematics IV	3	R
4.	EEE 202	Applied Electricity II	2	C
5.	CHE 302	Chemical Engineering Thermodynamics I	2	C
6.	CHE 304	Chemical Kinetics	3	C
7.	CHE 306	Introduction to Material and Energy balances	3	C
8.	CHE 308	Process Instrumentation	2	R
9.	CHE 310	Chemical Engineering Laboratory I	2	C
10.	CHE 300	SWEP II	2	C
		TOTAL	23	

2.3 400 Level Courses

FIRST SEMESTER

S/N	Course Code	Course Title	Units	Status
1.	GEN 401	Engineering Economics	2	R
2.	CHE 401	Chemical Engineering Laboratory II	2	C
3.	CHE 403	Transport Phenomena II	3	C
4.	CHE 405	Chemical Engineering Thermodynamics II	2	R
5.	CHE 407	Separation Processes II	3	C
6.	CHE 409	Plant Design I	4	C
7.	CHE 411	Chemical Engineering Analysis	2	R
8.	CHE 413	Particle Technology	2	R
9.	CHE 415	Environmental Engineering	3	R
		TOTAL	23	

SECOND SEMESTER

S/N	Course Code	Course Title	Units	Status
1.	CHE 400	Student Industrial Work Experience Scheme (SIWES)	6	C
		TOTAL	6	

2.4 500 Level Courses

FIRT SEMESTER

S/N	**Course Code**	**Course Title**	**Units**	**Status**
1.	GEN 501	Engineering Management	3	R
2.	CHE 501	Separation Processes III	3	C
3.	CHE 503	Process Control I	2	C
4.	CHE 505	Process Optimization	3	C
5.	CHE 507	Plant Design II	3	C
6.	CHE 509	Chemical Engineering Laboratory III	1	C
7.	CHE 511	Reservoir Engineering	3	C
8.	CHE 591	Research Project I	2	C
ELECTIVES				
9.	CHE 513	Technology of Fossil Fuel Processing	3	E
10.	CHE 515	Pulp and Paper Technology	3	E
11.	CHE 517	Fermentation Technology	3	E
12.	CHE 519	Polymer Science and Technology	3	E
		TOTAL	23	

SECOND SEMESTER

S/N	**Course Code**	**Course Title**	**Credits**	**Status**
1.	GEN 502	Engineering Law	2	R
2.	CHE 502	Chemical Reaction Engineering	4	C
3.	CHE 504	Process Control II	2	C
5.	CHE 506	Design Project	2	C
6	CHE 508	Biochemical Engineering II	3	C
7	CHE 510	Polymer Science and Technology	3	C
8	CHE 592	Research Project II	4	C
ELECTIVES				
8.	CHE 510	Petroleum Technology	3	E
9.	CHE 512	Coal Processing Technology	3	E
10.	CHE 514	Sugar Technology	3	E
11.	CHE 516	Detergent Technology	3	E
12.	CHE 518	Cement and Cement Technology	3	E
		TOTAL	24	

NB: One Elective in each semester.

2.5 Course Synopses

100-Level Courses

In the first year, all the students in the faculty of engineering shall take common courses. These courses are taken from the Faculty of Science, the General Studies and Entrepreneurial Unit in the university. The detailed of the general courses to be offered by the students in the faculty of engineering during their first year of study are presented below

2.5.1 100-Level Courses First Semester

CHM101: General Chemistry I **(3 Credits: LH 45)**

Course Overview

CHM101 (General Chemistry I) introduces fundamental concepts in chemistry, covering atoms, molecules, elements, compounds, and chemical reactions. Students delve into modern atomic theory, electronic configurations, periodic trends, molecular shapes, and valence forces. They also master chemical equations, stoichiometry, and thermodynamics, setting the stage for a comprehensive understanding of chemistry principles.

Course Objectives

The objectives of the course are to:

1. Develop a foundational understanding of atoms, molecules, elements, and compounds, and their roles in chemical reactions, laying the groundwork for advanced chemical studies.
2. Explore the modern electronic theory of atoms, including electronic configuration, periodicity, and the periodic table's construction, to grasp the organization of chemical elements and their properties.
3. Analyze hybridization and the shapes of simple molecules, allowing for the prediction of molecular geometries and an understanding of how chemical bonds form and influence molecular properties.
4. Gain insight into valence forces and the structure of solids, providing the knowledge needed to comprehend the behavior of materials in the solid state.
5. Develop proficiency in writing and balancing chemical equations, as well as applying stoichiometry, enabling precise measurements and calculations in chemical reactions.
6. Investigate elementary thermochemistry, rates of reaction, chemical equilibrium, and the principles of thermodynamics, empowering students to analyze and predict the energy changes in chemical processes.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Describe the modern electronic theory of atoms, including the arrangement of electrons within an atom, the concept of energy levels, and the organization of the periodic table.
2. Determine electronic configurations for various elements and understand the periodic trends in atomic properties such as size, ionization energy, and electronegativity.

3. Explain the concept of chemical bonding, including covalent and ionic bonding, and predict the shapes of simple molecules through hybridization theory.
4. Explain the concept of balancing chemical equations, perform stoichiometric calculations, and the principles of conservation of mass in chemical reactions.
5. Outline the structure of solids, the types of valence forces that hold them together, and how these forces affect the physical properties of materials.
6. Explain the kinetic theory of matter, rates of chemical reactions, chemical equilibrium, and basic thermodynamic principles, including concepts like entropy and enthalpy.
7. Define acids and bases, calculate pH and pOH, and understand the properties and reactions of acidic and basic substances, including salt formation.
8. Explain redox reactions, oxidation states, and the basics of electrochemistry, including the principles of galvanic cells and electrolysis.
9. Atoms, molecules 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.

Course Content

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. Hybridization and shapes of simple molecules. Valence forces and structure of solids. Chemical equations and stoichiometry, chemical bonding and intermolecular forces and 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.

CHM107: Practical Chemistry I **(1 Credit: PH 45)**

Course Overview

Practical Chemistry 1 is a dynamic laboratory course designed to provide students with hands-on experience in essential chemical techniques and analytical methods. Upon completion, students will possess the skills to conduct precise acid-base titrations, discerning accurate end points. They will master gravimetric analysis, enabling quantitative determination of substance masses in complex samples, and gain expertise in precipitation and filtration techniques. This course fosters strong mathematical and data analysis capabilities for effective interpretation of experimental results. Furthermore, students will learn to identify and analyze functional groups in organic compounds using chemical tests and spectroscopic methods. Practical Chemistry I bridge theoretical knowledge from CHM 101 and CHM 102 with practical applications, preparing students for success in advanced chemistry studies and future scientific endeavors.

Course Objectives

The objectives of the course are to:

1. Develop the ability to conduct acid-base titrations with precision, accurately determine the end point, and calculate the concentration of the analyte.
2. Apply gravimetric analysis methods to quantitatively determine the mass of specific substances in complex samples, demonstrating proficiency in quantitative chemical analysis.
3. Master the principles of precipitation and filtration techniques within gravimetric analysis experiments, and effectively communicate and report the experimental findings.
4. Acquire strong mathematical and data analysis skills to interpret experimental results, ensuring accurate conclusions are drawn from laboratory data.
5. Develop the capability to identify and analyze functional groups in organic compounds using a combination of chemical tests and spectroscopic methods, enhancing the understanding of organic chemistry concepts.
6. Enhance communication skills by presenting experimental findings effectively, including proper data analysis, interpretation, and reporting, preparing students for scientific research and professional settings.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Conduct acid-base titrations and determine the end point.
2. Employ gravimetric analysis methods to quantitatively determine the mass of a specific substance in a given sample.
3. Conduct practical on the principles of precipitation and filtration techniques in gravimetric analysis and report the findings.
4. Perform mathematical calculations and data analysis to interpret experimental results effectively.
5. Identify and analyze functional groups in organic compounds through various chemical tests and spectroscopic methods.

Course Content

Laboratory experiments designed to reflect the topics taught in CHM 101 and CHM 102 such as qualitative and quantitative chemical analyses, acid-base titrations. Gravimetric analysis. Calculation, data analysis and presentation. Functional group analysis.

MTH101: General Mathematics (Algebra and Trigonometry) (3 Credits: LH 45)

Course Overview

General Mathematics (Algebra and Trigonometry) equips students with essential mathematical tools. Topics include set theory with Venn diagrams, real numbers encompassing integers, rationals, and irrationals, and mathematical induction. Students delve into quadratic equations, the Binomial theorem, and complex numbers using Argand diagrams. Additionally, advanced trigonometric concepts, circular measure, and trigonometric functions are explored. This course fosters mathematical proficiency, providing a strong foundation for further mathematical pursuits and applications in various fields.

Course Objectives

The objectives of the course are to:

1. Develop the ability to effectively represent and manipulate set theory concepts, including subsets, union, intersection, and complements, using Venn diagrams for visual clarity.
2. Apply a comprehensive understanding of real numbers, including integers, rational numbers, and irrationals, to solve mathematical problems across various contexts and mathematical operations.
3. Demonstrate proficiency in mathematical induction to prove statements, analyze real sequences and series, and apply the principles of quadratic equations and the Binomial theorem in mathematical problem-solving.
4. Utilize complex numbers, including their algebraic properties and the application of Argand diagrams, to effectively solve complex mathematical problems and represent solutions graphically.
5. Apply advanced trigonometric concepts, such as circular measure, trigonometric functions of angles of any magnitude, and addition and factor formulae, to solve complex trigonometry-related problems and equations, enhancing problem-solving capabilities in mathematics.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Represent set theory, including concepts such as subsets, union, intersection, complements using Venn diagrams.
2. Apply understanding of real numbers, including integers, rational numbers, and irrational numbers, and apply them various mathematical contexts.
3. Apply mathematical induction to prove mathematical statements, analyze real sequences and series, and understand the theory of quadratic equations and the Binomial theorem.
4. Utilize complex numbers, including their algebraic properties and the use of Argand diagrams, to solve complex mathematical problems.
5. Apply advanced trigonometric concepts, including circular measure, trigonometric functions of angles of any magnitude, and addition and factor formulae, to solve trigonometry-related problems and equations.

Course Content

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

PHY101: General Physics I (Mechanics, Thermal Physics and Waves) (3Credits: LH 45)

Course Overview

This course provides a foundational understanding of physics concepts. Students will explore the fundamental principles of space, time, units, and dimensions. The course delves into the laws of mechanics, statics, dynamics, work, energy, and conservation. Kinematic principles are applied to analyze particle motion, including simple harmonic motion and elasticity. Thermal physics covers heat transfer and dynamic behaviors in systems, while the study of waves encompasses types, properties, superposition, sound propagation, unified spectra analysis, and practical applications in sound and light energies.

Course Objectives

The objectives of the course are to:

1. Explain the fundamental concepts of space, time, units, and dimensions, providing a solid foundation for understanding physical phenomena.
2. Describe and apply the fundamental laws of mechanics, encompassing statics and dynamics, work and energy, and conservation laws, enabling the analysis of mechanical systems and their behaviors.
3. Apply kinematic principles to analyze the motion of particles, including simple harmonic motion, motion of simple systems, and concepts related to elasticity, such as Hooke's law.
4. Analyze heat transfer in systems and understand the dynamic behaviors of thermal processes, encompassing gas laws, thermodynamics, and the kinetic theory of gases.
5. Explain the types and properties of waves, particularly in the context of sound and light energies. Understand wave superposition, sound propagation in various media, and the unified spectra analysis of waves, with a focus on practical applications in physics.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the concept of space and time, units and dimension.
2. Explain the fundamental laws of mechanics, statics, and dynamics; work and energy; conservation laws.
3. Apply kinematic principles to analyse the motion of particles simple harmonic motion; motion of simple systems; Elasticity; Hooke's law.
4. Analyse the heat transfer in a system and its identified dynamic behaviours.
5. Explain the types and properties of waves as applied to sound and light energies. Superposition of waves. Propagation of sound in gases, solids and liquids and their properties. The unified spectra analysis of waves. Applications.

Course Content

Space and Time, Units and Dimension, Kinematics; Fundamental Laws of Mechanics, statics and dynamics; work and energy; Conservation laws. Moments and energy of rotation; simple harmonic motion; motion of simple systems; Elasticity; Hooke's law, Young's shear and bulk moduli, Hydrostatics; Pressure; buoyance, Archimedes' Principles; Surface tension; adhesion, cohesion, capillarity, drops and bubbles; Temperature; heat; gas laws; laws of thermodynamics; kinetic theory of gases; Sound. Types and properties of waves as applied to sound and light energies. Superposition of waves. Propagation of sound in gases, solids and liquids and their properties. The unified spectra analysis of waves. Applications.

PHY103: Heat, Sound and Optics (3 Units: LH 45)

Course Overview

This course explores the profound principles of physics, covering a wide range of topics. It begins with a focus on mechanics, where students learn to describe motion, analyze forces, and apply conservation principles. The study then transitions to periodic phenomena and fluid dynamics, delving into wave behaviors, fluid-flow equilibrium, and the application of Newton's laws. Additionally, students explore thermodynamics, including temperature, heat transfer, and laws governing energy transformations, and delve into the fascinating realm of optics, encompassing wave optics, lenses, and polarization.

Course Objectives

The objectives of the course are to:

1. Develop the ability to precisely describe and predict the motion of objects using fundamental quantities such as position, velocity, and acceleration, employing kinematic equations to analyze changes over time.
2. Learn to determine when objects are in equilibrium by mathematically and diagrammatically evaluating forces acting on them. Predict the subsequent motion if equilibrium is disrupted.
3. Apply the principles of conservation, including momentum and energy, to analyze how multi-object systems evolve over time, facilitating a deeper understanding of dynamic systems.
4. Describe periodic phenomena using key quantities like amplitude, frequency, period, and wavelength. Predict how these phenomena will behave at different times or locations, enhancing the comprehension of wave behavior.
5. Apply Newton's laws and conservation principles to continuous fluid-flow systems, both idealized (non-viscous) and viscous fluids, to describe equilibrium conditions in terms of pressure, velocity, and flow rate, allowing for a comprehensive analysis of fluid behavior.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Precisely describe an object’s motion using the fundamental quantities of position, velocity, and acceleration, and use the kinematic equations to predict how this motion will change over time.
2. Determine when objects are in equilibrium by mathematically and diagrammatically adding up the forces on those objects and predict their subsequent motion if they are not in equilibrium.
3. Use conserved quantities like momentum and energy to infer how multi-object systems change over time.

4. Describe periodic (repeating) phenomena using the fundamental quantities of amplitude, frequency, period, and wavelength, and use them to predict how the phenomenon will behave at later times or locations
5. Apply Newton’s laws and conservation principles to continuous, fluid-flow systems to describe their equilibrium conditions in terms of pressure, velocity, and flow rate in both idealized (non-viscous) and viscous fluids.
6. Determine when objects are in equilibrium by mathematically and diagrammatically adding up the forces on those objects and predict their subsequent motion if they are not in equilibrium.

Course Content

Temperature, thermometer, heat transfer and PVT surfaces, Kinetic theory, first and second laws of Thermodynamics. Transverse and longitudinal waves and standing waves. Intensity, beats and Doppler effect. Electromagnetic spectrum. Huygen's principle. Images formed by a single surface, thin lenses and aberrations. The eye, optical instrument, interference, single slit diffraction grating and polarization. Malus's law.

PHY107: Practical Physics I **(1 Unit: PH 45)**

Course Overview

In PHY103, students embark on a hands-on journey through the fundamental realms of physics, honing their practical skills and scientific understanding. Through a series of engaging experiments, they learn to conduct precise measurements, make meticulous observations, and tabulate collected data. The course emphasizes the identification and evaluation of common experimental errors, fostering a culture of accuracy and reliability. Additionally, students master the art of graphical analysis, allowing them to draw meaningful conclusions from both numerical data and graphical representations. This immersive experience lays a solid foundation for future scientific endeavors.

Course Objectives

The objectives of the course are to:

1. Measurement Skills: Develop proficiency in conducting measurements of various physical quantities using appropriate instruments and techniques, ensuring precision and accuracy in experimental setups.
2. Acquire the ability to make detailed observations, collect experimental data, and organize it into tabulated formats. Apply data analysis techniques to extract meaningful information from collected data.
3. Recognize and evaluate common experimental errors that may affect the accuracy of measurements. Implement error analysis to understand the reliability of experimental results.
4. Gain competence in plotting data points and constructing graphs to represent experimental findings. Analyze graphs to discern trends, relationships, and patterns in the data, facilitating the interpretation of experimental outcomes.

Course Learning Outcomes

Upon completing the course, the student will 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.

Course Content

At least six experiments from the following: use of measuring instruments, viscosity, surface tension, oscillation about an equilibrium position, Hooke's law, moment of inertia, focal length of lenses, refractive index, optical instruments, the sonometer, heat capacity, volume expansion and latent heat. potential difference and internal resistance of cells, use of potentiometer circuit; the metre bridge, simple current measuring instruments. Planck's constants and radioactivity.

CSC101: Introduction to Computer Science (3 Credits)

Course Overview

CSC101 offers a captivating exploration of the world of computer science. Students delve into the rich history of computers and their transformative impact on commercial and scientific domains. They gain insights into computer characteristics, types, and system components. The course introduces the fundamental concept of software and delves into input/output peripherals, discussing their advantages and disadvantages. Additionally, students grasp the essentials of programming, including instruction sets, control programs, addressing modes, and the role of translators and loaders, equipping them with foundational computer science knowledge.

Course Objectives

The objectives of the course are to:

1. Historical Proficiency: Develop a comprehensive understanding of the history and evolution of computers, emphasizing their profound impact on commercial and scientific sectors throughout the years.
2. Describe the various characteristics, classifications, and types of computers, and gain insight into the intricate structure and components that constitute a computer system.
3. Explain the crucial role of software in computer systems, covering input/output peripheral devices and evaluating their advantages and disadvantages within the context of computer operations.
4. Comprehend the fundamentals of programming, including basic computer instructions, control programs, addressing modes (direct and indirect), and instruction formats. Explore the pivotal roles of translators and loaders in the programming process.
5. Apply theoretical knowledge to practical scenarios, gaining hands-on experience in program compilation and execution while mastering syntactic and lexical analysis, setting the stage for further exploration in computer science.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the history of computers and their evolution, highlighting their significant impact on commercial and scientific environments.
2. Describe the characteristics of computers, including their classification and types, and gain an understanding of the structure and components that make up a computer system.
3. Explain the concept of software and its role in computer systems, covering input/output peripheral devices and their advantages and disadvantages.
4. Explain the fundamentals of programming, including basic computer instructions, control programs, addressing modes (direct and indirect), instruction formats, and the role of translators and loaders.

Course Content

History of computers. Computer application in commercial and scientific environments, characteristics of computers, classification and types of computers, computer structure and its components. Introduction to software. Input/output peripheral devices, their advantages and disadvantages. Programming and information presentation. Basic instruction in computer, control programs. Transfer of control. Direct and indirect addressing. Instruction format. Translators, Loaders. Program compilation and execution; syntactic and lexical analysis. L30: T15:P0

GEN101: Introduction to Engineering Statistics (2 Credits)

Course Overview

Engineering statistics in general has historically challenge in transferring skills due to focus in engineering of uncertainty observation and process optimization rather than population analysis and active experimentation. This is particularly the case in Mechanical Engineering statistic with strong process focus, continuous rather than discrete data sets, and underlying system (and model) non-linearity. However, to properly understand and apply advance techniques, a basic understanding of elementary statistic is required. This course offers an opportunity to approach statistics from the basis to develop statistical capabilities as a core attribute.

Course Objectives

The objectives of the course are to:

1. Explain the basic concept of permutation and combination.
2. Explain the concept and principles of probability.
3. Explain random variables.
4. Describe probability and distribution functions.
5. Explain exploratory data analysis.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Use statistical methodology and tools in the engineering problem-solving process.
2. Compute and interpret descriptive statistics using numerical and graphical techniques.
3. Solve problems involving basic concepts of probability, random variables, probability distribution and joint probability distribution.
4. Compute point estimation of parameters, explain sampling distributions, and understand the central limit theorem.
5. Construct confidence intervals on parameters for a single sample.

Course Content

Statistical Data: their sources, collection and preliminary analysis by tables and graphs. Skewness and Kurtosis. Measure of central tendencies: Mean, weighted mean, standard deviation, mode, median and variance (grouped and ungrouped data). Time series and demographic measures and index numbers. Construction of questionnaires and simple index numbers. Use of random numbers and statistical tables. Inference: Estimation and test of hypothesis. Analysis and presentation of data. Curve fitting and goodness-of-fit tests. Regression and correlation of data (an introduction). L 30: T15: P0

GST101: **Communication in English I: (2 Credits: LH 30)**

Course Overview

GST101 equips students with essential communication skills in the English language. It fosters phonetic awareness by helping students identify sound patterns, enhancing pronunciation and listening abilities. The course delves into word formation processes, providing a deeper understanding of vocabulary and language structure. Students learn to construct both simple and complex sentences, facilitating effective written and spoken communication. Logical and critical reasoning skills are honed for meaningful presentations. Additionally, the art of public speaking and listening is explored, enhancing overall communication competence. The course also covers essay writing, comprehension, sentence construction, and report writing, preparing students for effective written and oral communication in various contexts.

Course Objectives

The objectives of the course are to:

1. Develop the ability to identify and analyze possible sound patterns in the English language, enhancing pronunciation and listening skills.
2. Classify various word formation processes, allowing for a deeper understanding of vocabulary and language structure.
3. Acquire the skills to construct both simple and fairly complex sentences in English, facilitating clear and effective communication.
4. Apply logical and critical reasoning skills to organize ideas coherently and present them meaningfully in both written and spoken form.
5. Demonstrate an appreciable level of competence in the art of public speaking and listening, fostering effective communication and presentation abilities.

6. Develop the capacity to write both simple and technical reports, honing skills in organization, grammar, style, and effective communication for various contexts and audiences.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Identify possible sound patterns in English Language.
2. Classify word formation processes.
3. Construct simple and fairly complex sentences in English.
4. Apply logical and critical reasoning skills for meaningful presentations.
5. Demonstrate an appreciable level of the art of public speaking and listening.
6. Write simple and technical reports.

Course Content

Effective communication and writing in English Language skills, essay writing skills (organization and logical presentation of ideas, grammar and style), comprehension, sentence construction, outlines and paragraphs.

GST107: **Use of Library, Study Skills and ICT** **(2 Credits: LH 30)**

Course Overview

GST107 introduces students to the essential skills required for academic success. It delves into the history and significance of libraries, emphasizing their role in education. The course covers a wide array of study skills, reference services, and various library materials, including e-learning resources. Students learn about library catalogues and classification systems, the intricacies of copyright and its implications on database resources, and the importance of bibliographic citations and referencing. In the realm of ICT, the course explores hardware and software technologies, input and output devices, and practical exercises in communication, internet services, and word processing, equipping students with valuable academic and technological proficiency.

Course Objectives

The objectives of the course are to:

1. Library Proficiency: Gain an in-depth understanding of the history and significance of libraries, including their role in education and the distinctions between various library types.
2. List and apply a diverse range of study skills, including reference services and utilizing library materials, e-learning, and e-materials for academic research and enhancement.
3. Outline different types of library catalogues (e.g., card catalogs, OPAC) and classification systems, enabling effective navigation of library resources.
4. Define and discuss copyright laws and their impact on database resources. Understand the importance of bibliographic citations and referencing and the potential consequences of improper citation practices.

5. Explore the evolution of modern ICT and identify hardware and software components. Develop proficiency in recognizing input, storage, and output devices, and gain practical skills in communication, internet services, and word processing, enhancing overall ICT literacy.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Discuss the history of libraries; Library and education; University libraries and other types of libraries.
2. List the different types of Study skills (reference services); List the types of library materials, using library resources including e-learning, e-materials and how it can be applied in other aspect of academic research.
3. Outline the types of Library catalogues (card, OPAC, etc.) and classification.
4. Define and discuss copyright and its implications on database resources. Outline the importance of Bibliographic citations and referencing; consequences that may occur, if not done properly.
5. Outline the development of modern ICT. Be able to identify the different parts of Hardware technology; Software technology; Input devices; Storage devices; Output devices as it applies to ICT.
6. Perform practical exercise on communication and internet services; Execute Word processing skills (typing, etc.).

Course Content

Brief history of libraries; Library and education; University libraries and other types of libraries; Study skills (reference services); Types of library materials, using library resources including e-learning, e-materials, etc.; Understanding library catalogues (card, OPAC, etc.) and classification; Copyright and its implications; Database resources; Bibliographic citations and referencing. Development of modern ICT; Hardware technology; Software technology; Input devices; Storage devices; Output devices; Communication and internet services; Word processing skills (typing, etc.).

2.5.2 100-Level Courses Second Semester

CHM102: Organic Chemistry (2 Units: LH 30)

Course Overview

CHM102 explores the rich history and significance of organic chemistry in shaping the modern world. Students delve into nomenclature and classification of organic compounds based on the homologous series concept. The course covers the structure and properties of organic compound classes, including alkanes, cycloalkanes, alkenes, and alkynes, while highlighting the importance of functional groups. It also delves into the unique characteristics of benzene and its connection to aromaticity, alongside techniques for isolating, purifying, and identifying organic compounds.

Course Objectives

The objectives of the course are to:

1. Historical Context: Understand the historical development and significance of organic chemistry, recognizing its pivotal role in shaping the modern world and scientific advancements.
2. Identify and classify organic compounds using various nomenclature systems, emphasizing the concept of homologous series for accurate classification.
3. Describe the structure and properties of specific organic compound classes, including alkanes, cycloalkanes, alkenes, alkynes, and explore the significance of functional groups in organic chemistry.
4. Analyze the unique characteristics of benzene and its relationship to the concept of aromaticity within organic compounds, providing insights into the behavior of aromatic compounds.
5. Explain the techniques used for the isolation, purification, and identification of organic compounds, gaining practical laboratory skills essential for organic chemistry experimentation and analysis.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the historical development and significance of organic chemistry as a branch of chemistry, recognizing its role in shaping the modern world.
2. Identify and classify the various nomenclature of organic compounds based on homologous series concept.
3. Describe the structure and properties of specific organic compound classes, including alkanes, cycloalkanes, alkenes, alkynes, and the significance of functional groups.
4. Analyze the unique characteristics of benzene and its relationship to the concept of aromaticity within organic compounds.
5. Explain the techniques for the isolation, purification, and identification of organic compounds.

Course Content

Historical survey of the development and importance of organic chemistry; nomenclature and classes of organic compounds, Homologous series; Alkanes, and cycloalkanes, alkenes, alkynes; Functional groups; Benzene and aromacity; isolation, purification and identification of organic compounds.

CHM104: Inorganic Chemistry (2 Units: LH 30)

Course Overview

In CHM104, fundamental ideas in inorganic chemistry are examined, with an emphasis on important ideas and their useful applications. Students study units and measures in the context of physical chemistry, allowing them to perform accurate measurements and convert units. Phase changes, matter states, and the fundamentals of thermodynamics are all covered in the course. It also explores the characterisation of acids, bases, and salts, as well as gas characteristics, equilibrium theories, thermochemical properties, and chemical kinetics.

Students also become more adept at redox reactions and potentials. Students leave this thorough course with the information they need to comprehend chemical reactions and processes.

Course Objectives

The objectives of the course are to:

1. Measurement Proficiency: Develop the ability to explain units and measurements in physical chemistry, mastering unit conversions and precise measurements for scientific accuracy.
2. Analyze states of matter and their transitions, applying thermodynamic principles to elucidate changes in state, such as phase transitions and phase diagrams.
3. Describe the properties and behaviors of gases, including gas laws, ideal and real gases, and apply this knowledge to practical scenarios.
4. Evaluate chemical equilibria, including equilibrium constants, Le Chatelier's principle, and equilibrium concentration calculations.
5. Calculate and analyze thermochemical properties such as enthalpy, entropy, and Gibbs free energy, using these concepts to comprehend energy changes in chemical reactions.
6. Explain the fundamentals of introductory chemical kinetics, encompassing reaction rates, rate laws, and reaction mechanisms, and apply this knowledge to predict reaction kinetics and mechanisms.
7. Define, characterize, and proficiently work with acids, bases, and salts, including calculating pH, pOH, and conducting titrations.
8. Describe redox reactions, identify oxidation and reduction processes, and calculate redox potentials and half-reactions, enabling a deep understanding of redox chemistry.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain units and measurements in the context of physical chemistry, including the ability to convert between different units and perform accurate measurements.
2. Analyse the various states of matter and their transitions, and apply principles of thermodynamics to explain changes in state, such as phase transitions and phase diagrams.
3. Describe the properties and behaviours of gases, including gas laws, ideal gases, and real gases, and apply this knowledge to practical situations.
4. Evaluate chemical equilibria, including the concept of equilibrium constants, Le Chatelier's principle, and the calculation of equilibrium concentrations.
5. Calculate and analyse thermochemical properties, including enthalpy, entropy, and Gibbs free energy, and apply these concepts to understand energy changes in chemical reactions.
6. Explain the fundamentals of introductory chemical kinetics, including reaction rates, rate laws, and reaction mechanisms, and apply this knowledge to predict reaction rates and mechanisms.

7. Define and characterize acids, bases, and salts, and demonstrate the ability to calculate pH, pOH, and perform titrations.
8. Describe redox reactions, identify oxidation and reduction processes, and calculate redox potentials and half-reactions.

Course Content

Units and measurement in physical chemistry. State of matter and change of state; Gases and their properties. Chemical equilibria; Thermochemistry; Introductory chemical kinetics; Acids, bases and salts; Redox reactions and redox potentials

CHM108: Practical Chemistry II (1 Credit: PH 45)

Course Overview

CHM108: Practical Chemistry II is a laboratory-focused course that builds upon the foundational knowledge gained in CHM101 and CHM102. Students will learn and apply essential safety rules and laboratory techniques specific to organic chemistry. They will also gain proficiency in handling common laboratory equipment, isolating and purifying organic compounds, and determining physical constants. This course provides hands-on experience in identifying and studying the properties and reactions of organic compounds, reinforcing concepts introduced in earlier chemistry courses.

Course Objectives

The objectives of the course are to:

1. List and adhere to basic safety rules in the organic chemistry laboratory to ensure a safe working environment.
2. Identify and effectively use common laboratory apparatuses and equipment, demonstrating competence in handling laboratory tools.
3. Apply fundamental organic laboratory techniques to conduct experiments, including the isolation and purification of organic compounds, and accurately document experimental procedures and results.
4. Perform experiments to determine the physical constants of organic compounds, acquiring the skills to measure and report on essential properties.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. List the basic safety rules in the organic chemistry laboratory
2. Identify and use the common laboratory apparatuses and equipment
3. Apply the basic organic laboratory techniques, carryout experiments and document report for the isolation and purification of organic compounds
4. Carryout experiments and document report for the determination of physical constants of organic compounds
5. Carryout simple experiments illustrating the identities and reactions of organic compounds and report inference.

Course Content

Continuation of laboratory experiments designed to reflect the topics taught in CHM 101 and CHM 102. Some of the experiments will have been carried out in CHM 107.

MTH102: General Mathematics II (Calculus) (3 Credits: LH 45)
Course Overview
MTH102: General Mathematics II (Calculus) covers the principles of calculus. The knowledge of differentiation and integration techniques will give pupils the capacity to solve a variety of mathematical issues involving functions, limits, continuity, rates of change, and curve drawing. The course covers applications of definite integrals in computing areas and volumes in addition to integration techniques. By the end, students will have a firm understanding of calculus and how it can be applied in practical situations.

Course Objectives
The objectives of the course are to:
1. Develop proficiency in applying various rules and techniques for differentiation and integration, allowing for the solution of complex mathematical problems.
2. Gain a deep understanding of functions involving real variables, including their graphical representations, limits, and continuity.
3. Learn how to apply definite integrals to calculate areas and volumes of solids, enabling practical applications in various fields.
4. Explain the derivative as the limit of a rate of change, facilitating a fundamental understanding of calculus concepts.
5. Acquire the skills to sketch curves, analyze extreme points, and optimize functions, enhancing problem-solving abilities in calculus.

Course Learning Outcomes
Upon completing the course, the student will be able to:
1. Solve mathematical questions that involve the different rules in differentiation and integration.
2. Solve questions involving function of a real variable, graphs, limits and continuity.
3. Solve some applications of definite integrals in areas and volumes of solids.
4. Solve questions involving the derivative as limit of rate of change.
5. Perform extreme curve sketching.
6. Solve questions involving integration as an inverse of differentiation.
7. Solve questions involving methods of integration and definite integrals.

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

MTH 104: Elementary Vectors, Geometry and Mechanics (3 Units: LH 45)
Course Overview

MTH 104: Elementary Vectors, Geometry, and Mechanics provides a complete exploration of mathematical and physical principles. The understanding of vector operations, vector representation in various dimensions, and vector applications will be imparted to the students. The course includes coverage of equations, geometrical shape properties, and two-dimensional coordinate geometry. Additionally, students will study the mechanical concepts of forces, momentum, and particle kinematics. As we look at practical applications such projectile motion, oscillatory behavior, and collision dynamics, our ability to solve problems will grow.

Course Objectives

The objectives of the course are to:

1. Master Vector Concepts: Develop the ability to geometrically represent vectors in one to three dimensions, calculate their components, and determine direction cosines.
2. Acquire proficiency in performing vector addition, scalar multiplication, and assessing the linear independence of vectors.
3. Learn to compute both scalar and vector products of two vectors and apply these concepts in various contexts and problem-solving situations.
4. Gain a deep understanding of two-dimensional coordinate geometry, including equations and properties of geometric shapes like straight lines, circles, parabolas, ellipses, and hyperbolas.
5. Explore the fundamental principles of mechanics, including kinematics, forces, momentum, and laws of motion under gravity. Apply these principles to analyze projectile motion, oscillatory motion, and collisions.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Represent vectors geometrically in one to three dimensions and determine their components and direction cosines.
2. Perform vector addition, scalar multiplication, and determining linear independence of vectors.
3. Compute both scalar and vector products of two vectors and apply these concepts in various contexts.
4. Differentiate and integrate vector functions with respect to a scalar variable.
5. Solve problems involving two-dimensional coordinate geometry, including the equations and properties of straight lines, circles, parabolas, ellipses, hyperbolas, tangents, and normal.
6. Analyze the kinematics of particles, calculating the components of velocity and acceleration for particles moving within a plane.
7. Determine the fundamental principles of force, momentum, and the laws of motion under gravity. They will apply these concepts to analyze projectile motion and resisted vertical motion.
8. Describe the behaviour of elastic strings and simple pendulums, including their oscillatory motion characteristics.
9. Perform calculation on impulse and analyze the impact of two smooth spheres colliding on a smooth surface, considering conservation laws and collision dynamics.

Course Contents

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

PHY102: Electricity and Magnetism (3 Units: LH 45)

Course Overview

PHY102: Electricity and Magnetism provides a comprehensive exploration of electromagnetism principles and electrical circuits. Students will understand fundamental concepts like Coulomb's law and Gauss's theorem, enabling them to analyze electric fields. The course covers electrical circuit components, including capacitors, Ohm's law, and Kirchhoff's laws, and their practical applications. Additionally, students will delve into magnetic effects, electromagnetic induction, and the operation of devices. Practical skills in using electrical measuring instruments and understanding semiconductor properties are emphasized, enhancing students' knowledge of electricity and magnetism.

Course Objectives

The objectives of the course are to:

1. Understand and apply fundamental principles of electromagnetism, including Coulomb's law and Gauss's theorem, to analyze and predict electric fields and their impact on charged particles.
2. Describe electrical circuits comprehensively, including capacitors, Ohm's law, and Kirchhoff's laws. Solve complex circuit problems and apply these principles to real-world scenarios.
3. Investigate the magnetic effects of current and electromagnetic induction. Explain the operation of devices like moving coil and ballistic galvanometers in various contexts.
4. Gain proficiency in using electrical measuring instruments, including multimeters, DC and AC meters, and generators, to measure and analyze electrical quantities accurately in circuits.
5. Explain the concepts of power in AC circuits and delve into semiconductor properties such as conductivity and mobility. Understand the principles of rectification in electrical circuits and their practical applications.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain and apply fundamental principles of electromagnetism, including Coulomb's law and Gauss's theorem, to analyze electric fields and their effects on charged particles.

2. Describe electrical circuits, including capacitors, Ohm's law, Kirchhoff's laws, and their application in solving circuit problems.
3. Describe the magnetic effect of current, electromagnetic induction, and the operation of devices such as moving coil and ballistic galvanometers.
4. Utilize electrical measuring instruments, including multimeters, DC and AC meters, and generators, to measure and analyze electrical quantities in circuits.
5. Explain the concepts of power in AC circuits, semiconductor properties such as conductivity and mobility, and the principles of rectification in electrical circuits.

Course Content

Coulomb's law. Gauss's theorem. Capacitors. Ohm's law. Kirchoff's laws, electrical energy, D.C. bridges and potentiometer. Magnetic effect of current, electromagnetic induction, moving coil and ballistic galvanometer. Multimeter, D. C. And A. C. Meters and generators. Hysteresis. Power in A. C. circuit, semiconductors, conductivity and mobility. Rectification.

GST102: **Communication in English II** **(2 Credits: LH 30)**

Course Overview

GST102: Improving language proficiency through communication in English II. Students will rewrite English paragraphs, correctly pronounce words, and analyze and restate English paragraphs. You'll gain assurance in your ability to communicate effectively across disciplines and in expressing your thoughts. The course develops excellent communication and writing skills, including those needed to write English compositions and articles, by covering logical paper presentation, phonetics, lexis, public speaking, figures of speech, summary, and report writing.

Course Objectives

The objectives of the course are to:

1. Enhance Reading Comprehension: Improve the ability to restate the meaning of English paragraphs by analyzing their content, enhancing reading comprehension skills.
2. Develop English writing skills to a level where grammatical errors are minimized, allowing for effective written communication.
3. Achieve correct pronunciation of English words and phrases, enhancing oral communication clarity and fluency.
4. Cultivate confidence in expressing opinions and thoughts in English, enabling effective verbal communication.
5. Apply acquired communication skills, including values and abilities, to other disciplines, fostering interdisciplinary communication proficiency.
6. Hone the ability to write English compositions and articles effectively, improving written communication and analytical skills.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Restate the meaning of an English paragraph after analyzing it

2. Write in English without making any grammatical errors.
3. Pronounce words correctly in the English language.
4. Confidently express your opinions in English.
5. Communicate values and abilities acquired via successful communication to other disciplines
6. Write English compositions and articles

Course Content

Logical presentation of papers; Phonetics; Instruction on lexis; Art of public speaking and oral communication; Figures of speech; Précis; Report writing.

GST108: Communication in French (2 Credits: LH 30)

Course Overview

GST108: Communication in French introduces students to the French language. They will learn the French alphabet and basic numeracy for effective written and oral communication. The course focuses on constructing simple sentences using a communication-based approach, as well as reading comprehension passages and answering questions. This foundation in French language skills prepares students for effective communication in both written and spoken French contexts.

Course Objectives

The objectives of the course are to:

1. Write and recite the French alphabet accurately.
2. Understand and apply basic numeracy skills necessary for effective written and oral communication in French.
3. Learn to construct simple sentences in French using proper grammar and vocabulary.
4. Develop the ability to comprehend and interpret simple French texts and answer questions based on them.
5. Gain confidence in basic oral and written communication in French, focusing on real-life situations.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Write down the French alphabets.
2. Outline the numeracy for effective communication (written and oral)
3. Construct simple sentence, read comprehension passages and answer questions.

Course Content

Introduction to French, Alphabets and numeracy for effective communication (written and oral), Conjugation and simple sentence construction based on communication approach, Sentence construction, Comprehension and reading of simple texts.

GST110: Basic Communication in Arabic (2 Credits: LH 30)

Course Overview

GST110: Basic Communication in Arabic provides students with essential language skills. Students will explore Arabic alphabets, basic sentence construction, and develop reading skills. By course end, students can discuss Arabic values, construct simple sentences, analyze complex words, and read Arabic texts effectively, enhancing their language proficiency.

Course Objectives

The objectives of the course are to:

1. Explain the cultural and linguistic significance of the Arabic language, highlighting its values and importance.
2. Demonstrate the ability to construct basic sentences in Arabic, using appropriate grammar and vocabulary.
3. Analyze and decipher complex words in both vocalized and un-vocalized Arabic texts, improving language comprehension.
4. Develop effective reading skills in Arabic and answer questions based on Arabic texts, enhancing overall language proficiency.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Discuss the values of Arabic Language.
2. Construct simple sentences in Arabic language.
3. Analyse difficult words from both vocalized and un-vocalized Arabic texts.
4. Reading Arabic text and answering question.

Course Content

Introduction to Arabic alphabets and writing systems. Elementary conversational drills.
Basic reading skills and sentence construction in Arabic.

PHY 108: Practical Physics II (2 Credits: LH 30; PH 45)

Course Overview

PHY 108: Practical Physics II is designed to develop students' hands-on skills in experimental physics. You will learn to conduct precise measurements, record observations, and analyze data while focusing on error assessment and graphical representation. The course covers various experiments, including those related to meters, oscillation, light, heat, and more. Additionally, you'll be introduced to computer programming, algorithm design, and problem-solving, providing a comprehensive foundation in practical physics and computational techniques.

Course Objectives

The objectives of the course are to:

1. Develop proficiency in conducting accurate measurements of various physical quantities using appropriate instruments and techniques.
2. Acquire the skills to make detailed observations, systematically collect data, and organize it into well-structured tables.

3. Recognize and assess common experimental errors, enabling the identification and mitigation of inaccuracies in measurements.
4. Gain competence in plotting data points and constructing graphs for data analysis and interpretation.
5. Develop the ability to draw meaningful conclusions from both numerical and graphical analyses of experimental data.
6. Learn to prepare and present comprehensive practical reports that effectively communicate experimental procedures and findings.

Course Learning Outcomes

Upon completing the course, the student will 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.
6. Prepare and present practical reports.

Course Contents

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

Introduction to computers and computing. Problems solving on computer algorithm, design using flowchart and pseudo-code. Introduction to high level programming languages, Basic and FORTRAN syntax, flow of control, input/output constructs, data types. Programming in FORTRAN. Extensive exercises in solving engineering problems using flowchart and pseudo-code.

CSC104: Computer Programming I (2 Credits: LH 30; PH 45)

Course Overview

CSC104, Computer Programming I, provides a foundational understanding of programming principles and structured programming concepts. You will learn the syntax and semantics of a high-level programming language, including variables, types, expressions, statements, and input/output operations. The course covers program control structures, functions, parameter passing, and structured decomposition. Through hands-on practice and debugging, students will gain the ability to develop and test simple programs in the selected programming language. This course is an essential step in building programming skills and problem-solving capabilities.

Course Objectives

The objectives of the course are to:

1. Understand and apply the principles of good programming, including structured programming concepts, for writing efficient and maintainable code.
2. Explain the syntax and semantics of a chosen high-level programming language, including variables, types, expressions, statements, and input/output operations.
3. Demonstrate proficiency in working with programming language constructs, such as variables, expressions, and simple input/output operations.
4. Describe and utilize program control structures, functions, parameter passing, and structured decomposition to solve complex problems.
5. Develop, debug, and test simple programs in the taught programming language, applying problem-solving skills and coding techniques learned in the course.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the principles of good programming and structured programming concepts.
2. Explain the programming constructs, syntax and semantics of a higher-level language.
3. Describe the chosen programming language variables, types, expressions, statements and assignment, Simple input and output.
4. Describe the programme control structures, functions and parameter passing, and structured decomposition.
5. Develop simple programmes in the taught programming language as well as debug and test them.

Course Content

Introduction to computers and computing. Problems solving on computer algorithm, design using flowchart and pseudo-code. Introduction to high level programming languages, Basic and FORTRAN syntax, flow of control, input/output constructs, data types. Programming in FORTRAN. Extensive exercises in solving engineering problems using flowchart and pseudo-code.

200-Level Courses

2.5.3 200-Level Courses First Semester

The 200-level foundation engineering courses are designed to introduce students to engineering fundamentals in their broadest sense. However, as electives, students may select three credits within their course of study. This hypothesis states that introducing engineering students to the basics of the field in their second year of study equips them with the knowledge they need to later determine whether they want to pursue a certain specialty.

MEE 209: Engineering Drawing I (2 Units)

Course Overview

Engineering drawing I is a foundational course designed to equip students with essential skills in creating precise and comprehensive engineering drawings. The course covers various aspects of engineering drawing techniques, including the transfer of lettering, dimensioning, orthographic projection, auxiliary and mechanical sectional views, graphical calculus, and architectural drawings. Through practical exercises and theoretical knowledge, students will gain proficiency in representing three-dimensional objects on a two-dimensional plane, analyzing true lengths and angles, and creating architectural drawings for construction and design purposes. The course emphasizes accuracy, clarity, and adherence to industry standards in engineering graphics.

Course Objectives

The objectives of the course are to:

1. Demonstrate competence in accurately transferring lettering in engineering drawings through appropriate techniques.
2. Apply dimensioning principles to create precise and clear engineering drawings, adhering to standard practices.
3. Utilize orthographic projection methods effectively to represent three-dimensional objects on a two-dimensional plane.
4. Create auxiliary views and mechanical sectional views to effectively communicate complex features and internal structures of objects.
5. Employ graphical calculus methods to analyze true lengths and angles in engineering drawings.
6. Acquire skills in interpreting and generating architectural drawings for construction and design purposes.
7. Demonstrate proficiency in producing accurate and detailed architectural drawings, including floor plans and elevations, for both residential and commercial structures using industry-standard software and techniques.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Draw accurate technical drawings, including auxiliary and sectional views, utilizing advanced dimensioning and tolerancing standards.
2. Utilize computer-aided graphics software to design and analyze complex engineering drawings and projects.
3. Apply blue-print reading skills to interpret and evaluate engineering drawings for key features, dimensions, and tolerances.
4. Collaborate effectively in teams to develop and present engineering design projects using computer-aided graphics tools.
5. Identify and solve design problems through structured decomposition and the application of advanced graphical techniques, resulting in optimized engineering designs.

Course Content

Transfer of lettering, dimensioning, orthographic projection, auxiliary and mechanical sectional view, true lengths, graphical calculus and architectural drawings.

MEE 203: Students Work Shop Experience (1 Units: LH 15)

Course Overview

Student Workshop Experience (MEE 203) is a practical course that introduces students to fundamental engineering practices and skills. This hands-on workshop covers the operation of hand and powered tools for cutting and fabricating wood and metal, providing supervised experience to ensure safe and proficient tool usage. Through practical exercises and projects, students develop essential skills in engineering fabrication, safety consciousness, and responsible tool usage, fostering practical engineering competency.

Course Objectives

The objectives of the course are to:

1. Introduce students to fundamental engineering practices and skills, with a focus on operating hand and powered tools for cutting and fabricating wood and metal.
2. Provide supervised hands-on experience in a controlled environment to ensure safe and proficient usage of tools and machines for specific engineering tasks.
3. Develop hands-on project completion and fabrication skills through practical exercises.
4. Cultivate safety consciousness and promote responsible hand/power tool usage in engineering applications.
5. Foster practical engineering skill development to enable students to perform engineering tasks effectively.
6. Enhance understanding of tools and machine capabilities/limitations to make informed decisions during engineering operations.
7. Instruct students in tool and machine selection for various engineering tasks, considering factors such as efficiency, precision, and safety.

Course Learning Outcomes

Upon completing the course, the student will be able to:’

1. Demonstrate competence in safely operating hand tools used in woodcutting and fabrication tasks.
2. Apply proper techniques for cutting and shaping metal using powered tools, ensuring precision and adhering to safety protocols. successfully complete hands-on projects that involve both wood and metal materials, showcasing acquired skills in fabrication.
3. Practice safe usage of hand and powered tools in a supervised environment, strictly adhering to established safety guidelines.
4. Engage in supervised hands-on activities, such as woodworking and metalworking, to develop practical engineering skills.
5. Explain the operations and limitations of various tools and machines commonly used in general engineering practices.
6. Identify and select appropriate tools and machines for specific engineering tasks based on material type and project requirements.

Course Content

Introduction to practices and skills in general engineering through instruction in operation of hand and powered tools for wood and metal cutting and fabrication. Supervised hands - on experience in safe usage of tools and machines for selected tasks.

MEE 205: Applied Mechanics I (3 Units: LH 45)

Course Overview

Fundamentals of Fluid Mechanics (MEE 204) is a comprehensive course that provides students with a strong foundation in the principles and applications of fluid mechanics. This course covers a wide range of topics, including fluid properties, fluid statics, conservation laws, friction effects in laminar and turbulent flows, dimensional analysis, dynamic similitude, and the principles of hydraulic machinery and hydropower systems. Through theoretical learning and practical exercises, students gain valuable insights into the behavior of fluids and their application in engineering.

Course Objectives

The objectives of the course are to:

1. Develop an understanding of forces, moments, and couples acting on engineering structures and machine components.
2. Analyze the equilibrium of simple structures and machine parts under various loading conditions.
3. Examine the principles of friction and its impact on the stability and motion of engineering systems.
4. Calculate first and second moments of area and determine centroids for plane figures to analyze structural properties.
5. Comprehend the kinematics of particles and rigid bodies in plane motion and apply newton's laws of motion to engineering problems.
6. Conduct kinetic energy and momentum analyses to understand the behavior of engineering systems during motion.
7. Analyze the dynamic behavior of particles and rigid bodies during motion.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Differentiate various types of forces, moments, and couples encountered in engineering systems, and analyze their effects.
2. Analyze the equilibrium of simple structures and machine components subjected to diverse external loads.
3. Determine the principles of friction and calculate frictional forces in engineering applications.
4. Explain first and second moments of area for plane figures and determine centroids to analyze their structural characteristics.
5. Apply kinematic principles to analyze the motion of particles and rigid bodies in plane motion.
6. Perform kinetic energy analyses for engineering systems in motion to determine their energy states.

7. Determine momentum for particles and rigid bodies during motion to analyze their dynamic behaviour.

Course Content

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

MEE 207: Engineering Materials (3 Units: LH 45)

Course Overview

Engineering Materials (MEE 207) is a fundamental course in the field of engineering that introduces students to the properties, structures, and behaviors of materials commonly used in engineering applications. This course covers topics such as atomic structures, inter-atomic bonding mechanisms, crystal and microstructure, and their relationships with the mechanical and thermal properties of metals, alloys, ceramics, and plastics. Additionally, the course explores the principles of material behavior in various environments and the fabrication processes used in engineering applications.

Course Objectives

The objectives of the course are to:

1. Introduce students to electronic configurations and atomic structures, establishing a foundation for understanding material properties.
2. Explore inter-atomic bonding mechanisms, crystal structures, and microstructures to reveal the relationship between structure and material properties.
3. Investigate the behavior of metals, alloys, ceramics, and plastics in different environments, considering their performance and applications.
4. Analyze the principles of material properties and their influence on material selection and design in engineering applications.
5. Examine various fabrication processes used to produce materials and their applications in engineering and technology.
6. Apply material selection techniques to engineering applications, considering factors such as performance, durability, and cost-effectiveness.
7. Critically evaluate material applications and limitations, considering real-world engineering challenges and constraints.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Describe electronic configurations and atomic structures, emphasizing their influence on material behaviour and properties.
2. Analyse bonding mechanisms and crystal structures in diverse materials to comprehend their unique properties.
3. Relate microstructure to material properties, examining how material processing affects the final product.

4. Compare the properties and performance of metals, alloys, ceramics, and plastics in various environments.
5. Explain the relationships between material structure and properties.
6. Explain the fabrication processes used to produce materials, such as casting, welding, and moulding.
7. Apply knowledge of material properties to select suitable materials for specific engineering applications.

Course Content

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. Fabrication processes and applications.

EMA 201: Engineering Mathematics I (3 Units: LH 45)

Course Overview

Engineering Mathematics I, provides students with essential mathematical tools and concepts for engineering applications. This course covers a wide range of topics, including limits and continuity, vector and matrix analysis, and differentiation of functions of two variables. Students will also delve into the world of differential equations, learning about nth-order differential equations and their real-world applications. Integration techniques, including double and triple integration, will be explored for solving engineering problems related to area and volume. The course will conclude with a study of partial differential equations, Fourier series, and their practical applications in engineering processes. Upon completing this course, students will have a solid foundation in mathematics to tackle complex engineering challenges.

Course Objectives

The objectives of the course are to:

1. Solve qualitative problems based on vector and matrix analyses, including determining linear independence and dependence of vectors and calculating rank.
2. Describe the concepts of limit theory and nth order differential equations and apply them to solve problems related to physical phenomena.
3. Solve problems involving differentiation of functions of two variables and understand the principles of maximization and minimization of functions with several variables.
4. Solve problems using double and triple integration to find the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's, and Green's theorem.
5. Utilize knowledge of ordinary differential equations and their applications, including developing mathematical models for linear differential equations and understanding the necessary and sufficient conditions for total differential equations.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank.
2. Describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena.
3. Solve the problems on differentiation of functions of two variables and know about the maximization and minimization of functions of several variables.
4. Solve the problems on 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. Use the knowledge of 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.
6. Solve question involving basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as Fourier series, initial conditions and its applications to different engineering processes.

Course Content

Limits, Continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, Vector algebra, Vector calculus, Directional Derivatives.

CIE 201: Strength of Materials (3 Units: LH 45)

Course Overview

Strength of Materials focuses on analyzing and explaining the behavior of structural components. After completing this course, students will be able to evaluate symmetrical and stable structural systems. Students use Hooke's rule to create stress-strain relations for both single and composite components while accounting for the impacts of temperature changes. Students compute shear forces, bending moments, and bending stresses on beams that have experienced various loads. Mohr's circle and stress transformation approaches are looked into for multi-dimensional stress systems. Additionally, covered are torsion in circular components and column buckling under various end fixity conditions. This course lays forth the fundamentals of sound structural engineering practices.

Course Objectives

The objectives of the course are to:

1. Structural System Analysis: Develop the ability to analyze and determine the stability and equilibrium of structural systems, ensuring they meet engineering requirements for safety and functionality.
2. Stress-Strain Analysis: Understand and apply Hooke's law to establish stress-strain relations for both single and composite members, enabling the prediction of material behavior under various loads.
3. Temperature-Induced Stresses: Calculate the stresses and strains in single and composite members resulting from temperature changes, ensuring the integrity of structures exposed to varying environmental conditions.

4. Shear and Bending Analysis: Analyze the distribution of shear forces and bending moments in beams subjected to distributed and concentrated loads, and determine bending stresses for evaluating beam deflections and slopes.
5. Multi-Dimensional Stress Analysis: Utilize Mohr's circle to assess normal and shear stresses in multi-dimensional stress systems. Apply stress transformation techniques to relate stresses to strains, facilitating comprehensive structural analysis.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Analyse the structural system that is stable and in equilibrium.
2. Determine the stress-strain relation for single and composite members based on Hooke's law.
3. Calculate the stresses and strains in single and composite members due to temperature changes.
4. Evaluate the distribution of shear forces and bending moments in beams with distributed and concentrated loads.
5. Determine bending stresses and their use in identifying slopes and deflections in beams.
6. Use Mohr's circle to evaluate the normal and shear stresses in a multi-dimensional stress system and transformation of these stresses into strains.
7. Evaluate the stresses and strains due to torsion on circular members.
8. Determine the buckling loads of columns under various fixity conditions at the ends.

Course Content

Consideration of equilibrium; composite members, stress-strain relation. Generalized Hooke's law. Stresses and strains due to loading and temperature changes. Torsion of circular members. Shear force, bending moments and bending stresses in beams with symmetrical and combined loadings. Stress and strain transformation equations and Mohr’s circle. Elastic buckling of columns.

GEN 201: Engineering in Society (1 Units: LH 15)

Course Overview

Engineering in Society provides a comprehensive understanding of the intricate relationship between engineering, society, and the broader world. This course equips students to differentiate between science, engineering, and technology, emphasizing their roles in innovation. Students also explore the various cadres of engineering professionals, from engineers and technologists to technicians and craftsmen, gaining insights into their roles and competencies. The course delves into the significance of professional bodies in engineering and the ethical aspects of the engineering profession. Additionally, it covers the goals of global development (Sustainable Development Goals) and emphasizes safety and risk assessment in engineering practice, fostering well-rounded engineers with a strong sense of responsibility.

Course Objectives

The objectives of the course are to:

1. Develop a clear understanding of the distinctions between science, engineering, and technology and their interconnectedness with the process of innovation.
2. Recognize and differentiate the roles and competencies of various engineering cadres, including engineers, technologists, technicians, and craftsmen.
3. Identify and differentiate between the relevant professional organizations and societies in the field of engineering.
4. Categorize and understand the significance of global development goals, with a particular focus on sustainable development goals (SDGs).
5. Acquire the ability to identify, evaluate, and manage safety and risk factors inherent in engineering practice, fostering a culture of safety and responsibility.

Course Learning Outcomes

Upon completing the course, the student will 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).
5. Identify and evaluate safety and risk in engineering practice.

Course Content

Philosophy of Science and Engineering. History of Engineering and Technology. The Engineering profession - engineering - engineering literacy professional bodies and engineering societies. Engineers' code of conduct and ethics. Engineers and nation building - economy, politics, business, safety in Engineering and introduction in Risk analysis, invited lecturers from professionals.

GST 201: Logic, Philosophy and Human Existence (2 Units: LH 30)

Course Overview

This course offers a comprehensive exploration of philosophy and logic, equipping students with valuable cognitive tools. You will delve into the main branches of philosophy, exploring foundational concepts, while mastering symbolic logic, including symbols for logical operations. Deductive reasoning, discourse analysis, and critical thinking techniques are emphasized to evaluate arguments across diverse contexts, from literature to law. By the end, you'll possess a profound understanding of philosophy and the skills to analyze, construct, and evaluate arguments effectively.

Course Objectives

The objectives of the course are to:

1. Provide a comprehensive overview of the main branches of philosophy and their foundational concepts, fostering a deep understanding of philosophical thought.
2. Demonstrate proficiency in symbolic logic, including the use of special symbols for logical operations like conjunction, negation, affirmation, disjunction, equivalence, and conditional statements.
3. Apply deductive reasoning techniques, employing rules of inference and bi-conditionals, while understanding qualification theory to evaluate and construct valid arguments.
4. Develop the ability to analyze various forms of discourse, identify argument structures, and assess their validity and soundness, distinguishing between inductive and deductive reasoning.
5. Apply principles of symbolic logic and critical thinking to evaluate arguments and reasoning in diverse contexts, including literature, law reports, novels, and newspaper publications.
6. Foster critical thinking skills by encouraging students to critically evaluate and question philosophical and logical arguments.
7. Cultivate effective communication skills for expressing philosophical and logical ideas clearly and persuasively in both written and verbal forms.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the main branches of philosophy and their foundational concepts, providing a broad understanding of philosophical thought.
2. Apply symbolic logic in explain the use of special symbols for logical operations such as conjunction, negation, affirmation, disjunction, equivalence, and conditional statements.
3. Apply deductive reasoning using rules of inference and bi-conditionals, and understand qualification theory to evaluate and construct valid arguments.
4. Analyze different types of discourse, recognize the nature of arguments, and assess their validity and soundness, distinguishing between inductive and deductive inferences.
5. Apply the principles of symbolic logic and critical thinking techniques to evaluate arguments and reasoning in various contexts, including literature materials, novels, law reports, and newspaper publications.

Course Content

A brief survey of the main branches of Philosophy; Symbolic logic; Special symbols in symbolic logic-conjunction, negation, affirmation, disjunction, equivalent and conditional statements, law of tort. The method of deduction using rules of inference and bi-conditionals, qualification theory. Types of discourse, nature or arguments, validity and soundness, techniques for evaluating arguments, distinction between inductive and deductive inferences; etc. (Illustrations will be taken from familiar texts, including literature materials, novels, law reports and newspaper publications).

GST 203: Nigerian Peoples and Culture (2 Units: LH 30)

Course Overview

This course provides a deep dive into the rich tapestry of Nigerian history, culture, and art, covering periods up to 1800, colonial rule, and the evolution of Nigeria as a political entity. You'll explore concepts of trade, economic self-reliance, social justice, and national development, delving into vital topics like individual values, norms, and current socio-political and cultural developments in Nigeria. With a focus on re-orientation and moral development, you'll also examine key initiatives such as Operation Feed the Nation, Green Revolution, and the fight against corruption.

Course Objectives

The objectives of the course are to:

1. Explain the concepts of trade and the economics of self-reliance in the context of Nigerian society, highlighting their historical significance and contemporary relevance.
2. Outline the key concepts in Nigerian history, culture, and art up to 1800, with a specific focus on the period of colonial rule, providing insights into the cultural evolution of the nation.
3. Describe the process of Nigeria's evolution as a political unit and analyze the challenges it has faced in nation-building since gaining independence.
4. Explain the principles of social justice, national development, and the role of the judiciary, fundamental rights, individuals, norms, and values in shaping Nigeria's societal fabric.
5. Explore contemporary issues, initiatives like Operation Feed the Nation, Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Social Justice and Economic Recovery (MAMSER), and the role of the National Orientation Agency (NOA) in addressing current socio-political and cultural developments in Nigeria.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Describe the concepts of trade and economics of self-reliance.
2. Outline the concepts of Nigerian history, culture, and art up to 1800 and Nigeria under colonial rule.
3. Describe the evolution of Nigeria as a political unit and Nigeria and challenges of nation building.
4. Explain the idea of social justice and national development Judiciary and fundamental rights, Individuals, norms, and values.
5. Explain re-orientation, moral and national development.
6. Describe the Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC).
7. Explain Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA) current socio-political and cultural developments in Nigeria.

Course Content

Study of Nigerian history, culture and arts in pre-colonial times; Nigerian's perception of his world; Culture areas of Nigeria and their characteristics; Evolution of Nigeria as a political unit; Indigene/settler phenomenon; Concepts of trade; Economic self-reliance; Social justice; Individual and national development; Norms and values; Negative attitudes and conducts (cultism and related vices); e-orientation of moral; Environmental problems.

CHM 201: Physical Chemistry II (3 Units: LH 45)

Course Overview

In CHM 201: Physical Chemistry II, students will develop advanced skills in solving quantitative chemistry problems while integrating multiple concepts. They will delve into the molecular-level understanding of chemical and physical processes to explain macroscopic properties. The course covers matter classification, referencing the periodic table, and applying significant theories like the kinetic molecular theory of gases and quantum mechanical theory of the atom. Furthermore, students will gain hands-on experience in the laboratory, conducting experiments safely using standard glassware and equipment.

Course Objectives

The objectives of the course are to:

1. Develop the ability to solve complex quantitative chemistry problems effectively and communicate the solutions with clear and comprehensive reasoning. Integrate multiple concepts to tackle multifaceted problems.
2. Describe, explain, and model chemical and physical processes at the molecular level to elucidate their influence on macroscopic properties, providing a deeper insight into the behavior of matter.
3. Master the skill of classifying matter based on its state and bonding behavior, utilizing the Periodic Table as a fundamental reference point for understanding the properties of elements and compounds.
4. Apply critical theories such as the Kinetic Molecular Theory of Gases and the Quantum Mechanical Theory of the Atom to solve general chemistry problems, bridging the gap between theoretical concepts and practical applications in the field of chemistry.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Solve quantitative chemistry problems and demonstrate reasoning clearly and completely. Integrate multiple ideas in the problem-solving process.
2. Describe, explain and model chemical and physical processes at the molecular level to explain macroscopic properties.
3. Classify matter by its state and bonding behavior using the Periodic Table as a reference

4. Apply important theories such as the Kinetic Molecular Theory of Gases or the Quantum Mechanical Theory of the Atom to the solution of general chemistry problems.
5. Perform general chemistry laboratory experiments using standard chemistry glassware and equipment and demonstrate appropriate safety procedures

Course Content

Ions in Solutions: Bronsted and generalized acid-based concepts; application to aqueous and non aqueous solvents. Equilibria; strengths of acids bases, pH hydrolysis of salts, buffer actions, acid base indicators, titrations, Concepts of activity, Debye Huckel theory. Conductance measurements. Interactions in electrolyte solutions. Surface Chemistry: Interfacial relationships. Criteria for spreading monomolecular films on water. Adsorption form solution, at gas – solid interface; adsorption isotherms. Classification of colloidal systems. Preparation and properties of lyophilic and lyophobic sols. Ideal solids, glasses and polymers. Colloidal systems, surface energies, wetting, adhesion and contact angles. Insoluble surface films. Micelle formation, Lyophobic and lyophilic properties.

2.5.4 200-Level Courses Second Semester

CHM 232: Organic Chemistry II (3 Units: LH 45)

Course Overview

In CHM 232: Organic Chemistry II, students will delve into the principles of general organic chemistry, with a primary focus on comprehending the structure, bonding, and reactivity of organic compounds. The course explores the preparation and reactions of benzene derivatives, encompassing electrophilic and nucleophilic substitution reactions within the benzene ring. Students will also delve into carbonyl chemistry, including synthetic applications and the synthesis of crucial functional groups. Stereochemistry is emphasized, covering organic compound stereochemistry, optical isomerism involving asymmetric centers, chirality concepts, and absolute configuration. Additionally, the course provides insights into the synthesis and stereochemistry of alicyclic compounds and introduces mechanistic organic chemistry, explaining the mechanisms underlying various organic reactions and transformations.

Course Objectives

The objectives of the course are to:

1. Gain a comprehensive understanding of general organic chemistry, emphasizing the structure, bonding, and reactivity of organic compounds.
2. Explain the preparation and reactions of benzene derivatives, including electrophilic and nucleophilic substitution reactions occurring in the benzene ring.
3. Discuss carbonyl chemistry and its practical applications, including the synthesis of important functional groups and their corresponding reactions.
4. Comprehend stereochemistry, encompassing the stereochemistry of organic compounds, optical isomerism involving asymmetric centers, concepts of chirality,

and absolute configuration. Additionally, gain insight into the mechanisms behind various organic reactions and transformations.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the principles of general organic chemistry, with a focus on understanding the structure, bonding, and reactivity of organic compounds.
2. Explain the preparation and reactions of benzene derivatives, including electrophilic and nucleophilic substitution reactions in the benzene ring.
3. Discuss carbonyl chemistry and its synthetic applications, including the synthesis of important functional groups and their reactions.
4. Explain stereochemistry, including the stereochemistry of organic compounds, optical isomerism of compounds with asymmetric centers, and the concepts of chirality and absolute configuration.
5. Discuss the synthesis and stereochemistry of alicyclic compounds and gain an introduction to mechanistic organic chemistry, explaining the mechanisms behind various organic reactions and transformations.

Course Content

Review of General organic chemistry, aromatic chemistry: preparation and reactions of benzene derivatives. Electrophilic and nucleophilic substitution in the benzene ring. Carbonyl chemistry and synthetic applications. Stereochemistry: Stereochemistry of organic compounds and optical isomerism of compounds with one or more asymmetric centres. Concepts of chirality and absolute configuration. The synthesis of alicyclic compounds and their stereochemistry. Introduction to mechanistic organic chemistry.

MEE 212: Engineering Drawing II (2 Units)

Course Overview

Engineering Drawing II (MEE 212) is an advanced course that builds on the foundational skills acquired in Engineering Drawing I. This course delves into more intricate aspects of engineering graphics, including auxiliary and sectional views, surface intersection development, isometric projection, dimensioning and tolerances, and an introduction to computer-aided graphics. Students will gain expertise in creating precise representations of complex engineering designs, enhancing their ability to communicate technical information effectively through drawings. Additionally, the course introduces students to modern computer-aided design tools, further equipping them for the demands of contemporary engineering and design fields.

Course Objectives

The objectives of the course are to:

1. Master advanced techniques in creating auxiliary and sectional views to effectively communicate complex engineering designs with precision.

2. Analyze and develop surface intersections to represent intricate components and enhance visualization in engineering drawings.
3. Demonstrate expertise in isometric projection methods, providing a three-dimensional perspective of objects on a two-dimensional plane.
4. Apply precise dimensioning and tolerancing principles to engineering drawings, ensuring accuracy in manufacturing and assembly processes.
5. Acquire an introduction to computer-aided graphics, utilizing specialized software for enhanced design and visualization purposes.
6. Develop proficiency in reading and interpreting blueprints to facilitate effective communication in engineering and manufacturing industries.
7. Apply blueprint reading skills to practical engineering projects.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Draw advanced auxiliary and sectional views that accurately depict complex features and internal structures in engineering drawings.
2. Produce diagram involving intersection development techniques to visualize the blending and intersection of multiple surfaces in three-dimensional objects.
3. Draw shapes in isometric projections, representing objects with clarity and realistic perspectives.
4. Employ dimensioning and tolerance practices effectively to ensure the precise manufacturing and assembly of engineering components.
5. Use computer-aided graphics software for engineering design and visualization.
6. Interpret and analyze blueprints of design and specifications of engineering projects.

Course Content

Advanced topics in auxiliary and sectional views, development, and intersection of surfaces, isometric projection, dimensioning and tolerances. Introduction to computer aided graphics. Blue-print reading.

MEE 214: Fundamentals of Fluid Mechanics (3 Units: LH 45)

Course Overview

The area of physics known as fluid mechanics is focused on the forces acting on and within fluids (liquids, gases, and plasmas). It has uses in a variety of fields, including biology, geophysics, oceanography, meteorology, astrophysics, and mechanical, aeronautical, civil, chemical, and biomedical engineering. Fluid dynamics is the study of how forces affect fluid motion, and fluid statics is the study of fluids at rest. It is a subfield of continuum mechanics, which represents matter from a macroscopic rather than a microscopic perspective. It does this by omitting the information contained in atoms. Research in fluid mechanics, especially fluid dynamics, is vigorous and frequently involves challenging math. Numerous issues are partially or completely unsolvable and are best handled by numerical approaches, which are often carried out on computers. This strategy is the focus of a contemporary field called computational fluid dynamics (CFD). Another experimental technique that makes use of fluid flow's highly visual character is particle image velocimetry, which visualizes and analyzes fluid flow.

Course Objectives

The objectives of the course are to:

1. Develop an understanding of fluid properties and fluid statics, encompassing pressure distribution and buoyancy principles.
2. Apply the fundamental conservation laws of fluid mechanics, including continuity, momentum, and energy equations.
3. Analyze friction effects and losses in both laminar and turbulent flows within ducts and pipes.
4. Utilize dimensional analysis and dynamic similitude to model and scale fluid flow problems effectively.
5. Comprehend the principles of construction and operation of selected hydraulic machinery, focusing on pumps and turbines.
6. Explore the design and operation of hydropower systems, with a focus on energy conversion and efficiency considerations.
7. Evaluate efficiency and performance characteristics of different hydraulic machines under various operating conditions.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain fluid properties, such as viscosity, density, and surface tension, and their influence on fluid behaviour. Calculate pressure distributions and buoyant forces in diverse fluid systems, analysing fluid statics problems.
2. Apply the principles of continuity, momentum, and energy equations to effectively solve fluid flow problems in both steady and unsteady states.
3. Differentiate between laminar and turbulent flows, and analyse friction losses in ducts and pipes using practical examples.
4. Utilize dimensional analysis to obtain dimensionless groups and apply them to fluid flow modelling problems.
5. Explain the operation principles of hydraulic machinery, including pumps and turbines.
6. Compare the efficiency and performance characteristics of different hydraulic machines under varying operating conditions.

Course Content

Properties of fluids, Fluids statics, Basic conservation laws, friction effects and losses in laminar and turbulent flows in ducts and pipes. Dimensional analysis and dynamic similitude, principles of construction and operation of selected hydraulic machinery. Hydropower systems.

MEE 218: Engineering Thermodynamics I (3 Units: LH 45)

Course Overview

Engineering Thermodynamics I (MEE 208) is a foundational course that introduces students to the fundamental principles and concepts of thermodynamics and their application in engineering systems. This course covers key topics such as the zeroth, first, second, and third laws of thermodynamics, the behavior of pure substances and perfect gases, ideal gas cycles, and the concept of enthalpy.

Course Objectives

The objectives of the course are to:

1. Introduce students to the fundamental concepts of thermodynamics and their application in engineering systems.
2. Establish quantitative relations for the zeroth, first, second, and third laws of thermodynamics to analyze energy transfers and transformations.
3. examine the behavior of pure substances and perfect gases, understanding their thermodynamic properties and characteristics.
4. Explore ideal gas cycles and their applications in engineering processes, including the Carnot cycle and the Brayton cycle.
5. Comprehend the concept of enthalpy and its significance in thermodynamic analysis and engineering applications.
6. Apply thermodynamic data for engineering calculations, including the use of property tables and charts.
7. Conduct comparative analysis of ideal gas cycles in various engineering applications

Course Learning Outcomes

Upon completing the course, the student will 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 gauge 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. Evaluate the application of 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. Evaluate the application of 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. Evaluate the 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.
13. Explain perpetual-motion machines, reversible and irreversible processes.

Course Content

Basic concepts, quantitative relations of Zeroth, first, second and third laws of thermodynamics. Behaviour of pure substances and perfect gases. Ideal gas cycles. Enthalpy concept

EMA 202: Engineering Mathematics II (3 Units: LH 45)

Course Overview

Engineering Mathematics II builds upon the mathematical foundations established in the previous course. Students will delve deeper into the world of mathematics with a focus on engineering applications. The course covers topics such as second-order differential equations, line and multiple integrals, and complex variables. Students will also explore transformation and mapping, gaining the skills to solve complex engineering problems. The course emphasizes the application of mathematical concepts to real-world scenarios, enabling students to develop problem-solving skills crucial for their engineering careers. Additionally, students will learn how to use tools like MATLAB for numerical solutions, further enhancing their mathematical capabilities.

Course Objectives

The objectives of the course are to:

1. Solve Ordinary Differential Equations (ODEs): Develop the ability to solve ODEs, particularly those related to physical systems with linear constant coefficient types, to model and analyze engineering problems.
2. Numerical Solutions with MATLAB: Gain proficiency in using MATLAB and other emerging applications to numerically solve differential equations, enabling efficient and accurate problem-solving.
3. Advanced Calculus Operations: Perform advanced calculus operations on vector-valued functions, including derivatives, integrals, and curvature. Extend these skills to functions of several variables, including directional derivatives and multiple integrals, for analyzing complex engineering scenarios.
4. Application of Line Integrals and Theorems: Apply the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem to solve engineering problems involving vector calculus. Develop competence in handling complex numbers within these contexts.
5. Complex Analysis and Conformal Mapping: Utilize the concepts of analyticity and the Cauchy-Riemann equations to work with harmonic and entire functions of complex variables. Apply the theory of conformal mapping to solve engineering problems and understand its significance in various fields.

Course Learning Outcomes

Upon completing the course, the student will be able to:

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

Course Content

Second order differential equations, line integral, multiple integral and their applications, differentiation of integral. Analytical functions of complex variables. Transformation and mapping. special functions.

GST 204: History and Philosophy of Science (2 Units: LH 30)

Course Overview

History and Philosophy of Science explores the rich tapestry of scientific thought and its philosophical foundations. Students will delve into the historical evolution of scientific inquiry and grapple with the demarcation problem. The course emphasizes empirical evidence, observation, and experimentation's pivotal role in the scientific method, encouraging critical evaluation of scientific knowledge. Participants will unravel the philosophical underpinnings of scientific theories, exploring concepts like explanation, causation, and scientific realism. Ethical and societal dimensions of scientific research are also addressed, fostering a nuanced understanding of science's impact. Moreover, students will apply philosophical frameworks and critical thinking skills to dissect contemporary scientific debates across disciplines. GST 204 equips learners with a profound grasp of the philosophy of science, underpinned by a broader exploration of philosophy's impact on human existence, politics, ethics, religion, values, character development, and more.

Course Objectives

The objectives of the course are to:

1. Analyze the historical development of the philosophy of science, exploring key concepts and debates surrounding the nature of scientific inquiry and addressing questions related to the demarcation problem.
2. Examine the fundamental role of empirical evidence, observation, and experimentation in the scientific method, critically assessing the strengths and limitations of scientific knowledge.
3. Explain the philosophical foundations of scientific theories, including concepts such as explanation, causation, and scientific realism, providing insight into the philosophical aspects of scientific knowledge.
4. Explore the ethical and social implications of scientific research and technology, with a focus on issues related to ethics in science and the responsible conduct of research, fostering ethical awareness in scientific endeavors.
5. Apply philosophical frameworks and critical thinking skills to analyze and engage with contemporary debates and controversies across various scientific disciplines, enhancing the ability to critically evaluate and discuss complex scientific issues.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Analyze the historical development and key concepts of the philosophy of science, including the nature of scientific inquiry and the demarcation problem.
2. Examine the role of empirical evidence, observation, and experimentation in the scientific method, and evaluate the strengths and limitations of scientific knowledge.
3. Explain the philosophical underpinnings of scientific theories, including the concepts of explanation, causation, and scientific realism.
4. Explain the ethical and social implications of scientific research and technology, considering issues related to ethics in science and the responsible conduct of research.
5. Apply philosophical frameworks and critical thinking skills to analyze contemporary debates and controversies in various scientific disciplines, fostering a deeper understanding of the philosophy of science.

Course Content

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.

GST 206: Peace and Conflict Resolution (2 Units: LH 30)

Course Overview

Peace and Conflict Resolution delves into essential concepts within peace studies and conflict resolution. Students will gain a comprehensive understanding of conflict types, their origins, and dynamics. The course emphasizes peace as a catalyst for unity and socio-economic development. Participants will acquire skills in conflict management, security analysis, and conflict prevention strategies. They will also explore principles of mediation, peacekeeping, and Alternative Dispute Resolution (ADR) techniques. The course delves into the cultivation of a culture of peace within communities and organizations, while also assessing the impact of international organizations in conflict resolution. Moreover, the complexities of the indigene/settler phenomenon in conflict and peace contexts are examined.

Course Objectives

The objectives of the course are to:

1. Understand and define key concepts related to peace studies and conflict resolution.
2. Analyze various forms of conflicts, including their origins and dynamics.
3. Recognize the pivotal role of peace in fostering unity and promoting socio-economic development.
4. Acquire practical skills in managing conflicts, conducting security analyses, and implementing conflict prevention strategies.
5. Demonstrate a deep understanding of mediation principles and the effective use of Alternative Dispute Resolution (ADR) techniques.
6. Explore the concept of a culture of peace within both communities and organizations.
7. Evaluate the impact and effectiveness of international organizations in the context of conflict resolution.
8. Examine the complexities surrounding the indigene/settler phenomenon within the framework of conflict and peace scenarios.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Define and explain fundamental concepts in peace studies and conflict resolution.
2. Analyse different types of conflicts, including their root causes and dynamics.
3. Explain the role of peace as a catalyst for unity and socio-economic development.
4. Explain skills in conflict management, security analysis, and conflict prevention strategies.
5. Explain principles of mediation, peacekeeping, and Alternative Dispute Resolution (ADR) techniques effectively.
6. Discuss culture of peace within communities and organizations.
7. Explain the impact and effectiveness of international organizations in conflict resolution.
8. Explain the complexities of the indigene/settler phenomenon in conflict and peace contexts.

Course Content

Basic Concepts in peace studies and conflict resolution; Peace as vehicle of unity and development; Conflict issues; Types of conflict, e. g. Ethnic/religious/political/ economic conflicts; Root causes of conflicts and violence in Africa; Indigene/settler phenomenon; Peace – building; Management of conflict and security. Elements of peace studies and conflict resolution; Developing a culture of peace; Peace mediation and peace-keeping;

Alternative Dispute Resolution (ADR). Dialogue/arbitration in conflict resolution; Role of international organizations in conflict resolution, e.g. ECOWAS, African Union, United Nations, etc.

CHE 202: Chemical Engineering Concept (2 Units: LH 30)

Course Overview

Chemical Engineering Concepts (CHE 202) is an introductory course that lays the foundation for understanding fundamental principles in chemical engineering. It covers essential topics such as units and dimensions, the mole unit, temperature, pressure, and physical and chemical properties. The course also delves into the intricacies of chemical equation stoichiometry, material balances, and the effects of recycle and purge on mass and energy balances. Furthermore, it explores the behavior of gases, vapors, liquids, and solids, including ideal and real gas relationships, vapor pressure, saturation, and humidity.

Course Objectives

The objectives of the course are to:

1. Demonstrate a comprehensive understanding of the fundamental principles of chemical engineering, encompassing units and dimensions, the mole unit, temperature, and pressure.
2. Develop proficiency in analyzing physical and chemical properties and apply appropriate techniques to solve engineering problems.
3. Master the concept of chemical equation stoichiometry and apply algebraic techniques to perform material balances.
4. Apply material balances to both open and closed systems and analyze problems involving components (elements).
5. Examine the impact of recycle, bypass, and purge on mass and energy balances in chemical processes.
6. Gain insights into the behavior of gases, vapors, liquids, and solids, including ideal and real gas relationships, vapor pressure, saturation, and humidity.
7. Analyze the concept of partial saturation and humidity in various environmental and engineering contexts, focusing on the principles, factors, and implications related to moisture content in gases and materials.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the concept of the mole unit and demonstrate proficiency in converting chemical engineering quantities using unit conversions.
2. Explain the measurement techniques to analyze physical and chemical properties of substances
3. Apply algebraic techniques to solve material balance problems in various chemical processes.
4. Evaluate material balances for open and closed systems.

5. Assess the impact of recycle, bypass, and purge streams on mass and energy balances in complex chemical systems.
6. Predict the behavior of non-ideal gases using real gas relationships and relevant equations.
7. Explain partial saturation and humidity, including the ability to calculate and interpret moisture content in different processes and systems.

Course Content

Introduction to Chemical Engineering. 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. Program of analysis of material balances. Program of analysis of material balances problem problems with direct solutions. Material balances using algebraic techniques control surface and stage balances for open and closed system. Problems involving components (elements). Recycle, Bypass, Purge; Effect of recycle and purge on mass and energy balances. Gases, vapours, liquid and solids. Ideal gas law, Real gas relationships. Vapour pressure. Saturation. Partial saturation and humidity.

CHE 200: SWEP I (2 Units: LH 30)

Course Overview

SWEP I (Student Work Experience Programme I) is a crucial component of the Chemical Engineering program designed to provide students with practical on-the-job experience in an industry of their choice. This course spans eight weeks during the long vacation following the completion of the second year (200 Level). It allows students to apply their theoretical knowledge to real-world situations and gain valuable insights into the professional world.

Course Objectives

The objectives of the course are to:

1. provide students with valuable on-the-job experience in an industry of their choice, allowing them to apply theoretical knowledge to real-world situations.
2. offer practical working experience, irrespective of the student's major, to foster diverse skills and adaptability in different work environments.
3. facilitate the integration of academic learning with practical work experiences, enhancing students' overall educational and professional growth.
4. cultivate a sense of responsibility, professionalism, and strong work ethics in students as they engage in a professional work setting.
5. encourage students to actively seek opportunities for career exploration and skill development within a supportive learning environment.
6. foster personal and professional growth through hands-on working experience.
7. require the development of a comprehensive program report or presentation, showcasing the knowledge gained and accomplishments achieved during the industrial experience.

Course Learning Outcomes

Upon completing the course, the student will be able 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
4. Acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences

Course Content

On the job experience in industry chosen for practical working experience but not necessarily limited to the student's major (8 weeks during the long vacation following 200 level).
Student are expected to have at least six to eight weeks Student Work Experience Programme (SWEP) immediately after 200 Level.

GEN 204: Basic Engineering Laboratory II (2 Units)

Course Overview

This course, Basic Engineering Laboratory II, is designed to provide students with practical experience in fluid mechanics and various engineering disciplines. Through hands-on experiments, students will learn measurement techniques, fluid pressure, Bernoulli's equations, friction losses, boundary layers, separation, drag, and lift. They will also develop essential skills in report writing and utilize software tools for data analysis and documentation. This course emphasizes the integration of theoretical concepts with real-world applications, enabling students to better understand and apply engineering principles.

Course Objectives

The objectives of the course are to:

1. Develop proficiency in fundamental fluid mechanics measurement techniques.
2. Analyze and differentiate between various measurement techniques, understanding their relevance and applications.
3. Conduct experiments to measure fluid pressure and establish its relationship with flow velocity.
4. Gain practical insight into the principles and applications of Bernoulli's equations.
5. Investigate and comprehend friction losses in internal flows through practical experimentation.
6. Explore boundary layers, separation, drag, and lift, developing hands-on knowledge.
7. Enhance report-writing skills, including the ability to convey experimental procedures, results, and conclusions effectively.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Conduct basic measurement techniques of fluid mechanics

2. Discuss the differences among measurement techniques, their relevance, and applications
3. Measure fluid pressure and relate it to flow velocity.
4. Demonstrate practical understanding of the various equations of Bernoulli
5. Demonstrate practical understanding of friction losses in internal flows
6. Demonstrate practical understanding of boundary layers, separation, drag, and lift.
7. Demonstrate the ability to write clear lab reports
8. Use word processors, graphics packages, and computational software in writing
9. Compare the results of analytical models introduced in lecture to the actual behavior of real fluid flows and draw correct and sustainable conclusions

Course Content
Laboratory investigation and report submission for selected experiments and projects in Thermodynamics, Materials science, Applied Mechanic, Applied Electricity and Fundamentals of Fluid Mechanics

300-Level Courses
From 300 levels upwards, the department in the different engineering disciplines shall take a departure and begin offering core courses in addition to general engineering mathematics and some borrowed courses from other departments in the faculty. The course synopsis in each of the department is such that it provides a comprehensive knowledge and insight into the varying specialties in each of the chosen discipline for professional practices in occupations and skills required.

2.5.5 300-Level Courses First Semester

EEE 203: Applied Electricity (3 Units: LH 45)
Course Overview
This course, applied electricity, delves into the fundamental principles of electricity, beginning with electric fields, charges, and magnetic fields. It progresses to cover topics such as DC circuit theory and the application of Kirchhoff's laws, Thevenin's and Norton's theorems, superposition, and reciprocity in solving complex electrical circuits. Additionally, the course explores AC circuit theory, impedance, capacitance, inductance measurements, transducers, and single-phase circuits, providing a comprehensive foundation in applied electrical concepts and techniques.

Course Objectives
The objectives of the course are to:
1. Gain a thorough understanding of fundamental electrical concepts, including electric fields, charges, currents, and magnetic fields.
2. Apply and analyze basic DC circuit theory, including Kirchhoff's laws, superposition, Thevenin's theorem, and Norton's theorem to solve complex electrical problems.
3. Develop a solid understanding of AC circuit theory and its application in analyzing and solving electrical circuits.

4. Apply AC circuit analysis techniques to solve problems related to impedance, admittance, susceptance, and single-phase circuits.
5. Learn and utilize measurement techniques for resistance, capacitance, and inductance, and explore the application of transducers in electrical systems.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Discuss the fundamental concept of electricity and electrical D.C. circuit.
2. State, explain and apply the basic D.C. circuit theorems.
3. Explain the basic A.C circuit theory.
4. Apply the basic Arc circuit to solution of simple circuitry.

Course Content

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

CHE 301: Transport Phenomena I (3 Units: LH 45; PH 45)

Course Overview

Transport Phenomena I (CHE 301) is a fundamental course in chemical engineering that covers various aspects of fluid dynamics and heat transfer. Topics include compressible flow with a focus on normal shock waves, the behavior of non-Newtonian fluids, radiative heat transfer mechanisms, unsteady-state conduction, convective heat transfer, and diffusion processes in gases, liquids, and solids. This course equips students with a deep understanding of the fundamental principles governing the movement of heat and mass in chemical processes and engineering systems.

Course Objectives

The objectives of the course are to:

1. Examine compressible flow phenomena, focusing on normal shock waves and their effects on fluid dynamics.
2. Explore the behavior of non-Newtonian fluids and their unique heat transfer characteristics in engineering applications.
3. Investigate the mechanism of radiative heat transfer, including heat exchange between radiating surfaces.
4. Analyze unsteady-state conduction and its implications in various engineering systems.
5. Study free and forced convective heat transfer, determining heat transfer coefficients and their application in heat exchanger design.
6. Explore the diffusion of vapors in gases and the diffusion processes in liquids and solids.
7. Demonstrate the ability to apply heat transfer principles and engineering concepts to design and optimize heat exchangers.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Analyse compressible flow behaviour, identifying and evaluating the implications of normal shock waves.
2. Describe the heat transfer characteristics of engineering applications involving non-Newtonian fluids.
3. Describe the mechanisms of radioactive heat transfer and compute heat exchange rates between radiating surfaces.
4. Analyse unsteady-state conduction problems, considering transient temperature distributions in engineering systems.
5. Determine heat transfer coefficients for free and forced convective heat transfer situations.
6. Calculate diffusion rates of vapours in gases and analyse diffusion processes in liquids and solids.
7. Apply heat transfer knowledge to design and optimize heat exchangers for efficient energy transfer.

Course Content

Compressible flow: Normal shock waves. Non-Newtonian fluids. Radiation: Mechanism of radiative heat transfer. Heat exchange between radiating surfaces. Unsteady state conduction. Free and forced convective heat transfer. Determination of heat transfer coefficients. Application to design of heat exchanges. Diffusion of vapors. Diffusion in liquids and solids.

CHE 303: Separation Processes I (3 Units: LH 30; PH 45)

Course Overview

CHE 303 (Separation Processes I) is a fundamental course in chemical engineering that delves into the principles and practices of separation processes. It covers stage-wise and continuous contact equipment, isothermal gas absorption, binary distillation, leaching, and the hydrodynamics of packed and plate columns. This course equips students with a deep understanding of separation techniques essential in chemical engineering processes, providing them with the knowledge and skills needed for designing and optimizing separation systems.

Course Objectives

The objectives of the course are to:

1. explore stage-wise and continuous contact equipment used in separation processes in chemical engineering.
2. analyze isothermal gas absorption processes, including the principles and applications of gas-liquid absorption.
3. study binary distillation, its theory, and practical applications in separating mixtures of volatile components.
4. analyze gas absorption and distillation processes.

5. examine leaching processes and their use in extracting valuable components from solid materials.
6. design of efficient leaching systems.
7. investigate the hydrodynamics of packed and plate columns, understanding their design and operational considerations.

Course Outcomes:

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

1. Demonstrate an understanding of the principles and applications of stage-wise and continuous contact equipment in separation processes.
2. Analyze the design and operation of isothermal gas absorption systems for effective gas-liquid separation.
3. Apply the principles of binary distillation to efficiently separate mixtures of volatile components.
4. Evaluate the efficiency and performance of gas absorption and distillation processes under varying operating conditions.
5. Investigate the leaching process and its efficacy in extracting valuable components from solid materials.
6. Assess the factors influencing leaching efficiency and design leaching systems accordingly.
7. Demonstrate an understanding of the hydrodynamics of packed and plate columns used in separation processes.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. List and explain the different types of Stage-wise and continuous contact equipment.
2. Discuss Isothermal gas absorption and perform calculations involving isothermal gas adsorption.
3. Explain how binary distillation works, part of a distillation column, and determine the number of stages using simple calculation for binary distillation.
4. Define leaching process as it applies to industrial process, especially in the extraction process. Outline the factors that affects leaching process.
5. Discuss hydrodynamics of packed and plate columns. Outline the various type of packed and plate columns used in industries.

Course Content

Stage-wise and continuous contact equipment. Isothermal gas absorption. Binary distillation. Leading. Hydrodynamics of packed and plate columns.

GEN 301: Engineering Statistics (2 Units: LH 30)

Course Overview

The Engineering Statistics course equips students with essential statistical skills and knowledge. By the course's conclusion, students will define key statistical terms and differentiate various probability distributions, applying them in real-world contexts. They will analyze datasets using central tendency and variability measures, understanding the characteristics and practical applications of probability distributions. Students will solve real-world problems through statistical inference, assess data sampling strategies, and explore regression and correlation analysis. Moreover, they will design experiments, synthesize findings for meaningful conclusions, and evaluate the appropriateness and practical implications of statistical methods.

Course Objectives

1. Develop a strong foundation by defining key statistical terms, differentiating between probability distributions, and comprehending their practical applications.
2. Gain proficiency in analyzing datasets using appropriate measures of central tendency and variability to extract meaningful insights.
3. Explore the characteristics and real-world applications of various probability distributions, enhancing your ability to apply them in diverse contexts.
4. Acquire problem-solving skills by applying probability distributions to real-world scenarios, including constructing confidence intervals and conducting hypothesis tests.
5. Assess different data sampling strategies and recognize their impact on statistical results, ensuring the reliability of data analysis.
6. Analyze relationships between variables with precision, utilizing regression and correlation analysis to determine strength and direction.
7. Learn to design experiments for data collection, synthesize findings to draw meaningful conclusions, and propose actionable recommendations based on statistical analysis.
8. Develop the ability to critically evaluate the appropriateness of statistical methods and drawn conclusions, while recognizing the practical implications and importance of statistical outcomes.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Define key statistical terms and concepts; Differentiate between various probability distributions and explain their applications.
2. Analyze given datasets using appropriate measures of central tendency and variability.
3. Explain the characteristics and real-world applications of various probability distributions.
4. Solve real-world problems involving probability distributions; Perform statistical inference tasks such as constructing confidence intervals and conducting hypothesis tests.
5. Evaluate different data sampling strategies and their impact on statistical results.
6. Analyze the strength and direction of relationships between variables using regression and correlation analysis.
7. Design experiments to collect relevant data for statistical analysis; Synthesize findings to draw meaningful conclusions and propose actionable recommendations.

8. Determine the appropriateness of statistical methods used and conclusions drawn; Judge the practical implications and importance of statistical outcomes.

Course Content

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles etc. Probability. Binomial, poison hyper- geometric, normal distributions, etc. Statistical inference intervals, tests hypothesis and significance. Regression and correlation.

CHE 305: Biochemical Engineering (3 Units: LH 60)

Course Overview

Biochemical Engineering (CHE 305) is an advanced course that introduces students to the fundamental principles of biotechnology and its wide-ranging applications. The course covers genetic modification methods for both prokaryotic and eukaryotic organisms, focusing on optimizing biochemical characteristics and stabilizing cellular structures. Topics include transformation, transduction, conjugation, and protoplast fusion, as well as natural DNA recombination and advanced techniques like phage, virus, bacterial plasmid, and vector DNA mapping. Through this course, students gain a deep understanding of the latest developments in biotechnology and its practical applications in fields such as microbial enzyme technology, bioreactor design, post-harvest technology, and agricultural waste recycling.

Course Objectives

The objectives of the course are to:

1. Introduce students to the definition and fundamental principles of biotechnology.
2. Explore the various areas of application of biotechnology in different fields.
3. Study the methods of genetic modification in prokaryotic and eukaryotic organisms for optimizing biochemical characteristics and stabilizing cellular structures.
4. Investigate transformation, transduction, conjugation, and protoplast fusion as genetic modification techniques.
5. Examine natural DNA recombination and the advantages and methods of induced phage, virus, bacterial plasmid, or vector DNA mapping techniques.
6. Analyze selected topics of application areas in biotechnology, such as microbial enzyme technology, bioreactor design, post-harvest technology, and agricultural waste recycling.
7. Apply biotechnology principles to address real-world challenges and design innovative solutions in various fields

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the fundamental principles of biotechnology and recognize its significance across various scientific disciplines.
2. Identify and analyze the diverse areas of application of biotechnology, exploring its potential in different fields.

3. Describe the methods of genetic modification utilized to optimize biochemical characteristics and stabilize cellular structures in both prokaryotic and eukaryotic organisms.
4. Examine transformation, transduction, conjugation, and protoplast fusion as effective techniques for genetic modification in biotechnology.
5. Explain natural DNA recombination and the various methods of DNA mapping used in biotechnology.
6. Apply knowledge of biotechnology to comprehend the utilization of gene pools in different applications, such as microbial enzyme technology and bioreactor design.
7. Explain biotechnology principles and applications in diverse fields.

Course Content

Introductory Biotechnology. Definition and principles of biotechnology; Areas of application in biotechnology. Methods of genetic modification of prokaryotic and 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 e.g. Microbial enzyme technology, bioreactor design; practice of post-harvest technology and agricultural waste recycling.

CHE 307: Polymer Process Engineering (3 Units: LH 45)

Course Overview

Polymer Process Engineering (CHE 307) is a fundamental course in chemical engineering that focuses on the manufacture, processing, and applications of organic polymeric materials. This course delves into the chemistry of polymer production, covering various polymerization processes, and examines the molecular structure of polymers, including chain length, branching, and cross-linking, to understand their impact on material properties. Additionally, the course explores the structure-property relationships of both thermoplastic and thermosetting polymers, emphasizing the mechanical, thermal, and chemical properties influenced by their structure. Furthermore, the course addresses the vital aspects of polymer processing techniques and considers environmental and sustainability factors in polymer materials and processing.

Course Objectives

The objectives of the course are to:

1. Introduce students to the manufacture, processing, and applications of organic polymeric materials.
2. Study the chemistry of polymer manufacture, understanding the different polymerization processes used to produce polymers.
3. Explore the molecular structure of polymers, including chain length, branching, and cross-linking, and its impact on polymer properties.

4. Investigate the structure-property relationships of thermoplastic and thermosetting polymers, understanding how their structure influences their mechanical, thermal, and chemical properties.
5. Compare thermoplastic and thermosetting polymers.
6. Explore the importance of polymer processing techniques.
7. Study the environmental and sustainability aspects of polymer materials and processing.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the processing and applications of organic polymeric materials.
2. Describe the chemistry of polymer manufacture.
3. Describe the molecular structure of polymers.
4. Explain the structure-property relationships for thermoplastic and thermosetting polymers.

Course Content

Introduction to the manufacture, processing, and applications of organic polymeric materials. The chemistry of polymer manufacture, the molecular structure of polymers, and the structure-property relationships for thermoplastic and thermosetting polymers are covered.

CHE 309: Process Simulation (2 Units: LH 30)

Course Overview

Process Simulation is a critical course in the Chemical Engineering program that introduces students to the principles and applications of process simulation, with a focus on utilizing industry-standard software like HYSYS. Through hands-on training, students learn to model and simulate chemical processes, gaining practical skills in process modeling, analysis, and optimization. This course equips students with the tools and knowledge required for advanced process design and control, aligning with the university's mission of enhancing intellectual growth, academic excellence, and entrepreneurship.

Course Objectives

The objectives of the course are to:

1. Introduce students to the principles and concepts of process simulation in chemical engineering.
2. Familiarize students with the hysys software (or any other process simulation software) as a powerful tool for process modeling and analysis.
3. Provide hands-on experience in using process simulation software to model and simulate chemical processes.
4. Study the components and units available in the simulation software, such as reactors, heat exchangers, distillation columns, etc.
5. Analyze and interpret simulation results to understand the behavior of chemical processes under different operating conditions.
6. Analyze simulation results for system performance.

7. Design and optimization of chemical processes.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the principles and significance of process simulation in chemical engineering.
2. Proficiently navigate and operate process simulation software, such as HYSYS or other equivalent tools.
3. Model and simulate chemical processes using simulation software, incorporating various unit operations and components.
4. Apply process simulation to study, design and optimize diverse chemical processes, including distillation, reaction kinetics, and heat transfer.
5. Interpret simulation data to make well-informed decisions regarding process design and operation.
6. Analyse simulation results to comprehend the impact of process variables on system performance.

Course Content

Introduction to process simulation using the HYSYS software or any other process simulation software.

EMA 301: Engineering Mathematics III (3 Units: LH 45)

Course Overview

In EMA 301: Engineering Mathematics III, students will delve into advanced mathematical concepts crucial for engineering applications. They will apply double and triple integration to calculate the area and volume of engineering solids, with an understanding of qualitative applications of Gauss, Stokes, and Green's theorems. The course covers vector and matrix analysis, including topics like linear independence and rank determination. Students will prove key theorems such as the Cauchy integral theorem and apply integral transformations to solve differential and integral equations. They will also master the fundamental theorem of line integrals and surface integrals. The ability to write simple algorithms for computational proficiency is emphasized. This course provides the mathematical foundation necessary for engineering problem-solving.

Course Objectives

The objectives of the course are to:

1. Apply double and triple integration to calculate the area and volume of engineering solids. Explain the qualitative application of Gauss, Stokes, and Green’s theorems in engineering contexts.
2. Solve qualitative problems involving vector and matrix analysis, including concepts like linear independence, vector dependence, and rank determination.
3. Prove fundamental theorems such as the Cauchy integral theorem, Gauss theorem, Green's theorem, and Stoke's theorem, and understand their practical applications.
4. Apply integral transformation techniques to solve problems involving differential and integral equations in engineering scenarios.

5. Solve problems utilizing the fundamental theorem of line integrals and surface integrals, demonstrating proficiency in applying these concepts to engineering problems.
6. Develop simple algorithms to showcase computational proficiency in solving engineering statistical problems, enhancing problem-solving skills.
7. Master mathematical concepts including linear algebra, matrices, determinants, coordinate transformations, and functions of several variables, enabling their application in engineering problem-solving.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Apply double and triple integration in finding the area and volume of engineering solids and explain the qualitative application of Gauss, Stokes and Green's theorem.
2. Solve qualitative problems based on vector and matrix analysis such as linear independence, dependent of vector and rank.
3. Prove the Cauchy integral, Gauss, Green's and Stoke's theorem and applications.
4. Apply integral transformation in solutions involving differential and integral equations.
5. Solve problems using fundamental theorem of line integrals and surface integral.
6. Write simple algorithm to demonstrate computational proficiency

Course Content

Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices, Theory of Linear Equations, Eigen Values and Eigen Vectors. Analytical Geometry, Coordinate Transformation, Solid Geometry, Polar, Cylindrical and Spherical Coordinates. Elements of Functions of Several Variables, Surface Variables. Ordinary Integrals, Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors, The Gradient of Scalar quantities. Flux of Vectors, The Curl of a Vector Field, Gauss, Greens and Stoke's Theorems and Applications. Singular Valued Functions. Multivalued Functions, Analytical Functions, Cauchy Riemann's Equations. Singularities and Zeroes, Contour Integration including the use of Cauchy's Integral Theorems, Bilinear Transformation.

GST 301: Introduction to Entrepreneurship Studies (2 Units)

Course Overview

Introduction to Entrepreneurship Studies is a comprehensive exploration of the entrepreneurial landscape. By course completion, students will grasp fundamental concepts and theories related to entrepreneurship, including opportunity recognition, value creation, and risk-taking. They will identify the defining characteristics of entrepreneurs and understand the pivotal role of micro and small businesses in wealth generation, employment creation, and financial independence. The course delves into elements of innovation, enterprise formation, partnership, networking, and business planning. Moreover, it covers contemporary entrepreneurial issues in Nigeria, Africa, and the world at large, along with the basic principles of e-commerce. Students will also engage in hands-on ventures such as soap making, photography, and more, fostering practical entrepreneurial skills.

Course Objectives

The objectives of the course are to:

1. Develop a comprehensive understanding of entrepreneurship concepts, theories, and their practical applications, including opportunity recognition, value creation, and risk-taking.
2. State the defining characteristics of an entrepreneur, recognizing the traits that drive entrepreneurial success.
3. Analyze the pivotal role of micro and small businesses in wealth creation, employment generation, and fostering financial independence in economies.
4. Identify key elements in innovation, demonstrating the ability to innovate and adapt in dynamic entrepreneurial environments.
5. Describe the stages in enterprise formation, partnership development, and networking, including the essentials of effective business planning.
6. Gain insight into contemporary entrepreneurial issues in Nigeria, Africa, and globally, staying informed about evolving trends and challenges.
7. State the basic principles of e-commerce, understanding its significance in modern entrepreneurial endeavors.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the concepts and theories of entrepreneurship, 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. Identify key elements in innovation.
5. Describe the stages in enterprise formation, partnership and networking, including business planning.
6. Describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world.
7. State the basic principles of e-commerce.

Course Content

Some of the ventures to be focused upon include the following:

1. Soap/Detergent, Tooth brushes and Tooth paste making
2. Photography
3. Brick, nails, screws making
4. Dyeing/Textile blocks paste making
5. Rope making
6. Plumbing
7. Vulcanizing

8. Brewing

2.5.6 300-Level Courses Second Semester

GST 302: Introduction to Entrepreneurial Skills (2 Units)

Course Overview

Introduction to Entrepreneurial Skills, students embark on a journey of practical learning and innovation. By course completion, students will have the capability to manufacture everyday household items, master fundamental photography skills, and craft essential building materials through hands-on techniques. They'll delve into textile design and dyeing processes while gaining a comprehensive understanding of entrepreneurship, capital requirements, financial planning, innovation, and legal aspects. Furthermore, students will explore possible business opportunities in Nigeria and acquire practical trades skills in areas like rope making, plumbing, vulcanizing, and brewing, equipping them for diverse entrepreneurial endeavors.

Course Objectives

The objectives of the course are to:

1. Develop practical skills to produce common household items like soap, detergent, toothbrushes, and toothpaste through hands-on manufacturing processes.
2. Acquire fundamental photography skills, including camera operation, composition, and basic photo editing techniques, enabling the capture and enhancement of visual images.
3. Demonstrate the ability to craft essential building materials such as bricks, nails, and screws through practical manufacturing techniques.
4. Create and utilize dyeing and textile block paste for fabric design and printing, showcasing an understanding of the dyeing process.
5. Apply practical skills in trades like rope making, plumbing, vulcanizing, and brewing, gaining hands-on experience in these trades for various applications.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Produce common household items such as soap, detergent, toothbrushes, and toothpaste through hands-on manufacturing processes.
2. Apply fundamental photography skills, including camera operation, composition, and basic photo editing techniques, to capture and enhance visual images.
3. Apply knowledge and skills in crafting essential building materials, including bricks, nails, and screws, through practical manufacturing techniques.
4. Create and utilize dyeing and textile block paste for fabric design and printing, demonstrating an understanding of the dyeing process.
5. Apply the art of rope making, plumbing, vulcanizing, and brewing, gaining hands-on experience in these practical trades for various applications.

Course Content

Introduction to entrepreneurship and new venture creation; Entrepreneurship in theory and practice; The opportunity, Forms of business, Staffing, Marketing and the new venture; Determining capital requirements; Raising capital; Financial planning and management; Starting a new business, Feasibility studies; Innovation; Legal Issues; Insurance and environmental considerations. Possible business opportunities in Nigeria.

EMA 302: Engineering Mathematics IV (3 Units: LH 45)

Course Overview

EMA 302, Engineering Mathematics IV, equips students with advanced mathematical tools and techniques essential for engineering applications. By course completion, students will proficiently solve second-order and partial differential equations, including those with variable coefficients. They will also tackle linear integral equations and understand their relation to integral transforms. Additionally, students will gain expertise in interpolation, applying Runge-Kutta and similar methods to solve ordinary and partial differential equations. This course empowers students with mathematical skills vital for addressing complex engineering challenges.

Course Objectives

The objectives of the course are to:

1. Master Differential Equations: Develop proficiency in solving second-order differential equations, including those with variable coefficients.
2. Solve partial differential equations, gaining competence in handling complex mathematical problems.
3. Learn to solve linear integral equations, understanding their significance in engineering applications.
4. Relate integral transforms to the solution of both differential and integral equations, with a focus on Fourier, Laplace, Mellin, and Handel transforms.
5. Explain and apply interpolation formulas, facilitating accurate data estimation and analysis in engineering contexts.
6. Apply Runge-Kutta and other similar numerical methods to solve ordinary and partial differential equations, enhancing problem-solving skills in mathematical modeling.

Course Learning Outcomes

Upon completing the course, the student will be able to

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

Course Content

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

GEN 302: Engineering Communication (2 Units: LH 30)

Course Overview

Engineering Communication, empowers students with crucial communication skills essential in the engineering field. By course completion, students will excel in planning, organizing, and delivering effective oral presentations, using visual aids and technical information to support their messages. They will also apply the principles of effective communication in interpersonal and mass communication contexts. Additionally, students will master speed reading techniques for extracting main ideas and specific information from written material. The course emphasizes principles of technical writing, including clarity, conciseness, organization, and proper documentation and citation styles.

Course Objectives

The objectives of the course are to:

1. Develop the ability to plan, organize, and deliver compelling oral presentations, ensuring clarity and engagement.
2. Learn to use appropriate visual aids and incorporate statistical and technical information effectively to support and enhance oral messages.
3. Apply principles of effective communication in both interpersonal and mass communication contexts, adapting communication strategies to various scenarios.
4. Acquire speed reading techniques to efficiently extract main ideas and locate specific information from written material, optimizing information absorption.
5. Master the principles of technical writing, including clarity, conciseness, and organization, while also understanding the importance of appropriate documentation and citation styles in engineering communication.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Plan, organize, and deliver effective oral presentations.
2. Use appropriate visual aids, statistical and technical information to support their messages.
3. Apply the principles of effective communication in both interpersonal and mass communication contexts.
4. Communicate main ideas from written material and locating specific information through speed reading techniques.
5. Apply the principles of technical writing, including clarity, conciseness and organization.
6. Use of appropriate documentation and citation styles.

Course Content

Oral communication: Public speaking skills with effective use of visual aids and statistical and technical information. Principles of effective communication in interpersonal and mass communication process. Effective reading skills- extracting main ideas and reading for specific information through speed reading. Written communication: principles of technical writing.

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

Course overview

Applied Electricity II provides an in-depth exploration of electrical machines, covering the principles and operation of DC motors, synchronous alternators, and transformers, with a focus on their equivalent circuits. It also delves into three-phase balanced circuits and their practical applications in electrical systems. Additionally, the course introduces semiconductor devices, control systems (both open-loop and closed-loop), and the fundamentals of communication systems, including TV, radio, and telephone systems, highlighting their significance in modern technology and society.

Course Objectives

1. Explain the fundamental principles and operation of electrical machines, including DC motors, synchronous alternators, and transformers, and analyze their equivalent circuits.
2. Explain three-phase balanced circuits and their practical applications in electrical systems.
3. Describe the operation and characteristics of semiconductor devices such as PN junction diodes, transistors, thyristors, FETs, and Zener diodes.
4. Explain the basics of control systems, differentiating between open-loop and closed-loop systems, and analyze their applications in engineering.
5. Explain the fundamentals of communication systems, including the principles of TV, radio, and telephone systems, and understand their significance in modern technology and society.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the fundamental principles and operation of electrical machines, including DC motors, synchronous alternators, and transformers, and analyze their equivalent circuits.
2. Explain the three-phase balanced circuits and their practical applications in electrical systems.
3. Describe the operation and characteristics of semiconductor devices such as PN junction diodes, transistors, thyristors, FETs, and Zener diodes.
4. Explain the basics of control systems, differentiating between open-loop and closed-loop systems, and analyze their applications in engineering.

5. Explain the fundamentals of communication systems, including the principles of TV, radio, and telephone systems, and their significance in modern technology and society.

Course Content

Basic machines - DC, synchronous alternators, transformers, equivalent circuits. Three phase balanced circuits, PN junction Diode, Transistors, Thyristors FETs, Zener, Rectifiers. Basic control systems, open/closed loop systems. Communications fundamentals, introduction of TV, Radio, Telephone systems.

CHE 302: Chemical Engineering Thermodynamics II (2 Units: LH 30)

Course Overview

CHE 302 is a critical course within the Chemical Engineering program that delves into advanced topics in chemical engineering thermodynamics. It covers essential concepts such as thermodynamic cycles, including the Carnot cycle, and their significance in energy conversion processes. The course also explores thermodynamic turbines, including steam and gas turbines, which are fundamental in power generation and propulsion systems. Furthermore, it addresses refrigeration systems and their applications in cooling and heat transfer processes.

Course Objectives

The objectives of the course are to:

1. Investigate various thermodynamic cycles, including the carnot cycle and its significance in energy conversion processes.
2. Analyze thermodynamic turbines, focusing on steam and gas turbines used in power generation and propulsion systems.
3. Examine refrigeration systems and their applications in cooling and heat transfer processes.
4. Explore the behavior of pure substances under different temperature and pressure conditions, considering equations of state and compressibility relations.
5. Study the thermodynamics of gaseous mixtures, including ideal gas mixtures and their approximations.
6. Analyze heat effects in chemical reactions, phase changes, and mixing and solution processes.
7. Examine heat capacities of liquids and solids as a function of temperature, and their influence on energy calculations.
8. Investigate thermodynamics in flow processes, including continuity, momentum, and energy equations.
9. Analyze the behavior of fluid flow in pipes, considering laminar and turbulent flows, Reynolds number, and friction factors.
10. Study the operation of compressors, including single-stage and multistage configurations, and the effect of clearance.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the principles and applications of various thermodynamic cycles, including the Carnot cycle.
2. Analyze the performance and efficiency of thermodynamic turbines, such as steam and gas turbines.
3. Explain refrigeration systems and their applications in cooling and heat transfer processes.
4. Apply equations of state and compressibility relations to analyze the behavior of pure substances under different conditions.
5. Utilize Dalton's and Amiga's laws to calculate thermodynamic properties for ideal gas mixtures in the initial weeks.
6. Apply thermodynamic principles to analyze heat effects in chemical reactions and phase changes.
7. Calculate heat capacities of liquids and solids as functions of temperature and assess their impact on energy calculations.
8. Analyze enthalpy concentration diagrams and partial enthalpies for different substances, such as H2SO4 and H2O.
9. Evaluate flow processes in fluid mechanics, including continuity, momentum, and energy equations.

Course Content

Cycles, Carnot; thermodynamic Turbines Seam and Gas, Refrigeration; General P-V-T Relations. The P-V-T behaviour of pure substances; Equation of state for gases; The principle of corresponding state; Compressibility relations; reduced pressure; reduce volume; temperature; pseudo critical constants. P-V-T approximations for gaseous mixture ideal gas mixtures. Dalton‟s law of additive pressure; Amagat‟s law of additive volumes; Pesudocritical point method; Kay‟s rule, Gililland‟s method; Behaviour of liquids. 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, single and multiple effect evaporators with regards to heat effects. Thermodynamics of Flow Processes. Fundamental equations, continuity equation; equation of motion; energy equation; Bernoulli‟s equation; Flow in pipes, laminar and turbulent flows; Reynolds number, friction factor. Fanning equation; Flow meter, Nozzles; Compressors single stage and multistage, effect of Clearance.

CHE 304: Chemical Kinetics (3 Units: LH 45)

Course Overview

Chemical Kinetics (CHE 304) is a comprehensive course that delves into the measurement, analysis, and understanding of chemical reaction rates and mechanisms. This course covers a wide range of topics, including homogeneous reactions, catalysis, chain reactions, kinetics of heterogeneous and catalytic reactions, photochemistry, absorption of gases on solids, and the application of gas chromatography. Through this course, students will acquire critical analytical skills, enabling them to investigate reaction kinetics and factors influencing reactions, laying a strong foundation for academic excellence and problem-solving in the field of chemical engineering.

Course Objectives

The objectives of the course are to:

1. Conduct measurements and analysis of wreathing reactions to understand reaction rates and mechanisms.
2. Study homogeneous reactions and investigate their kinetics and influencing factors.
3. Examine catalysis and its role in accelerating chemical reactions in various systems.
4. Explore chain reactions and their propagation mechanisms in chemical processes.
5. Analyze the kinetics of heterogeneous and catalytic reactions, considering surface phenomena and rate-determining steps.
6. Study photochemistry and its role in light-induced chemical reactions.
7. Investigate the absorption of gases on solids and its implications in gas-solid interactions.
8. Apply the principles of gas chromatography as a separation technique based on gas-solid interactions.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Conduct measurements and analyze reactions to determine reaction rates and mechanisms
2. Explain catalysis and its role in accelerating chemical reactions, considering ethical and sustainability aspects
3. Explain chain reactions and their propagation mechanisms
4. Analyze the kinetics of heterogeneous and catalytic reactions, considering surface phenomena and ethical decision-making
5. Evaluate the absorption of gases on solids and its implications in gas-solid interactions, applying knowledge to real-world scenarios
6. Explain the principles of application of gas chromatography for separation, modeling, and prediction

Course Content

Measurement and analysis of wreathing reaction. Homogeneous reactions. Catalysis. Chain reactions. Kinetics of heterogeneous and catalytic reactions. Photochemistry. Absorption of gases on solids. Application to gas chromatography.

CHE 306: Introduction to Material & Energy Balances (3 Units: LH 45)

Course Overview

CHE 306 is a foundational course in chemical engineering that provides students with essential knowledge and skills in material and energy balances. The course covers topics such as units and dimensions, the mole unit, measurement techniques, temperature, pressure, and the physical and chemical properties of substances. Students will learn how to solve complex chemical engineering problems, particularly those related to material balances, control systems, and energy balances. This course also explores the behavior of gases, liquids, solids, and the concept of enthalpy, making it a crucial foundation for chemical engineering principles.

Course Objectives

The objectives of the course are to:

1. introduce students to the concepts of units and dimensions, emphasizing their importance in chemical engineering calculations.
2. study the mole unit and its application in chemical stoichiometry and material balances.
3. explore conventions in the methods of analysis and measurement used in chemical engineering processes.
4. examine the measurement and characterization of temperature, pressure, and physical and chemical properties of substances.
5. analyze techniques for solving chemical engineering problems, particularly those related to material balances and control systems.
6. study the behavior of gases, vapors, liquids, and solids, including the ideal gas law and vapor pressure phenomena.
7. explore energy balances, heat capacity, and enthalpy changes in chemical systems with and without phase transitions.
8. investigate the application of mass and energy balances to unit operations, such as distillation, and the use of charts and diagrams for calculations.
9. analyze complex problems involving multiple mass and energy balances, including adiabatic and non-adiabatic processes.
10. study unsteady-state material and energy balances, focusing on transient conditions in chemical systems.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain units and dimensions and their critical role in chemical engineering calculations.
2. Apply the mole unit and chemical stoichiometry to effectively solve material balance problems in diverse chemical processes
3. Analyze conventions in the methods of analysis and measurement employed in chemical engineering experiments
4. Measure and characterize temperature, pressure, and physical and chemical properties of substances
5. Employ problem-solving techniques, including material balances, to address chemical engineering problems.
6. Utilize the ideal gas law and real gas relationships to analyze the behavior of gases, vapors, liquids, and solids.

7. Calculate enthalpy changes with and without phase transitions, understanding their significance in energy balances
8. Analyze the application of mass and energy balances to unit operations, such as distillation, and proficiently use charts for calculations
9. Solve problem involving mass and energy balances, including adiabatic and non-adiabatic processes
10. Explain unsteady-state material and energy balances for transient conditions in chemical systems

Course Content

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. Program of analysis of material balances. Program of analysis of material balances problem problems with direct solutions. Material balances using algebraic techniques control surface and stage balances for open and closed system. Problems involving components (elements). Recycle, Bypass, Purge; Effect of recycle and purge on mass and energy balances. Gases, vapours, liquid and solids. Ideal gas law, Real gas relationships. Vapour pressure. Saturation. Partial saturation and humidity. Material balanced involving condensation and vaporization phase phenomena. Energy balances. Concepts and Units. Heat capacity. Calculation of enthalpy changes without change phase. Enthalpy for phase transition. General Energy balance. Reversible process the mechanical energy balance. Heat of reaction. Heat of solution and mixing combine material and energy balances; Application fundamental concept of mass and energy balances and mass transfer to unit operation in distillation. Simultaneous use of material and energy balances for the steady state. Enthalpy concentration chart. Humidity chart and their use. Complex problems; Lever rule Geometrical construction for mass. I energy balances for adiabatic and non adiabatic process. Unsteady state material and energy balances.

CHE 308: Process Instrumentation (2 Units: LH 30)

Course Overview

CHE 308, Process Instrumentation, is a fundamental course that delves into the realm of measuring instruments used in engineering processes. This course covers a wide spectrum of topics, including the principles and applications of instruments for measuring level, pressure, flow, temperature, and physical properties. Moreover, it delves into advanced chemical composition analyzers, such as gas chromatographs and mass spectrometers, which play a pivotal role in industrial chemical analysis. Additionally, students will explore the intricacies of sampling systems and their significance in ensuring accurate process measurements. The course also encompasses the critical aspects of instrument selection, calibration, and maintenance. Overall, CHE 308 equips students with the essential knowledge and skills required to excel in process instrumentation, a vital aspect of chemical engineering.

Course Objectives

The objectives of the course are to:

1. Introduce students to various measuring instruments used for level, pressure, flow, temperature, and physical property measurements in engineering processes.
2. Study chemical composition analyzers and their applications in analyzing and monitoring chemical compositions in industrial settings.
3. Explore gas chromatographs and mass spectrometers as advanced analytical tools for precise chemical analysis and identification.
4. Examine sampling systems and their importance in collecting representative samples for accurate process measurements.
5. Study the application of instrumentation knowledge for measuring device selection.
6. Explore calibration and maintenance of measuring instruments.
7. Compare analysis of analytical instruments.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Identify, and describe measuring instruments used for level, pressure, flow, temperature, and physical property measurements.
2. Analyse the principles and working mechanisms of chemical composition analysers for effective process monitoring and control.
3. Operate gas chromatographs and mass spectrometers proficiently to conduct chemical analysis and accurately identify substances.
4. Evaluate the significance of sampling systems in ensuring representative and reliable data for process measurements.
5. Apply knowledge of instrumentation to select appropriate measuring devices for specific engineering applications.
6. Conduct calibration and maintenance of measuring instruments to determine their accuracy and reliability.
7. Compare the performance and capabilities of different analytical instruments, such as gas chromatographs and mass spectrometers.

Course Content

Measuring instruments for level, pressure, flow, temperature and physical properties. Chemical composition analysers. Measurement. Gas chromatograph. Mass Spectrometer. Sampling systems.

CHE 310: Chemical Engineering Laboratory I (2 Units: PH 90)

Course Overview

CHE 310 is a laboratory course designed to provide chemical engineering students with hands-on experience in conducting experiments related to transport phenomena, kinetics, and separation processes. In this course, students will explore the fundamental principles of heat transfer, mass transfer, fluid flow, and chemical kinetics through practical laboratory exercises. They will also gain valuable insights into various separation processes, including distillation, extraction, and chromatography. Through these experiments, students will develop critical thinking and analytical skills as they analyze data and draw meaningful conclusions. This course bridges theoretical knowledge with practical application, preparing students for real-world problem-solving in the field of chemical engineering.

Course Objectives

The objectives of the course are to:

1. Provide students with hands-on experience in conducting laboratory experiments related to transport phenomena, kinetics, and separation processes.
2. Introduce students to the fundamental principles and concepts of transport phenomena, including heat transfer, mass transfer, and fluid flow.
3. Study the kinetics of chemical reactions and the factors influencing reaction rates in various experimental setups.
4. Explore different separation processes, such as distillation, extraction, and chromatography, through practical laboratory exercises.
5. Foster critical thinking and analytical skills in analyzing experimental data and drawing meaningful conclusions.
6. Apply theoretical knowledge in transport phenomena and kinetics.
7. Apply effective collaboration and communication during lab sessions.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. 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
4. Evaluate the accuracy of prescribed theoretical models
5. Describe technical information and arguments in a professional manner.

Course Content

Laboratory experiments in transport phenomena. Kinetics and separation process.

CHE 300: SWEP II (2 Credits)

Course Overview

The Students Work Experience Program II (SWEP II) is a continuation of SWEP I, an intensive engineering training program that teaches engineering students how to use hand and power tools for material cutting and fabrication in order to produce self-sufficient and skilled engineers. The curriculum connects the academic and professional worlds, giving students the chance to master software programs that are pertinent to their areas of concentration. The course lasts 12 weeks and is held at the students' educational facility.-

Course Objectives

The objectives of the course are to:

1. Provide students with practical working experience in an industry setting during the long vacation following their 200 level studies.

2. Encourage students to gain hands-on experience in a professional work environment, irrespective of their major.
3. Prepare students for their future careers by exposing them to real-world work situations and challenges.
4. Foster the development of essential workplace skills, such as communication, teamwork, problem-solving, and time management.
5. Facilitate the application of theoretical knowledge gained in academic studies to practical situations in the industry.
6. Explain the significance of practical working experience in relation to their chosen field of study and future career aspirations.
7. Illustrate the importance of teamwork in achieving organizational goals and individual success within a professional setting.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Apply the knowledge of simulation in demonstrate proficiency in some.
2. Use animated videos to demonstrate knowledge of simulated models in Chemical Engineering
3. Carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers,
4. Generate data from laboratory analysis and develop empirical models.
5. Write engineering reports from lab work and fill logbooks of all experience gained in their chosen careers.

Course Content

On the job experience in industry chosen for practical working experience but not necessarily limited to the student's major (8 weeks during the long vacation following 200 level). Students are expected to have at least two (2) months Student Work Experience Programme (SWEP) immediately after 300 Level.

400-Level Courses

2.5.7 400-Level Courses First Semester

CHE 401: Chemical Engineering Laboratory II (2 Units: LH 30)

Course Overview

CHE 401 is a critical course in the Chemical Engineering program, designed to provide students with hands-on experience in applying the principles of transport phenomena, separation processes, and thermodynamics. Through laboratory experiments, students gain practical knowledge of mass, momentum, and heat transfer in chemical processes. They also learn about various separation techniques and how these are employed in chemical engineering applications. Furthermore, the course emphasizes the application of thermodynamic principles to analyze and optimize chemical processes, a fundamental aspect of chemical engineering. Overall, CHE 401 plays a pivotal role in equipping students with the practical skills and critical thinking abilities necessary for success in the field of chemical engineering.

Course Objectives:

The objectives of the course are to:

1. Apply principles of transport phenomena to analyze and predict mass, momentum, and heat transfer in chemical processes.
2. Demonstrate understanding of separation processes and their application in chemical engineering.
3. Apply thermodynamic principles to analyze and optimize chemical processes.
4. Perform laboratory experiments using standard chemical engineering equipment and techniques
5. Analyze experimental data and present findings effectively.
6. Apply critical thinking to troubleshoot experimental challenges.
7. Collaborate effectively within a laboratory setting and contribute to group projects.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Apply Fick's law to predict diffusion rates in different materials, calculate Reynolds number and predict flow regimes in fluid systems, analyze convective heat transfer coefficients for various fluid-solid systems.
2. Differentiate between distillation, absorption, and extraction processes, design and evaluate a distillation column for separation of binary mixtures, compare different separation techniques for specific industrial applications.
3. Calculate equilibrium constants for chemical reactions using thermodynamic data, analyze energy balances in chemical reactors, optimize process conditions based on thermodynamic constraints.
4. Assemble and operate distillation setups with proper instrumentation, conduct viscosity measurements for different fluids using viscometers, use experimental data to determine diffusivity coefficients.
5. Analyze experimental uncertainties and errors in collected data, present experimental results through clear graphical representations, interpret trends and draw conclusions based on experimental outcomes.
6. Identify sources of experimental errors and propose strategies for mitigation, adjust experimental parameters to overcome unexpected technical issues, propose alternative methods to achieve desired experimental outcomes
7. Participate actively in group experimental setups and data collection, communicate effectively with team members to achieve common goals, Contribute insights and ideas during group discussions and problem-solving.

Course Content

Laboratory experiments in transport phenomena. Separation processes and thermodynamics.

CHE 403: Transport Phenomena II (3 Units: LH 45)

Course Objectives

The objectives of the course are to:

1. Comprehend boundary layers, turbulence, and fluid flow behavior through the application of Navier-Stokes equations.
2. Analyze and predict fluid velocity profiles using the universal velocity profile equation, distinguishing between laminar and turbulent flow conditions.
3. Evaluate and compare condensation and boiling processes for various substances, recommending suitable heat transfer methods tailored to specific applications.
4. Design and optimize chemical reactors by considering both mass transfer and chemical reaction rates, proposing solutions to enhance reaction efficiency.
5. Assess the efficiency of different inter-phase mass transfer methods, such as distillation and absorption, and propose improvements for enhancing mass transfer rates.
6. Calculate and predict eddy diffusion effects in industrial processes, suggesting strategies to minimize diffusion limitations.
7. Conduct critical assessments of the strengths and limitations of the Navier-Stokes equations in various fluid flow scenarios and propose alternative approaches where applicable.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the concept of boundary layers and turbulence, and apply Navier-Stokes equations to describe fluid flow behavior.
2. Analyze and predict fluid velocity profiles using the universal velocity profile equation, and differentiate between laminar and turbulent flow conditions.
3. Evaluate and compare the condensation and boiling processes for various substances, and recommend suitable heat transfer methods for specific applications
4. Design and optimize chemical reactors considering both mass transfer and chemical reaction rates, and propose solutions for enhancing reaction efficiency.
5. Assess the efficiency of different inter-phase mass transfer methods, such as distillation and absorption, and propose improvements for enhancing mass transfer rates.
6. Calculate and predict eddy diffusion effects in industrial processes, and suggest strategies to minimize diffusion limitations.
7. Conceptualise critical assessments of the strengths and limitations of the Navier-Stokes equations in various fluid flow scenarios, and propose alternatives where applicable

Course Content

Boundary layer theory and turbulence. Navier-Stokes equations. Universal velocity profile. Condensation and boiling. Eddy diffusion. Theories of mass transfer. Mass transfer with chemical reaction. Inter- phase mass transfer.

CHE 405: Chemical Engineering Thermodynamics II (3 Units: LH 45)

Course Overview

CHE 405 is an advanced course in chemical engineering that delves into the principles of phase equilibria and chemical reaction equilibria. Students will explore topics such as fugacity, equilibrium constants, activity coefficients, and their role in determining phase behavior in chemical systems. The course also covers the effects of temperature and pressure on equilibria, providing a comprehensive understanding of the thermodynamic aspects of chemical processes, which is crucial for chemical engineers.

Course Objectives

The objectives of the course are to:

1. Recall fundamental concepts and principles of phase equilibria and chemical
2. Apply the principles of Raoult’s law, Henry’s law, and equilibrium constants to solve problems related to gas and liquid phase equilibria.
3. Analyze and interpret phase diagrams, activity coefficients, and Gibbs-Duhem equation to predict phase behavior and mixing properties.
4. Design strategies to achieve desired conversions and phase compositions for specific chemical processes.
5. Apply the knowledge of phase equilibria and chemical reactions to propose solutions for real-world chemical engineering challenges.
6. Evaluate the effects of temperature and pressure on chemical equilibria and conversions in various reaction systems.
7. Explain the relationships between temperature, pressure, and phase behavior in chemical systems.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. List and define key terms related to phase equilibria and chemical reaction equilibria.
2. Describe how changes in temperature and pressure affect phase equilibria and equilibrium constants.
3. Calculate the fugacity of gas mixtures, use Raoult's law and Henry's law to determine phase compositions, and compute equilibrium constants for different reactions.
4. Analyze phase diagrams to predict the phases present in a system, calculate activity coefficients, and apply the Gibbs-Duhem equation to multicomponent systems.
5. Assess how changes in temperature and pressure impact equilibrium constants and conversion rates in different chemical reactions.
6. Develop process conditions to achieve target conversions for both gas and liquid phase reactions.
7. Propose innovative solutions using thermodynamic principles to address local challenges, contributing to the enhancement of local problem-solving.

Course Content

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

CHE 407: Separation Processes II (3 Units: LH 30; PH 45)

Course Overview

CHE 407 is a critical course in chemical engineering that delves into advanced separation processes. This course covers topics such as drying of solids, multiple-effects evaporators, crystallization, ion-exchange, and reverse osmosis, all of which are essential in the chemical industry for separating and purifying various substances. Through this course, students will gain the knowledge and skills needed to design and optimize separation processes, ensuring the efficient removal of moisture, concentration of solutions, and purification of solids and liquids.

Course Objectives:

The objectives of the course are to:

1. Apply principles of drying and humidification to remove moisture from solids and liquids
2. Analyze and design multiple-effects evaporators for efficient heat transfer and concentration processes.
3. Apply crystallization principles to separate and purify solids from solutions
4. explain the principles of ion-exchange processes for separation a purification.
5. Evaluate the principles and applications of reverse osmosis for liquid separation.
6. Connect separation process knowledge to local challenges and entrepreneurial opportunities.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Describe the mechanisms of moisture transfer in solids, calculate drying rates and times for different solid materials, design a drying process for a specific solid material, considering temperature, humidity, and airflow.
2. Explain the working principles of multiple-effects evaporators, compare and contrast single-effect and multiple-effects evaporators, design a multiple-effects evaporator system for a given concentration task.
3. Describe nucleation and crystal growth mechanisms, analyze factors affecting crystal size and purity, design a crystallization process to obtain desired crystal properties.
4. Explain the concept of ion-exchange and its applications, analyze the factors influencing ion-exchange kinetics, Design an ion-exchange process for specific ion removal from a solution.
5. Describe the reverse osmosis process and its driving forces, compare reverse osmosis with other membrane separation techniques, Design a reverse osmosis system for

water purification, analyze the principles of water cooling and humidification for temperature and humidity control.
6. Explain the concepts of heat exchange and heat transfer coefficients, design a water-cooling system for a given industrial application, Describe the mechanisms of water vapor absorption and humidification.
7. Identify local challenges where separation processes can provide solutions, propose innovative applications of separation processes for entrepreneurial ventures, develop a business plan integrating separation processes to address a local problem.

Course Content

Drying of solids. Multiple-effects evaporators. Crystallisation. Ion-exchange. Reverse osmosis, humidification and water cooling.

CHE 409: Plant Design I (3 Units: LH 45)

Course Overview

CHE 409, Plant Design I, is a crucial course that focuses on the principles of chemical engineering process design. It provides students with the knowledge and skills needed to address real-world process design problems. The course covers a wide range of topics, including the sources of design data, process and engineering flow diagrams, and the mechanical design of process vessels and piping systems. Additionally, it emphasizes environmental and site considerations, cost analysis, and safety aspects in the design process. Through this course, students will develop the expertise to formulate feasibility reports, evaluate economic factors, and ensure that ethical and safety considerations are integrated into their design projects.

Course Objectives

The objectives of the course are to:

1. explain the fundamental principles of chemical engineering process design, including design data sources and process flow diagrams
2. Interpret and analyze real-world process design problems, considering method study and critical examination techniques
3. Apply mechanical design principles to design process vessels and piping systems, considering relevant standards and regulations.
4. Evaluate environmental and site considerations in process design, identifying potential impacts and proposing mitigation strategies
5. Develop a comprehensive process outline chart that integrates method study, critical examination, and process services for efficient operations
6. Assess the economic feasibility of a process design, including costing and formulation of a feasibility report.
7. Integrate safety considerations into the process design, identifying potential hazards and implementing measures for risk reduction.
8. Assess the economic feasibility of a process design, including costing and formulation of a feasibility report.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Create detailed flow sheets for chemical engineering processes, demonstrating their understanding of unit operations and interconnections.
2. Perform precise heat and mass balances on chemical processes and assess process efficiency and areas for improvement.
3. Identify potential hazards in chemical processes and conduct risk assessments to ensure safe operations.
4. Perform economic analyses of chemical engineering projects, considering factors such as costs and return on investment.
5. Prepare and defend a technological/engineering design project through effective oral presentations and technical report writing
6. Evaluate the environmental impact of chemical processes and propose strategies for minimizing negative effects, aligning with sustainability principles.
7. Design chemical engineering plants and select appropriate equipment, considering process requirements, safety, and economics

Course Content

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.

CHE 411: Chemical Engineering Analysis (2 Units: LH 30)

Course Overview

CHE 411 is a course designed to equip students with the mathematical and statistical tools necessary for analyzing and solving complex chemical engineering problems. It covers topics such as ordinary and partial differential equations, numerical solutions for chemical engineering operations, statistics, analysis of variance, and regression analysis. By mastering these concepts and techniques, students will be well-prepared to model chemical processes, optimize engineering operations, and make data-driven decisions in their future careers as chemical engineers.

Course Objectives

The objectives of the course are to:

1. Apply ordinary and partial differential equations to model chemical engineering processes and analyze their behavior.
2. Utilize numerical methods to solve chemical engineering operations and evaluate their efficiency.
3. Analyze statistical data and experimental results to make informed decisions in chemical engineering applications.

4. Evaluate different types of observations and apply analysis of variance to assess variations in chemical processes.
5. Design experiments and apply regression analysis to optimize chemical engineering processes and enhance efficiency.
6. Formulate solutions to local challenges by integrating scientific principles and chemical engineering concepts.
7. Identify opportunities for entrepreneurial ventures within the chemical engineering field and develop feasible plans.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Apply ordinary and partial differential equations to model and analyze chemical engineering processes.
2. Utilize numerical methods to solve complex chemical engineering problems and quantify their solutions.
3. Analyze experimental data using statistical techniques, enabling them to draw meaningful conclusions and make informed decisions.
4. Evaluate variations in chemical processes through the application of analysis of variance methods.
5. Design experiments and employ regression analysis to optimize chemical engineering operations.
6. Conceptualise innovative solutions to local challenges by integrating scientific principles and chemical engineering concepts effectively.
7. Identify potential entrepreneurial opportunities within the chemical engineering domain and develop viable business plans.

Course Content

Applied ordinary and partial differential equations. Chemical engineering operations and their numerical solutions. Statistics: types of observation. Analysis of variance. Tests of significance. Regression analysis. Design of experiments.

CHE 413: Particle Technology (2 Units: LH 30)

Course Overview

Particle Technology is a comprehensive course that delves into the properties and behavior of particles in various fluid systems. It covers fundamental concepts such as Stoke's and Newton's Laws to predict particle motion and settling characteristics in different fluid environments. Additionally, the course explores topics like flow through packed beds, fluidization, sedimentation, flocculation, filtration, and particle size reduction through screening, classification, and grinding processes. This course equips students with the knowledge and skills necessary to understand and manipulate particles in fluid systems, which is crucial in chemical engineering processes.

Course Objectives

The objectives of the course are to:

1. Explain the fundamental properties of particles and their behavior in fluid systems
2. Interpret and apply Stoke's and Newton's Laws to predict particle motion and settling behavior in different fluid environments.
3. Apply principles of fluid flow to analyze the dynamics of particles through packed beds and fluidized systems.
4. Design and optimize sedimentation and flocculation processes for separation of particles from suspensions
5. Evaluate filtration mechanisms and design effective filtration processes for particle separation
6. Formulate strategies for particle size reduction through screening, classification, and grinding processes.
7. Critically assess the challenges and benefits of fluidization in various industrial applications.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Describe the key properties of particles and explain their influence on fluid-particle interactions.
2. Analyze particle motion in fluids using Stoke's and Newton's Laws to predict settling velocities and behaviors.
3. Calculate pressure drops and flow characteristics for particles in packed beds and fluidized conditions.
4. Develop strategies for efficient separation of particles from suspensions using sedimentation and flocculation techniques.
5. Assess different filtration mechanisms and design filtration systems for specific particle sizes and characteristics.
6. Devise methods to control particle size distribution through screening, classification, and grinding techniques.
7. Critique the advantages and limitations of fluidization in different industrial contexts.

Course Content

Properties of particles. Motion of particles in a fluid, Stoke's and Newton's Laws. Flow through packed beds. Fluidization. Sedimentation and flocculation. Filtration. Screening, Classification and grinding.

CHE 415: Environmental Engineering (3 Units: LH 45)

Course Overview

CHE 415 is a comprehensive course that delves into the critical field of environmental engineering. It explores the complex relationship between pollution and the environment, covering both natural and man-made sources of pollution. Students will gain a deep understanding of air pollution, including its various forms and sources, and learn about the legislation and methods used to control gaseous emissions. Additionally, the course addresses water pollution, emphasizing the impact of industrial effluents on rivers and ecosystems. Various treatment processes, from precipitation to biological methods, will be studied in detail. Solid waste disposal, including innovative waste-to-energy approaches, is also a focal point. Finally, students will explore less conventional forms of pollution such as noise, thermal, and nuclear pollution, and learn strategies for mitigating their environmental impact.

Course Objectives

The objectives of the course are to:

1. Define key terms related to pollution and the environment, including natural and manmade pollution, air and water pollution, and legislation.
2. Describe the inter-relationship between pollution and the environment, and explain the effects of air and water pollution on weather, vegetation, materials, and human health.
3. Analyze industrial sources of air and water pollution, and design solutions to control gaseous emissions using methods such as cyclones, electrostatic precipitators, and wet washers.
4. Assess the impact of industrial effluents on river pollution, and apply relevant legislation and standards to determine permissible effluent discharge levels.
5. Compare and contrast different water treatment processes, and recommend appropriate treatment methods for various impurities, including biological treatment processes.
6. Formulate strategies for solid waste disposal, including incineration and dumping, and propose innovative approaches to convert solid wastes into useful materials or energy.
7. Assess the impact of noise, thermal, and nuclear pollution on the environment, and recommend mitigation measures for each type of pollution.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Define pollution and environment and explain the inter-relationship, natural and manmade pollution, the economics of pollution.
2. Outline the effects on weather vegetation materials and human health.
3. List and explain legislation laws relating to air pollution, methods of control of gaseous emission and destruction, cyclones inertia separators electrostatic precipitator bag filters and wet washers.
4. Discuss dispersal from chimneys and perform calculation of chimney height, flare stacks, water pollution river pollution by industrial effluent.
5. List the legislation and standards for effluent discharge, impurities in natural water and their effects, brief survey of ecology and outline the effects of effluent on the ecosystems
6. Describe the treatment processes including precipitation flocculation coagulation, sedimentation, clarification and colour removal.
7. Perform, analyse and reach a substantial understanding on the principles of biological treatment processes, cost of treatment, treatment for water re-use, ion exchange cooling water treatment.

8. Discuss disposal of solid wastes by incinerator and dumping and possible future trends including conversion of solid wastes into useful material or energy.
9. List and types of pollution and their various treatments.

Course Content

Pollution and the environment definitions and inter-relationship; natural and manmade pollution; the 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 etc. Dispersal from chimneys and 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.

GEN 401: Economics for Engineers (2 Units: LH 30)

Course Overview

GEN 401 is a critical course that equips engineering students with the knowledge and skills to make informed economic decisions in the field of engineering. It covers economic analysis of engineering projects, including the evaluation of capital investments, selection of engineering alternatives, and considerations of risk. Additionally, the course delves into corporate financial practices relevant to engineering projects. By providing students with a strong foundation in economic principles and their practical application in engineering, GEN 401 prepares them to excel academically and contribute to the development of sustainable and economically viable engineering solutions.

Course Objectives

The objectives of the course are to:

1. explain the fundamental concepts of economic analysis in engineering projects.
2. Interpret value systems and their impact on engineering decisions
3. Apply economic principles to evaluate capital investment decisions.
4. Analyze risky decisions in engineering project contexts
5. Analyze corporate financial practices relevant to engineering projects
6. Propose engineering alternatives based on economic considerations
7. Evaluate the economic viability of new projects and replacement policies.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Define key economic terms used in engineering project evaluation, such as Net Present Value (NPV), internal rate of return (IRR), and cost-benefit analysis.
2. Explain how societal, environmental, and ethical considerations influence economic choices in engineering projects.
3. Calculate and compare financial metrics (NPV, IRR) to assess the feasibility of engineering projects and make recommendations.
4. Assess the impact of uncertainty and risk on project outcomes, and propose risk mitigation strategies
5. Examine financial statements and performance indicators to evaluate the financial health of companies involved in engineering projects
6. Generate alternative project scenarios with cost implications, and justify the best option using economic reasoning
7. Critique and compare different project proposals and replacement strategies using economic criteria.

Course Content

Economic analysis of engineering projects; value systems economic decisions on capital investments and choice of engineering alternatives; new projects, replacement and abandonment policies, risky decisions; corporate financial practices.

2.5.8 400-Level Courses Second Semester

CHE 400: Students' Industrial Work Experience Scheme (SIWES) (6 Credits)

Course Overview

Students' Industrial Work Experience Scheme (SIWES) provides students with a unique opportunity to bridge the gap between academia and the professional world. During this course, students undertake an industrial work experience in various sectors. The course emphasizes problem-solving skills, allowing students to analyze real-world industrial challenges and propose practical solutions. Through hands-on experience, students apply their theoretical knowledge in industrial settings, experiencing the transition from student life to the world of work. They identify and creatively address engineering challenges within their workplace and the larger society, honing their critical thinking and creativity. Additionally, students enhance their presentation skills during SIWES seminars, maximizing the benefits of this transformative experience.

Course Objectives

The objectives of the course are to:

1. Develop the ability to analyze real-world industrial problems and propose effective solutions based on acquired knowledge and experience.
2. Apply theoretical knowledge to practical industrial scenarios through hands-on experience, bridging the gap between classroom learning and real-world application.
3. Experience the transition phase from student life to the professional world of work, adapting to the work environment and its demands.

4. Identify industrial and engineering challenges within the place of engagement and society at large, creatively devising impactful solutions to address them.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Analyze real-world industrial problems and propose solutions.
2. Apply theoretical knowledge to practical industrial scenarios through hands-on experience.
3. Experience the transition phase of students from school to the world of work and the environment
4. Identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them
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 Content

To take place in industry for one semester plus the long vacation following 400 level

500-Level Courses

2.5.9 500-Level Courses First Semester

CHE 501: Separation Processes III (3 Units: LH 30; PH 45)

Course Overview

CHE 501 is an advanced course in separation processes within the chemical engineering program. It delves into the principles and applications of various separation techniques, including solvent extraction, extractive and azeotropic distillation, multicomponent gas absorption, distillation of multi-component mixtures, and novel separation processes. Students will gain the knowledge and skills needed to design and optimize separation systems for complex chemical engineering processes. This course equips students with a deep understanding of separation technologies, enabling them to excel academically and contribute to the development of new knowledge and technologies in the field of chemical engineering.

Course Objectives

The objective of this course is to

1. Explain the principles and applications of solvent extraction, extractive, and azeotropic distillation in chemical engineering processes.
2. Design and optimize multicomponent gas absorption systems for various industrial applications.
3. Explain distillation techniques for separating multi-component mixtures; calculate and predict separation efficiencies.
4. Explore and evaluate novel separation processes, understanding their advantages, limitations, and potential applications in the industry.

5. Apply theoretical knowledge to practical scenarios, effectively solving complex separation problems commonly encountered in chemical engineering.
6. Evaluate the environmental impacts of separation processes and propose strategies for minimizing negative effects.
7. Explain sustainability, safety, and responsible production practices within the context of separation processes.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the principles and applications of solvent extraction, extractive, and azeotropic distillation in chemical engineering processes.
2. Design and optimize multicomponent gas absorption systems for various industrial applications.
3. Explain distillation techniques for separating multi-component mixtures, Calculate and predict separation efficiencies.
4. Explain and evaluate novel separation processes, understanding their advantages, limitations, and potential applications in the industry.
5. Apply theoretical knowledge to practical scenarios, effectively solving complex separation problems commonly encountered in chemical engineering.
6. Evaluate the environmental impacts of separation processes and propose strategies for minimizing negative effects.
7. Explain sustainability, safety, and responsible production practices within the context of separation processes.

Course Content

Solvent extraction. Extractive and azeotropic distillation. Multicomponent gas absorption. Distillation of multi-component mixtures. Novel separation process.

CHE 503: Process Control I (2 Units: LH 30)

Course Overview

CHE 503, Process Control I, is a fundamental course in chemical engineering that explores the principles of process dynamics, transfer functions, frequency response analysis, and discrete events in the context of chemical engineering systems. This course equips students with the knowledge and skills needed to understand and control dynamic behavior in chemical processes and equipment. Students will learn how to model and analyze chemical processes, optimize their performance, and design control systems for stability and desired outcomes.

Course Objectives

The objective of this course is to

1. Explain the principles of process dynamics and how they govern the behavior of chemical engineering systems.

2. Analyze and derive transfer functions to model the dynamic behavior of chemical processes and equipment.
3. Apply frequency response analysis techniques to study the stability and performance of chemical engineering systems under different operating conditions.
4. apply discrete event modeling and simulation to optimize and improve the efficiency of chemical processes.
5. identify and analyze various disturbances and disturbances in chemical processes and propose appropriate control strategies.
6. design and implement control systems for chemical processes to achieve desired performance and stability.
7. State the importance of safety and responsible production in chemical engineering processes and apply this knowledge to process dynamics and control systems.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the fundamental concepts of process dynamics and identify their significance in chemical engineering applications.
2. Derive transfer functions for different chemical engineering systems and interpret their mathematical properties.
3. Conduct frequency response analysis to predict the dynamic behavior of chemical processes and equipment.
4. Model and simulate discrete events in chemical processes to optimize system performance.
5. Analyse the response of chemical processes to disturbances and design control strategies to maintain stability and desired performance.
6. Design and implement control systems for chemical processes, considering safety and responsible production principles.
7. Evaluate the impact of control strategies on the overall sustainability and environmental aspects of chemical engineering processes.

Course Content

Process dynamics. Transfer functions. Frequency response analysis. Discrete events.

CHE 505: Process Optimisation (3 Units: LH 45)

Course Overview

Process Optimization is a comprehensive course that delves into the principles of calculus and their application in finding the maximum and minimum values of functions. It equips students with the knowledge and techniques necessary for optimizing chemical engineering processes and product designs. The course covers a range of optimization methods, including unconstrained peak seeking, single and multi-variable search techniques, constrained optimization, linear programming, numerical optimization, and discrete event simulation. By mastering these techniques, students will develop critical thinking and problem-solving skills essential for excelling in the field of chemical engineering.

Course Objectives

The objectives of this course are to

1. Explain the principles of calculus and how they are applied to find maxima and minima of functions.
2. Employ unconstrained peak seeking methods to identify optimal solutions in chemical engineering problems.
3. Apply single and multi-variable search techniques to optimize chemical processes and product designs effectively.
4. Analyze and implement constrained optimization techniques for solving real-world chemical engineering challenges.
5. Utilize linear programming methods to optimize resource allocation and decision-making in chemical engineering processes.
6. Employ numerical optimization techniques to solve complex chemical engineering problems with precision.
7. Apply discrete event simulation methods to model and optimize chemical processes with varying conditions and events.

Course Learning Outcomes:

Upon completing the course, students will be able to

1. Apply calculus concepts to determine maximum and minimum points of functions in chemical engineering contexts.
2. Implement various unconstrained peak seeking methods to identify optimal values for parameters in chemical processes.
3. Use single and multi-variable search techniques to optimize chemical processes, product designs, and production techniques.
4. Analyze and solve real-world chemical engineering problems by applying constrained optimization techniques effectively.
5. Use linear programming methods to optimize resource allocation and decision-making in chemical engineering projects.
6. Apply numerical optimization techniques to find accurate solutions for complex chemical engineering challenges.
7. Model and optimize chemical processes considering discrete events and varying conditions.

Course Content

Maxima of functions through the use of calculus. Unconstrained peak seeking methods. Single and multi-variable search techniques. Constrained optimisation techniques. Linear programming. Numerical optimisation techniques. Discrete events.

CHE 507: Plant Design II (3 Units: LH 45; PH 135)

Course Overview

In Plant Design II, students delve into the intricate world of chemical engineering plant design. This course equips students with the expertise needed to create comprehensive flow sheets for chemical processes, incorporating unit operations and interconnections. Students perform precise heat and mass balances, evaluate process efficiency, and identify areas for improvement. They conduct risk assessments to ensure safety and economic analyses for project viability. Effective oral presentations and technical report writing skills are honed while defending technological/engineering design projects. Students also consider sustainability and environmental impact, aligning their designs with modern principles.

Course Objectives

The objectives of this course are to

1. Develop the ability to create detailed flow sheets for chemical engineering processes, showcasing a deep understanding of unit operations and interconnections.
2. Master the art of performing precise heat and mass balances on chemical processes, enabling the assessment of process efficiency and identification of areas for improvement.
3. Identify potential hazards in chemical processes and conduct comprehensive risk assessments to ensure safe operations.
4. Acquire proficiency in performing economic analyses for chemical engineering projects, considering critical factors such as costs and return on investment.
5. Prepare and defend technological/engineering design projects effectively through oral presentations and technical report writing, demonstrating the ability to communicate complex design concepts clearly.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Create detailed flow sheets for chemical engineering processes, demonstrating their understanding of unit operations and interconnections.
2. Perform precise heat and mass balances on chemical processes and assess process efficiency and areas for improvement.
3. Identify potential hazards in chemical processes and conduct risk assessments to ensure safe operations.
4. Perform economic analyses of chemical engineering projects, considering factors such as costs and return on investment.
5. Prepare and defend a technological/engineering design project through effective oral presentations and technical report writing
6. Evaluate the environmental impact of chemical processes and propose strategies for minimizing negative effects, aligning with sustainability principles.
7. Design chemical engineering plants and select appropriate equipment, considering process requirements, safety, and economics

Course Content

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 consideration.

CHE 509: Chemical Engineering Laboratory III (1 Credit)

Course Overview

CHE 509 is a laboratory course that focuses on the practical application of chemical engineering principles related to transport phenomena, separation processes, and thermodynamics. In this course, students will conduct hands-on experiments to gain a deep understanding of fluid mechanics, heat transfer, mass transfer, and separation techniques like distillation and filtration. They will also explore the fundamental principles of thermodynamics as they apply to chemical process design. Through data collection, analysis, and interpretation, students will develop critical thinking and problem-solving skills. Furthermore, this course encourages collaboration and teamwork as students work together to design and conduct group experiments, aligning with the university's mission to prepare students for ethical leadership and promote a sense of community engagement.

Course Objectives

The objective of this course is to

1. explain the principles of transport phenomena, including fluid mechanics, heat transfer, and mass transfer, as applied to chemical engineering processes.
2. Highlight the theoretical background and practical applications of separation processes, such as distillation, extraction, and filtration, in the context of chemical engineering operations.
3. explain the fundamental principles of thermodynamics and their relevance to chemical process design and optimization.
4. conduct experiments related to transport phenomena and separation processes, including data collection, analysis, and interpretation.
5. operate laboratory equipment and use software commonly employed in chemical engineering experiments.
6. Apply theoretical concepts to solve real-world engineering problems related to transport phenomena and separation processes.
7. Collaborate effectively with peers to design and conduct group experiments, fostering teamwork and communication skills.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Describe and apply the principles of transport phenomena to analyze and design chemical engineering processes involving fluid flow, heat transfer, and mass transfer.
2. Design and optimize separation processes for specific chemical engineering applications, taking into account factors such as efficiency, cost, and environmental impact.

3. Apply thermodynamic principles to assess the feasibility and efficiency of chemical processes and propose modifications for improvement.
4. Acquire hands-on experience in conducting transport phenomena and separation processes experiments, and effectively analyze experimental data to draw meaningful conclusions.
5. Utilize laboratory equipment and software to carry out experiments, troubleshoot issues, and ensure safety protocols are followed.
6. Solve engineering problems related to transport phenomena and separation processes, exhibit critical thinking skills and the ability to apply theoretical knowledge to real-world scenarios.
7. Showcase effective teamwork and communication skills through group laboratory work, including the ability to collaborate, delegate tasks, and present findings coherently.

Course Content

Laboratory experiments in transport phenomena. Separation processes and thermodynamics

CHE 511: Research Methodology (2 Units: LH 30)

Course Overview

CHE 511 is an essential course that introduces students to the principles and techniques of research methodology in the field of chemical engineering. It covers various aspects of the research process, including research methods and procedures, literature review, data analysis, and research report writing. The course equips students with the necessary skills to plan and conduct research, analyze data, and effectively communicate research results through reports and presentations. By providing this foundation in research methodology, CHE 511 prepares students to excel academically and contribute to the development of new knowledge and technologies, aligning with the university's mission of enhancing intellectual growth and promoting academic excellence.

Course Objectives

The objective of this course is to

1. Explain the fundamental principles of petroleum geology, including the formation, migration, and accumulation of hydrocarbons in the Earth's subsurface.
2. Explain various exploration methods and technologies used in the oil and gas industry to locate potential hydrocarbon reserves.
3. Explain the processes involved in crude oil production, from drilling and extraction to refining and distribution.
4. Discuss the environmental challenges associated with oil and gas operations and propose effective pollution control strategies to mitigate the negative impacts.
5. Acquire knowledge of natural gas production techniques, including extraction, processing, and utilization.
6. Assess the environmental impacts of petroleum exploration and production activities, as well as propose measures to minimize harm and promote sustainable practices.

7. Identify and address local challenges related to petroleum exploration and production using scientific and chemical engineering principles.

Course Overview

CHE 511, Research Methodology, is a foundational course in the field of Chemical Engineering that provides students with essential knowledge and skills related to research methods and procedures. The course covers various aspects of the research process, including literature review, data analysis, interpretation, and presentation of research results. It also focuses on the planning and execution of research projects in Chemical Engineering, emphasizing the importance of conducting research with integrity and ethical considerations. Additionally, students will learn how to prepare comprehensive research reports, theses, and dissertations that meet academic standards and guidelines, and how to adapt research findings for publication in journals and presentation at conferences.

Course Objectives

The objective of this course is to

1. Identify and explain various research methods used in the field of Chemical Engineering.
2. conduct a literature review and accurately cite references in research work.
3. Analyze and interpret data effectively, using appropriate statistical techniques and software tools.
4. plan and conduct research projects in Chemical Engineering.
5. Present research findings in a clear, organized, and professional manner.
6. Prepare comprehensive research reports, theses, and dissertations that meet academic standards and guidelines.
7. prepare research reports for journal publication and presenting research findings at conferences.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Identify and apply suitable research methods in the context of Chemical Engineering research.
2. Conduct a thorough literature review and accurately reference cited sources in their research work.
3. Utilize appropriate data analysis techniques to draw meaningful conclusions from research data.
4. Design and execute research projects, adhering to ethical principles and relevant protocols.
5. Communicate research findings through presentations and written reports, ensuring clarity and coherence.
6. Produce well-structured research reports, theses, and dissertations that contribute to the body of knowledge in Chemical Engineering.

7. Prepare research papers suitable for journal publication and effectively present research findings at academic conferences.

Course Content

Introduction to Research methods in Engineering. Research Methods and Procedures. Literature Review and Reference citation. Data Analysis and Interpretation. Presentation of Research results. Planning and Conducting the Research. Writing the Research Reports – Thesis and Dissertation. Preparation of Research Reports for Journal publication and conference presentation. Evaluation of Research reports.

CHE 591: Research Project 1 (2 Units)

CHE 591 is a research-focused course that provides students with the opportunity to conduct individual research projects under the guidance of academic staff. The projects undertaken in this course are designed to address national and state industrial problems in Nigeria, with a specific focus on chemical engineering principles. Students will delve into real-world challenges faced by the chemical engineering industry and propose practical solutions. This course aims to develop students' research and problem-solving skills, fostering critical thinking and encouraging collaboration with industry professionals and government agencies. It aligns with the university's mission by enhancing intellectual growth, promoting academic excellence, and addressing practical problems to benefit the community and industry.

Course Objectives

The objective of this course is to

1. Develop a comprehensive understanding of the chemical engineering principles relevant to addressing national, state, and industrial problems in Nigeria.
2. Identify and analyze key challenges faced by the chemical engineering industry in the country and propose feasible solutions.
3. Encourage students to conduct in-depth research on topics related to national development and sustainability in the chemical engineering context.
4. Foster critical thinking and problem-solving skills in approaching complex issues in the Nigerian chemical engineering landscape.
5. Promote collaboration and communication among students, industry professionals, and government agencies to facilitate knowledge sharing and innovation.

Course Learning Outcomes

Upon completing the course, the student 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
7. Present the final report (orally and in writing).

Course Content

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

CHE 513: Technology of Fossil Fuel Processing (Elective) (3 Units: LH 45)

Course Overview

This course delves into the critical aspects of fossil fuels, including their sources, availability, and characterization. It explores modern processing technologies employed in the extraction, refining, and utilization of fossil fuels such as petroleum, natural gas, tar sands, and coal. Furthermore, the course scrutinizes various product lines and products derived from these fossil fuels, considering economic, environmental, and social implications. It also highlights the importance of sustainable and environmentally-friendly alternatives in fossil fuel processing and product development.

Course Objectives

The objectives of this course are to

1. Enumerate the sources of fossil fuels, including petroleum, natural gas, tar sands, and coal, and their availability for energy and chemical production.
2. Characterize the properties and composition of different fossil fuel resources and how they impact processing and product outcomes.
3. Explore modern processing technologies used in the extraction, refining, and utilization of fossil fuels.
4. Analyze and compare different product lines and products derived from fossil fuels, considering their economic, environmental, and social implications.
5. Evaluate alternative product lines and products that can bederived from fossil fuels, emphasizing sustainable and environmentally-friendly options.
6. Specify product requirements based on market demand, safety regulations, and environmental considerations in the context of fossil fuel processing.
7. Propose innovative approaches to enhance fossil fuel processing and product development.

Course Learning Outcomes:

Upon completing the course, students will be able to

1. Identify and describe various sources of fossil fuels and their availability for industrial use.
2. Characterize and analyze the chemical and physical properties of different fossil fuel resources.
3. Explain the principles and technologies used in the processing and refining of fossil fuels.
4. Compare and contrast different product lines and products derived from fossil fuels, considering their economic viability and environmental impact.
5. Propose alternative product lines and environmentally sustainable products based on scientific and chemical engineering principles.

6. Develop product specifications that comply with safety standards and environmental regulations in fossil fuel processing.
7. Apply critical thinking and problem-solving skills to address challenges and optimize fossil fuel processing techniques.

Course Content

Source, availability and characterisation of fossil fuel (Petroleum, Natural gas, tar sands, coal). Modern processing technology: Choice of product lines and products: Alternative product lines and products and product specification to be emphasized.

CHE 515: Pulp and Paper Technology (Elective) (3 Units: LH 45)

Course Overview

Pulp and Paper Technology is an elective course designed to provide students with an in-depth understanding of the paper manufacturing process. It covers the properties of raw materials used in paper production, including their suitability for various stages of manufacturing. Students will explore different pulping methods, such as mechanical and chemical pulping, and learn about their advantages and limitations. The course also emphasizes energy recovery techniques to enhance efficiency and reduce the environmental footprint of paper production. Additionally, students will study bleaching methods for producing high-quality pulp while considering environmental and safety aspects. Strategies for utilizing by-products generated during paper manufacturing to minimize waste and promote sustainability will be discussed. The economic and ecological aspects of paper manufacturing, including its impact on the local economy and job creation, will also be examined.

Course Objectives

The objectives of this course are to

1. List different raw materials used in the paper manufacturing process and state their properties and suitability for various stages of production.
2. Describe and compare various pulping methods, such as mechanical and chemical pulping, and mention the advantages and limitations of each process.
3. Develop strategies to efficiently recover and utilize energy from the paper manufacturing process to enhance overall energy efficiency and reduce environmental impact.
4. Apply different bleaching methods to produce high-quality pulp while considering environmental implications and safety aspects.
5. Explore and propose innovative ways to utilize by-products generated during paper manufacturing, minimizing waste and promoting sustainability
6. Analyze the economic viability of paper production and assess its ecological impact on the local and global environment.
7. Discuss the importance of the paper manufacturing industry in the local economy and its potential to create job opportunities by harnessing locally available resources.

Course Learning Outcomes:

Upon completing the course, students will be able to

1. Distinguish between different raw materials used in paper manufacturing based on their properties and appropriateness for specific processes.
2. Explain the pulping processes, including their advantages, disadvantages, and applications.
3. Devise strategies for effective energy recovery within the paper manufacturing process to optimize resource utilization.
4. Demonstrate the use of various bleaching techniques and assess their impact on the quality of the pulp.
5. Propose innovative ways to utilize by-products generated during paper manufacturing to reduce waste and enhance sustainability.
6. Analyze the economic viability of paper production, considering factors such as production costs, market demand, and profitability.
7. Assess the ecological impact of paper manufacturing and develop strategies to mitigate negative effects on the environment.

Course Content

Properties of the raw materials. Preparation of pulpwood. Pulping processes. Energy recovery. Bleaching of pulps and stock preparation. Utilisation of by-products. Economics and ecological aspects of paper manufacture.

CHE 517: Fermentation Technology (Elective) (3 Units: LH 45)

Course Overview

Fermentation Technology (CHE 517) is a specialized course within the Chemical Engineering program that explores the principles of microbiology and biochemistry as they relate to fermentation processes. It covers various aspects of fermentation, including the types of substrates used, batch and continuous fermentation methods, and the production of malted beverages like beer and wine. Additionally, the course delves into the crucial role of enzymes in fermentation and their applications in biotechnology. Students will learn to apply scientific and engineering principles to design and optimize fermentation processes while considering their environmental impacts.

Course Objectives

The objective of this course is to

1. Explain the principles of microbiology and biochemistry as they apply to fermentation processes.
2. Differentiate between different types of substrates used in fermentation and their respective impacts on the process.
3. Explain the key steps involved in batch and continuous fermentation, and analyze their advantages and limitations.
4. Explain the processes involved in malting, brewing, and wine-making, and identify the factors that influence the quality of the final products.

5. Explain the role of enzymes in fermentation and their significance in biotechnological applications.
6. Apply scientific and engineering principles to design and optimize fermentation processes for specific applications.
7. Analyze the environmental impacts of fermentation technologies and develop strategies to minimize negative effects.

Course Outcomes:

Upon completing the course, the student will be able to:

1. Describe the relationship between microbiology, biochemistry, and fermentation processes and how they contribute to the production of various products.
2. Identify and classify different types of substrates suitable for fermentation and assess their suitability for specific applications.
3. Compare and contrast batch and continuous fermentation processes, and select the appropriate approach for different scenarios.
4. Evaluate the different stages of malting, brewing, and wine-making and propose improvements to enhance product quality.
5. Assess the role of enzymes in fermentation and apply this knowledge to improve biotechnological processes.
6. Design and optimize fermentation processes, considering factors such as yield, efficiency, and product quality.
7. Formulate strategies to minimize the environmental impact of fermentation technologies and suggest sustainable practices for their implementation.

Course Content

Introductory microbiology and biochemistry. Substrates. The fermentation process. Batch and continuous fermentation. Malting and brewing. Wine making Enzymes in fermentation
Introductory microbiology and biochemistry. Substrates. The fermentation process. Batch and continuous fermentation. Malting and brewing. Wine making Enzymes in fermentation

CHE 519: Polymer Science and Technology (Elective) (3 Units: LH 45)

Course Overview

Polymer Science and Technology (CHE 519) is an elective course that provides students with a comprehensive understanding of polymers, including their characteristics, structures, physical properties, and manufacturing processes. The course covers key topics such as rheology, solubility, molecular weights, plasticity, and elasticity of polymers. It also delves into polymerization reactions and manufacturing methods, with a focus on Ziegler-Natta catalysis. Students will learn about the environmental impact of polymer processes and explore strategies for sustainable and responsible polymer production.

Course Objectives

The objective of this course is to

1. Describe the fundamental characteristics of polymers, including their structures, physical properties (rheology, solubility, molecular weights), plasticity, and elasticity.
2. Explain the various polymerization reactions and manufacturing methods, with a specific focus on Ziegler-Natta catalysis.
3. Explore different sources of monomers used in polymer synthesis and explain the significance of selecting appropriate monomers for specific applications.
4. Explain the processing and technology involved in polymer production, including techniques for shaping and forming polymers into useful products.
5. Utilize the William Landel Ferry equation to predict and analyze the mechanical behavior of polymers at different temperatures.
6. Evaluate the environmental impact of various polymer processes and technologies and develop strategies for reducing negative effects on the environment.
7. Identify opportunities for sustainable practices in polymer production and prioritize safety and responsible production methods.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Describe polymers and their characteristics.
2. Explain source of monomers.
3. Describe the structure and physical properties of polymers: rheology, solubility, plasticity, elasticity and molecular weights.
4. Explain the William Landel Ferry equation.
5. Describe the polymerisation reactions and manufacturing methods.
6. Describe the processing and technology of polymers.

Course Content

Introduction to polymer and their characteristics. Source of monomers. Structure and physical properties of polymers: rheology, solubility and molecular weights. Plasticity and elasticity. The William Landel Ferry Equation, Polymerisation reactions and manufacturing methods; Ziegler Natta catalysis. Processing and Technology of Polymers.

GEN 501: Engineering Management (3 Units: LH 45)

Course Overview

Engineering Management is a critical course that equips chemical engineering students with essential management skills and knowledge. It covers functions and responsibilities of management, efficient organizational structures, staff training and compensation in the context of chemical engineering operations and projects. This course emphasizes the importance of effective communication, budgeting, and cost control, all of which are vital in chemical engineering. Additionally, it delves into principles of general management and planning, applying them directly to chemical engineering projects and organizations. Through GEN 501, students develop management competencies tailored to the chemical engineering field, preparing them for leadership roles in alignment with the university's mission of ethical leadership and academic excellence.

Course Objectives

The objective of this course is to

1. explain the functions and responsibilities of management in the context of chemical engineering operations and projects.
2. Discuss the principles of organizing for efficiency in chemical engineering processes and projects.
3. Explain the skills in training, recruitment, and compensation of staff specific to the chemical engineering field.
4. Assess and conduct staff appraisals effectively in chemical engineering environments.
5. Apply budgeting and cost control techniques in chemical engineering projects.
6. Demonstrate effective communication skills relevant to chemical engineering contexts.
7. Analyze and apply principles of general management and planning in chemical engineering projects and organizations.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Identify and explain the various functions and responsibilities of management in chemical engineering settings.
2. Identify chemical engineering tasks and projects for maximum efficiency and effectiveness.
3. Explain strategies for training, recruiting, and compensating staff in chemical engineering organizations.
4. Explain the process staff appraisals and provide constructive feedback in a chemical engineering context.
5. Explain budget creation and management for chemical engineering projects and implement cost control measures.
6. Explain the communication strategy with team members, stakeholders, and superiors in chemical engineering projects.
7. Apply principles of general management and planning to develop viable solutions for chemical engineering challenges.

Course Content

Functions and responsibilities of management. Organising for efficiency. Training, recruitment and compensation of staff. Staff appraisal. Budget and cost control. Effective communication. General Management, Planning. Essence of management task. Patterns of leadership. Creating a viable organisation. Productivity and motivation, Organizing task. The span of control and the delegation of authority. Organizational theory and concepts. Industrial safety. Industrial relations.

2.5.10 500-Level Courses Second Semester

GEN 502: Engineering Law **(2 Units: LH 30)**

Course Overview

GEN 502 is a foundational course in engineering law that provides students with a comprehensive understanding of legal principles relevant to the engineering profession. The course covers topics such as the formation of contracts, liabilities in torts, the professional role and liabilities of engineers, property law, partnership, and intellectual property. Additionally, it delves into employment contracts, industrial and labor law, maritime law, and the basic principles of Nigerian law. Through case studies and practical examples, students will gain insight into the legal aspects of the engineering field, equipping them with the knowledge and skills needed to navigate legal issues in their professional careers.

Course Objectives

The objectives of the course are to:

1. To introduce engineering students to those aspects of law which are most relevant to engineering practice.
2. To promote familiarity with and understanding of those areas of law.
3. To develop skills of analysis and problem solving.
4. To facilitate effective written expression and argumentation.

Course Learning Outcomes

Upon completing the course, the student 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
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 Content

Introduction and sources of law. Formation of contracts. Liabilities in torts: assaults, negligence and strict liability. Professional role and liabilities of Engineers. Contract of Employment: independent contractors, workmen compensation. Property law. Partnership. Intellectual property, copyright, trademarks and patent. Registration and incorporation of companies and effects. Case studies relating to professionals. Arbitration. Function of law, Basic principles of Nigerian Law. Introduction to the law of contracts. Law of Business associations. Industrial and Labour Law. Maritime Law.

CHE 502: Chemical Reaction Engineering (4 Units: LH 45; PH 45)

Course Overview

CHE 502, Chemical Reaction Engineering, is a comprehensive course that covers the classification and types of chemical reactions, design equations for single and multiple reactions, and the kinetics of homogeneous technological processes. It also explores the effects of temperature and pressure on reactions, fluid mixing, and residence time distribution. Students will be introduced to various chemical engineering reactors and systems, including fluidized bed, trickle bed, and slurry reactors. Additionally, the course delves into factors influencing the choice of reactors, catalysis characterization, and rate-controlling regimes in gas-solid reactions catalyzed by porous catalysts, including catalyst decay and reactivation. Furthermore, students will gain insights into the design aspects of both homogeneous and heterogeneous reaction systems, as well as catalyzed reaction systems.

Course Objectives

The objectives of this course are to

1. Explain the legal framework relevant to Chemical Engineering and its applications in various aspects of professional practice.
2. Identify the key elements of contracts and their formation, particularly as they relate to engineering projects and services.
3. Analyze and evaluate liabilities in torts, including cases of assaults, negligence, and strict liability, with an emphasis on applying this knowledge to engineering scenarios.
4. Examine the professional roles and liabilities of engineers, developing a comprehensive understanding of the ethical and legal responsibilities within the field.
5. explain the legal aspects of employment contracts, including the distinctions between independent contractors and employees, as well as workmen compensation issues.
6. Explore property law, partnership principles, and intellectual property rights, especially copyright, trademarks, and patents, and their relevance in chemical engineering innovation and product development.
7. Discuss the processes and procedures involved in the registration and incorporation of companies, and their effects on the business landscape in the context of chemical engineering ventures.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Discuss the different types of reactions, methods of operation and design equations for single and multiple reactions.
2. Define, formulate and analyse the kinetics of homogeneous technological processes. temperature and pressure effects. fluid mixing and residence time distribution.
3. List and discuss chemical engineering reactors and chemical technological systems.
4. Outline the types of fluidized bed trickle bed and slurry reactors, list the factors that can affect the choice of reactors characterization of catalysis.
5. Discuss the rate controlling regimes in gas solid reactions catalysed by porous catalysts effectiveness factor scale up procedure catalyst decay and reactivation.
6. Design for homogeneous and heterogeneous reactions systems.
7. Discuss the design of catalyzed reaction systems.

Course Content

Classification and types of reactions. Methods of operation and design equations for single and multiple reactions. Kinetics of Homogeneous Technological Processes. Temperature and pressure effects. Fluid mixing and residence time distribution; Introduction to Chemical Engineering Reactors and Chemical Technological Systems. Fluidized bed trickle bed and slurry reactors. Factors affecting choice of reactors characterization of catalysis; Rate controlling regimes in gas solid reactions catalyzed by porous catalysts effectiveness factor scale up procedure catalyst decay and reactivation. Introduction to Designs for Homogeneous and Heterogeneous Reactions" Systems. Introduction to Design for Catalyzed Reaction Systems.

CHE506: Design Project (2 Units: LH 30)

Course Overview

CHE 506 (Design project) is a comprehensive course in chemical engineering that focuses on the design of chemical processes and plant operations. In this course, students tackle a design problem involving a chemical process, encompassing the creation of detailed flow sheets, heat and mass balances, and the design of plant equipment and unit operations. Throughout the course, students are encouraged to consider economic and safety aspects, ensuring that their designs are not only efficient but also cost-effective and secure. They are required to submit and defend a bound copy of a technological/engineering design project, which includes sections like introduction, literature review, process design, equipment specifications, and environmental considerations. This course provides students with the practical skills and knowledge needed to excel in chemical engineering design and aligns with the university's mission by fostering critical thinking, problem-solving, ethical decision-making, and an understanding of environmental and societal impacts in the pursuit of academic excellence and entrepreneurship.

Course Objectives

The objectives of this course are to

1. Develop comprehensive flow sheets for chemical engineering processes, showcasing their understanding of various unit operations and their interconnections.
2. Perform accurate heat and mass balances on chemical processes, enabling them to assess process efficiency and identify potential areas for improvement
3. Design chemical engineering plants and select appropriate equipment based on process requirements, safety considerations, and economic feasibility.
4. Identify potential hazards in chemical processes and perform risk assessments to ensure safe operations and mitigate potential accidents.
5. Evaluate the environmental impact of chemical processes and propose strategies to minimize negative effects, aligning with sustainable and responsible production principles.
6. Conduct economic analyses of chemical engineering projects, considering factors such as capital and operating costs, return on investment, and cost-benefit ratios.

7. Prepare and defend a bound copy of a technological/engineering design project, effectively presenting their ideas and findings through oral presentations and technical report writing.

Course Learning Outcomes

Upon completing the course, students will be able to

1. Prepare accurate flow sheets that illustrate the process flow and understand the fundamental principles of each unit operation involved.
2. Perform heat and mass balances with proficiency, ensuring that input and output quantities are accurately accounted for in chemical processes.
3. Design chemical engineering plants with consideration for safety, adhering to industry standards, and maximizing economic viability.
4. Identify potential hazards in chemical processes and propose appropriate measures to minimize risks and enhance overall safety.
5. Assess the environmental impacts of chemical processes and devise strategies to reduce the negative effects, promoting environmentally conscious engineering practices.
6. Conduct comprehensive economic analyses, evaluating the viability of chemical engineering projects and making informed decisions based on cost considerations.
7. Present their design projects convincingly through oral defense and well-structured technical reports, demonstrating their ability to communicate complex engineering concepts effectively.

Course Content

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 consideration.

CHE504: Process Control II (2 Units: LH 30)

Course Overview

CHE504, Process Control II, is a critical course within the Chemical Engineering program that focuses on control system design and advanced control strategies. It covers topics such as cascade control, feedforward and feedback control, multi-variable control, and the importance of control valves in regulating chemical processes. This course equips students with the knowledge and skills necessary to design, implement, and troubleshoot control systems in chemical engineering applications.

Course Objectives

The objectives of this course are to

1. Explain the principles of control system design in chemical engineering.
2. Explain the concept and application of cascade control in chemical processes.
3. Differentiate between feedforward and feedback control strategies and their respective uses in chemical engineering.
4. Discuss the challenges and approaches in multi-variable control for complex chemical processes.
5. Analyze the role and importance of control valves in regulating process parameters.
6. Design and implement basic control systems for chemical processes.
7. Evaluate the performance of control systems and troubleshoot issues in real-world scenarios.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Design and implement control systems for chemical processes, considering various control strategies.
2. Set up and optimize cascade control systems for improved process stability and performance.
3. Develop and apply feed forward and feedback control schemes to address specific process challenges effectively.
4. Apply multi-variable control techniques to manage complex chemical processes and achieve desired outcomes.
5. Operate and calibrate control valves to regulate process variables accurately.
6. Evaluate control system performance through data analysis and make necessary adjustments for better efficiency.
7. Identify and troubleshoot control system issues in chemical processes, ensuring safe and reliable operations.

Course Content

Control system design. Cascade control. Feed forward and feedback control. Introduction to multi-variable control. The control valve.

CHE 508: Process Safety and Loss Prevention (2 Units: LH 30)

Course Overview

CHE 508, Process Safety and Loss Prevention, is a critical course that addresses the safety aspects of chemical process industries. It explores potential hazards in these industries, emphasizing the importance of safety measures to prevent accidents. The course introduces the Hazard and Operability (HAZOP) technique, a systematic approach to identify and assess potential hazards in process plants. It also covers accident causes, prevention strategies, plant maintenance for minimizing losses, and waste disposal with a focus on pollution control. Legal implications related to losses and accidents are discussed, highlighting the importance of compliance with environmental regulations and safety standards. Overall, this course equips students with essential knowledge and skills to ensure safety, sustainability, and ethical responsibility in chemical engineering processes.

Course Objectives

The objective of this course is to

1. analyze potential hazards in chemical process industries and understand the importance of safety measures to prevent accidents.
2. apply the HAZOP (Hazard and Operability) technique to systematically identify and assess potential hazards in process plants.
3. develop strategies and protocols to prevent accidents and ensure safety in chemical process industries.
4. plan and implement maintenance practices to minimize losses and ensure optimal operation of chemical plants.
5. Explain the techniques used to treat and dispose waste generated in chemical processes, and develop strategies for pollution control.
6. discuss the legal implications of various losses and accidents in chemical process industries, including compliance with environmental regulations and safety standards.
7. Explain the principles of sustainability, responsible production, and the importance of minimizing environmental impacts in chemical engineering processes.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Identify and classify various hazards present in chemical process industries, including physical, chemical, and operational hazards.
2. Implement safety measures and protocols within process plants to mitigate the risks associated with chemical processes.
3. Analyze and explain the root causes of accidents in process plants, considering factors such as human error, equipment failures, and environmental conditions.
4. Develop strategies for accident prevention, including the design and implementation of safety systems and procedures.
5. Perform Hazard and Operability (HAZOP) analysis techniques in order to identify and assess process hazards, and develop effective risk reduction strategies
6. Explain pollution control methods, including emissions monitoring, waste treatment technologies, and compliance with environmental regulations.
7. Outline legal and regulatory frameworks governing the chemical process industry, including environmental laws, safety regulations, and liability issues

Course Content

Hazards in chemical process industries. Safety in plants. Causes of accidents in process plants. Prevention of accidents. Hazop technique. Maintenance of plant to minimise losses. Waste disposal and efficient treatment. Pollution control. Legal implications of various losses.

CHE 592: Research Project II (4 Units; PH 270)

Course Overview
CHE 598 is design research-focused course that provides students with the opportunity to conduct individual research projects under the guidance of academic staff. The projects undertaken in this course are designed to address national and state industrial problems in Nigeria, with a specific focus on chemical engineering principles. Students will delve into real-world challenges faced by the chemical engineering industry and propose practical solutions. This course aims to develop students' research and problem-solving skills, fostering critical thinking and encouraging collaboration with industry professionals and government agencies. It aligns with the university's mission by enhancing intellectual growth, promoting academic excellence, and addressing practical problems to benefit the community and industry.

Course Objectives
The objectives of the course are to:
1. To develop a comprehensive understanding of the chemical engineering principles relevant to addressing national, state, and industrial problems in Nigeria.
2. To identify and analyze key challenges faced by the chemical engineering industry in the country and propose feasible solutions.
3. To encourage students to conduct in-depth research on topics related to national development and sustainability in the chemical engineering context.
4. To foster critical thinking and problem-solving skills in approaching complex issues in the Nigerian chemical engineering landscape.
5. To promote collaboration and communication among students, industry professionals, and government agencies to facilitate knowledge sharing and innovation.

Course Learning Outcomes
Upon completing the course, the student will be able to:
1. Conceptualise research questions, design experiments, collect data, and draw valid conclusions based on their research.
2. Evaluate and report on the sustainability impacts of their research, considering societal, economic, and environmental factors.
3. Use modern engineering and IT tools to collect, analyze, and present research data effectively
4. Communicate their research findings through well-structured reports, presentations, and documentation that consider diverse audiences
5. Demonstrate critical thinking skills in the context of their research, identifying potential limitations and proposing solutions
6. Conduct research in an ethical and responsible manner, adhering to relevant codes of conduct.

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

CHE 510: Petroleum Technology (Elective) (3 Units: LH 45)

Course Overview

This Petroleum Technology (Elective) course delves into the multifaceted realm of petroleum technology and engineering. Students gain insights into the concept of petroleum technology, methods for oil and gas exploration, and techniques used in their exploitation. The course explores the transformation of organic matter into crude oil and the challenges faced in oil and gas resource development. Students also learn about subsurface completion operations and use Nodal analysis software to address vertical lift performance issues. Topics such as flow measurement, separator sizing, and the impact of inflow-outflow relationships on well life are covered. Throughout the course, students develop essential tools for effective problem-solving and the management of oil and gas ventures.

Course Objectives

The objectives of the course are to:

1. Gain a deep understanding of petroleum technology/engineering concepts.
2. Explain the various methods used in the exploration of oil and gas resources.
3. Describe the techniques involved in the exploitation of oil and gas reserves.
4. Understand the process of transforming organic matter into crude oil.
5. Identify and analyze the challenges encountered in the development of oil and gas resources.
6. Recognize the operations and equipment required for subsurface completion in oil and gas wells.
7. Develop proficiency in solving vertical lift performance problems using Nodal analysis software.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain concept of petroleum technology/engineering.
2. Explain methods used to explore for oil and gas.
3. Explain techniques behind oil and gas exploitation.
4. Explain transformation of organic matter to crude oil.
5. Identify problems encountered in developing oil and gas resources.
6. identify the operations and equipment required for subsurface completion.
7. Solve vertical lift performance problems in wells using Nodal analysis software.
8. Describe the problems associated with flow measurement and their solutions.
9. Calculate the size of a vertical and horizontal separator.
10. Describe the effect of the inflow-outflow relationship on the life of the well. And
11. Develop tools for solving these problems and running the oil and gas business.

Course Content

Petroleum geology. Petroleum exploration. Crude oil production. Pollution control. Natural gas production.

CHE 512: Coal Processing Technology (Elective) (3 Units: LH 45)

Course Overview

CHE 512 is a specialized course that delves into the science and technology of coal processing. It covers the formation of coal, its physical and chemical properties, and various processes like carbonization, combustion, gasification, and liquefaction that transform coal into valuable products. Additionally, the course addresses the crucial environmental aspects of coal utilization, emphasizing the need to balance energy production with sustainability and environmental responsibility.

Course Objectives

The objective of this course is to

1. explain the formation, physical, and chemical properties of coal.
2. Explain the carbonization process and its significance in converting coal into useful products.
3. Describe the combustion of coal and its role in energy production.
4. Analyze the gasification process of coal and its potential applications.
5. Discuss the liquefaction of coal and its implications for the production of liquid fuels.
6. Evaluate the environmental aspects associated with coal utilization, including emissions and environmental impacts.
7. Develop strategies to address environmental challenges related to coal utilization.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the formation, physical, and chemical properties of coal.
2. Explain the carbonization process and its significance in converting coal into useful products.
3. Describe the combustion of coal and its role in energy production.
4. Analyse the gasification process of coal and its potential applications.
5. Discuss the liquefaction of coal and its implications for the production of liquid fuels.
6. Evaluate the environmental aspects associated with coal utilization, including emissions and environmental impacts.
7. Develop strategies to address environmental challenges related to coal utilization.

Course Content

Introduction to coal formation. Physical and chemical properties of coal. Carbonisation of coal. Combustion of coal. Gasification of coal. Liquefaction of coal. Environmental aspects of coal utilisation.

CHE 514: Sugar Technology (Elective) (3 Units: LH 45)

Course Overview

Sugar Technology is an elective course that delves into the intricate process of manufacturing refined sugar from sugarcane. It provides students with an in-depth understanding of the equipment and operations involved in sugar refining. Additionally, the course explores crucial considerations such as safety, economic efficiency, and environmental impact throughout the sugar production process. Students will learn about the utilization of by-products generated during sugar refining, with a focus on sustainable practices and energy recovery. The course equips students with the knowledge and skills needed to optimize sugar production while adhering to quality and environmental standards.

Course Objectives

The objective of this course is to

1. Explain the process and operations involved in the manufacture of refined sugar from cane, including the key equipment used in the process.
2. Explain the considerations related to safety, economic efficiency, and environmental impact during the production of refined sugar.
3. Analyze the utilization of by-products generated from the sugar refining operation, identifying potential applications and benefits.
4. Evaluate and propose strategies for energy recovery in the sugar refining process to enhance overall efficiency.
5. Design and develop plans to optimize the production of refined sugar, considering factors such as quality, yield, and cost-effectiveness.
6. Assess the environmental impacts of sugar refining operations and formulate strategies for reducing negative effects and promoting sustainable practices.
7. Explain safety protocols and responsible production practices for the sugar refining industry.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Describe the step-by-step process of manufacturing refined sugar from cane, including the equipment used at each stage.
2. Conduct a safety and environmental assessment of a sugar refining plant, identifying potential hazards and proposing measures to mitigate risks.
3. Analyze the by-products generated during sugar refining and propose viable applications or methods for their utilization.
4. Create a comprehensive energy recovery plan for a sugar refining operation, outlining methods to maximize energy efficiency and minimize waste.
5. Optimize the production process to achieve desired quality, yield, and cost targets for refined sugar.
6. Develop a sustainability strategy for a sugar refining plant, considering the environmental impact of the processes and proposing eco-friendly alternatives.
7. Design safety protocols and responsible production guidelines that comply with industry standards for a sugar refining facility.

Course Content

Description of the equipment and considerations of the process and operations involve in the manufacture of refined sugar from cane. Utilisation of the by-products of the refining operation. Safety, economic and environmental considerations. Energy recovery.

CHE 516: Detergent Technology (Elective) (3 Units: LH 45)

Course Overview

Detergent Technology is a specialized elective course that delves into the history, types, and mechanisms of detergents. Students will gain a comprehensive understanding of detergents' chemical compositions and how they function in cleaning various surfaces. The course covers the manufacturing processes involved in producing soap base through direct saponification of oils and fats, as well as the production of fatty acids. It also explores the methods for manufacturing solid soap, soap powders, and non-soap detergents.

Course Objectives

The objective of this course is to

1. Identify different types of detergents and understand their chemical composition.
2. Describe the mechanism of detergency and explain how detergents work to clean various surfaces.
3. Demonstrate knowledge of the manufacturing process of soap base through direct saponification of oils and fats.
4. Analyze the production of fatty acids and their applications in detergent manufacturing.
5. Illustrate the procedures involved in producing solid soap and soap powders.
6. Investigate the methods for manufacturing non-soap detergents and understand their advantages and uses.
7. Evaluate the environmental impacts of detergent production and develop strategies to mitigate negative effects.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the detergency mechanism and apply it to explain how detergents effectively clean different surfaces.
2. Utilize appropriate measurement techniques to analyze physical and chemical properties of substances
3. Create soap base by directly saponifying oils and fats
4. Analyze the production process of fatty acids and assess their significance in detergent manufacturing.
5. Develop solid soap and soap powders using appropriate techniques.
6. Conceptualise non-soap detergents with specific properties for different applications.
7. Evaluate the environmental impacts of detergent production and propose feasible strategies to reduce negative effects, promoting sustainable and responsible production practices.

Course Content

Historical outline. Types of detergents. Mechanism of detergency. Oil and fats, manufacture of soap base by direct saponification of oils and fats. Manufacture of fatty acids. Production of solid soap, soap powders. Manufacture of non-soap detergents.

CHE 518: Cement and Cement Technology (Elective) (3 Units: LH 45)

Course Overview

CHE 518, an elective course in the chemical engineering program, delves into the fascinating world of cement chemistry and technology. Students will gain comprehensive insights into the raw materials used in cement production, the intricate composition of cement mixtures, and the complex sintering processes involved. Understanding the technology behind clinker and cement production, as well as the various types of cement and their applications, will be at the core of this course. Moreover, students will explore the hydration of cement, its effects on concrete properties, and its interactions with different substances. Importantly, this course will address the environmental aspects of cement production, including strategies for mitigating its environmental footprint. Additionally, students will learn to design and analyze blended cement production, utilizing locally available resources. Lastly, the course will spotlight the role of cement in carbon sequestration and its potential contribution to addressing climate change.

Course Objectives

The objective of this course is to

1. Explain the principles of cement chemistry and the technology behind cement production.
2. Analyze the different types of cement and their respective properties and applications.
3. Explain the hydration process of cement and its implications on concrete strength and durability.
4. Discuss the environmental impacts of cement production and develop strategies for reducing its negative effects.
5. Design and analyze the production of blended cement using locally available resources.
6. Explore the role of cement in carbon sequestration and its potential contribution to climate change mitigation.
7. Apply knowledge of cement chemistry and production to address local challenges and enhance problem-solving capabilities.

Course Learning Outcomes

Upon completing the course, the student will be able to:

1. Explain the chemical processes involved in cement production and describe the key raw materials used.
2. Differentiate between various types of cement and determine their suitability for specific construction and engineering purposes.
3. Explain the hydration reactions of cement and predict the performance of concrete in different environmental conditions.
4. Identify the environmental consequences of cement manufacturing and propose measures to minimize carbon emissions and energy consumption.
5. Create formulations for blended cement using alternative materials, promoting sustainability and economic efficiency.

6. Discuss the concept of carbon sequestration through cement utilization and assess its impact on greenhouse gas reduction.
7. Propose innovative solutions to local engineering and construction problems by incorporating cement technology.

Course Content

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.

3.0 Students' Evaluation of Courses

There would be an established avenue put in place offering opportunity to students to evaluate courses delivered to them at the end of each semester. This would be an integral component of the course credit system; serving as feedback mechanism for achieving the following:

i. Improvement in the effectiveness of course delivery.
ii. Continual update of lecture materials to incorporate emerging new concepts.
iii. Effective usage of teaching aids and tools to maximize impact of knowledge on students.
iv. Improvement in students' performance through effective delivery of tutorials, timely in presentation of continuous assessment and high-quality examination.

In order to achieve effective learning, all students should normally be permitted to evaluate those courses registered at the end of each semester, preferably before the final semester examinations. It is very important that students' evaluation of courses be administered fairly and transparently through the use of well-designed questionnaires, maintain confidentiality demanded by such exercise and apply their scientifically processed outcome to improving effective course delivery in all ramifications.

3.1 Evaluation

3.1.1 Techniques of Student Assessment

(a) Practical

By the nature of the disciplines in Engineering and Technology, laboratory practical is very important in the training of the graduates. To reflect this importance of practical work, a minimum of 9 hours per week (3 credits) should be spent on students' laboratory practical. Furthermore, it is very important to determine performance of the student in the practical component of the program. To achieve this, all the laboratory practical have been lumped together to form a course which the student must pass. It is expected that the weighting given in the various courses is reflected in number and nature in the design of the experiments. These practical must follow the trend in the current development of the program.

(b) Tutorials

There should be one hour of tutorial for every four hours of lecture. Thus, a course of one credit unit should comprise 12 hours of lecture and three hours of tutorials.

(c) Continuous Assessments

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

i. Scores from continuous assessment shall normally constitute 30 per cent of the final marks for courses which are primarily theoretical.
ii. For courses which are partly practical and partly theoretical, scores from continuous assessment shall constitute 50% of the final marks.
iii. For courses that are entirely practical, continuous assessment shall be based on a student's practical work or reports and shall constitute 100 percent of the final marks.

(d) Examinations

In addition to continuous assessment, final examinations should normally be given for every course at the end of each semester. The final grade would be based on the following breakdown, subject to section 1.5.1 (c) of this document:

Final Examination: 60% - 70%

Continuous assessment (Quizzes, Tutorials, Homework, Tests): 30% - 40%

i. Each course shall normally be completed and examined at the end of the semester in which it is offered.
ii. A written examination shall normally last a minimum of one hour for one-unit course.

3.1.2 SIWES Rating and Assessment

In Engineering education, industrial attachment is very crucial. The minimum duration of this attachment should be 34 weeks (one semester and 2 long vacations) and would be broken into the following modules: Students Work Experience Program (10 weeks – long vacation); Students Industrial Work Experience Scheme (24 weeks, one semester plus long vacation).

To make the training effective, it is important that the students learn how to operate some of the ordinary machines and tools they will encounter in the industry before they go for the attachment. Therefore, they would start with Student Work Experience Program, which is conducted in the Faculty Workshops, under strict industrial conditions. On successful completion of Students Work Experience Program, the Students Industrial Work Experience Schemes would be done in industries under strict industrial conditions and supervision.

Normally, industrial attachment would be graded and no student should graduate without passing all the modules of the attachment and this should be used in degree classification.

3.2 Graduation Requirements

3.2.1 Degree Classifications

The determination of the class of degree shall be based on the Cumulative Grade Point Average earned at the end of the program. The GPA is computed by dividing the total number of credit points (TCP) by the total number of units (TNU) for all the courses taken in the semester.

The minimum total credit unit required for graduation for the program would be **201 for UTME and 170 for Direct Entry students**. The CGPA shall be used in the determination of the class of degree as summarized in Table 2.

Table 2. Degree Classification

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

3.3 Grade Point Average and Cumulative Grade Point Average

3.3.1 Grading of Courses

Grading of courses shall be done by a combination of percentage marks and letter grades translated into a graduated system of Grade Point as shown in Table 1.2.

Table 3. Grade Point System

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

3.3.2 Grade Point Average (GPA)

Performance in any semester is reported in Grade Point Average. This is the average of weighted grade points earned in the courses taken during the semester. The Grade Point Average is obtained by multiplying the Grade Point average in each course by the number of Credit Units assigned to that course, and then summing these up and dividing by the total number of Credit Units taken for the semester. For the purpose of determining a student's standing at the end of every semester, the Grade Point Average (GPA) system shall be used. The GPA is computed by dividing the total number of Units x Grade Point (TUGP) by the total number of units (TNU) for all the courses taken in the semester as illustrated in Table 1.3.

Table 4. Calculation of GPA or CGPA

Course	Units	Grade Point	Units x Grade Point (UGP)
C_1	U_1	GP_1	U_N x GP_N
C_2	U_2	GP_2	U_N x GP_N
-	-	-	
-	-	-	
Ci	Ui	GP_i	U_N x GP_N
-	-	-	
-	-	-	
C_N	U_N	GP_N	U_N x GP_N
TOTAL	**TNU**		**TUGP**

3.3.3 Cumulative Grade Point Average (CGPA)

This is the up-to-date mean of the Grade Points earned by the student in a program of study. It is an indication of the student's overall performance at any point in the training program. To compute the Cumulative Grade Point Average, the total of Grade Points multiplied by the respective Credit Units for all the semesters are added and then divided by the total number of Credit Units for all courses registered by the student. The Cumulative Grade Point Average (CGPA) over a period of semesters is calculated in the same manner as the GPA by using the grade points of all the courses taken during the period.

3.4 Miscellaneous

3.4 Maximum Duration for Graduation

The maximum length of time allowed to obtain a degree in the Department shall be fourteen semesters for the 5-year degree program and twelve semesters for students admitted directly into the 200 level. For extension beyond the maximum period, a special permission of Senate shall be required on the recommendation of the Departmental and Faculty Board.

3.4.2 Probation

A student whose Cumulative Grade Point Average is below 2.0 at the end of a particular year of study, earns a period of probation for one academic session.

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

3.4.3 Withdrawal

A candidate whose Cumulative Grade Point Average is below 1.50 at the end of a particular year of probation should be required to withdraw from the Department. However, in order to minimize waste of human resources, consideration should be given to transfer to other program within the University.

3.4.4 Orientation

At the beginning of the session, the Department of Chemical Engineering usually organizes an orientation program for new students. This is in addition to the orientation program that is organized by the university. The purpose of the program is to acquaint the new students with the peculiarities of the Department and introduce the officers of the Department. Fresh students also freely interact with lecturers and are encouraged to ask questions on anything they would like to know about the Department and its programs.

3.4.5 Add/Drop of Courses

At the discretion of Heads of Programs and course lecturers, a student may be allowed to make minor changes in registration at the beginning of a semester as long as these changes do not contravene any current University, Faculty, and Departmental Regulations. No course change will be allowed if more than one-fifth of the course material has been covered.

3.4.6 Change of Department/Program

The university does not allow interfaculty transfer. However, a student may be allowed by the Dean of the Faculty to change from one program to another program within the Faculty on the following conditions:

- Not later than the 2nd week in level 300
- The appropriate is obtained from the MIS (Management Information Services) and duly completed after paying the necessary fees.
- Approval of the two Heads of programs involved;
- The student was not admitted on the basis of OND or HND qualifications.
- The student has spent more than a year in the current program.

3.4.7 Suspension of Studies

Where a student misses a substantial part of a semester for health reasons, the Faculty board shall recommend ‘suspension of studies’ for senate approval. Where a student is given suspension of studies, he/she shall be required to take courses afresh (but not as carry-overs), or undertake alternative ones where applicable on his/her return. No GPA shall be computed for a semester where the student is on suspension of studies. However, if the suspension is only for one semester, performance in the other semester shall be used in computing the Cumulative Grade Point Average (CGPA).

3.4.8 Withdrawal from Studies

Withdrawal from studies may be either compulsory or voluntary

3.4.9 Compulsory

Compulsory withdrawal from a program shall be recommended by the Faculty to the Senate on any of the following grounds.

i. Failure to register for the prescribed number of credits within the prescribed period.
ii. Failure to attain the required standard in English language within the stipulated time limit
iii. Failure to attend classes for a period, which exceeds 30 consecutive days except on, certified medical grounds.
iv. Failure to get a CGPA of 1.50 or better at the end of the probation period.
v. Failure to complete the program within the maximum permissible period of study i.e. 4 semesters beyond the minimum allowable period.

3.4.10 Voluntary Withdrawal

A student may withdraw voluntarily from the program by applying to the Faculty, stating the reasons for the withdrawal. The Faculty Board will then make the appropriate recommendations to the University Senate for its final approval.

3.4.11 Lecture and Examination Time Table

Before the commencement of each semester, a lecture Time Table containing the lecture timings and venues for all Faculty courses is released by the Faculty Time Table Officer. Departments thereafter produce their Time Tables in accordance with the Faculty Time Table.

3.4.12 Transcript/Partial Transcript

Transcripts of examinations results shall be signed and stamped by Deans of Faculties and countersigned by the Registrar or his/her representative and shall be in such a form as may be approved from time to time. Numerical marks in individual courses shall not be given but letter grades, GPA and GCPA. A student who applies for a change of institution and has his/her application approved shall be entitled to collect a partial transcript showing the courses taken up to the time of leaving institution and the results obtained thereof.

3.4.13 Notification of Results

No results of examinations may be normally announced until after they have been approved by the Senate Business Committee (SBC) or Senate, as the case may be. However, the Chairman of Senate may give approval in advance for the earlier announcement of results on a provisional basis and subject to Senate approval, to be made where special urgency exists. The results of semester examinations for all levels is usually released after the approval of senate for final year examinations, or SBC in case of lower-level examinations.

3.4.15 Correction of Results

If an incorrect result of a student is mistakenly submitted and approved by the senate, the Department shall, after having detected the mistake correct the result and reflect the correction in the semester of the course taken. Normal approval process shall thereafter be followed to get the corrected results approved and recorded in all concerned units.

3.4.16 Verification of results

Where a student observes that an incorrect result has been recorded for him/her (for example, he/she is reported absent after having sat for an examination) he/she should report the matter to his/her level coordinator. The level coordinator shall then follow the laid down verification process to ascertain the correct result. Where a mistake is confirmed, the process of correction of result shall then be started.

2.0 STAFF PROFILE

LECTURING STAFF

S/n	Staff Pin	Name	Rank	Sex	Qualification	Area of Specialization
1	P.01396	Onyekwere, O. S.	SL	M	B.Eng. (FUTO) M.Eng. (MAUTY) PhD (UNIBEN)	Industrial Engineering (Process and system optimization)
2	P.01358	Government, R. M.	SL	M	B.Eng. (ESUT) M.Eng. (NAU) PhD (NAU)	Chemical Engineering (Petrochemical and polymer technology)
3	P.00386	Popoola, C. A.	SL	M	B.Eng. (LAUTECH) M.Eng. (UI) PhD (UAM)	Production Engineering (Tribology)
4	P.01387	Aliyu, A.	L I	M	B.Eng. (FUTMINNA) M.Eng. (FUTMINNA) PhD (INDIA)	Chemical Engineering (Material synthesis and characterization)
5	P.01471	Azodo, A. P.	L I	M	B.Eng. (FUTMINNA) M.Eng. (FUNAAB) PhD (FUNAAB)	Mechanical Engineering (Ergonomics and safety engineering)
6	P.00637	Thaddeus, J.	L I	M	B.Eng. (UNIMAID) M.Eng. (LONDON) PhD (UNN)	Mechanical Engineering (Energy and power)
7	P.01002	Abutu, D.	L I	M	B.Eng. (ABU) MSc (ABU)	Chemical Engineering
8	P.01359	Olowokere, J.	L I	M	B.Eng. (FUTMINNA) M.Eng. (FUTMINNA)	Chemical Engineering (Material/environmental engineering)

9	P.01349	Gin, A. W.	L I	M	B.Eng. (FUTMINNA) M.Eng. (FUTMINNA) PhD (MALAYSIA)	Chemical Engineering (Reaction engineering and adsorption)
10	P.00998	Odiakaose, C.	L I	M	B.Eng. (UAM) M.Eng. (FUTY)	Mechanical Engineering (Industrial and material engineering)
11	P.01342	Ibrahim T. K.	L I	M	B.Eng. (ABU) MSC (ABU)	Mechanical Engineering (Production engineering)
12	P.01554	Odineze, C. M.	L I	M	B.Eng. (ATBU) M.Eng. (FUTMINNA)	Mechanical Engineering (Environmental engineering)
13	P.01426	Tsokwa, T.	L I	M	B.Eng. (UNIMAID) M.Eng. (MAUTY)	Chemical Engineering (Biochemical and Environmental Engineering)
14	P.01200	Ibrahim, A. G.	L II	M	B.Eng. (UNIMAID) MSc (ABU)	Chemical Engineering (Process and Environmental Engineering)
15	P.00577	Owhor, S. C.	L II	M	B.Eng. (RSUST) M.Eng. (UAM)	Mechanical Engineering (Energy and power)
16	P.01057	Akpan, J. J.	L II	M	B.Eng. (NAU) M.Eng. (CRANFIELD)	Mechanical Engineering (Energy and safety engineering)
17	P.02772	Mohammed, M. N.	AL	M	B.Eng. (ABU) MSc (PANNONIA)	Environmental Engineering
18	P.01506	Jibatswen, T.	L II	M	B.Eng.	Mechanical

		Y.			(UNIMAID) M.Eng. (JSTUM)	Engineering
19	P.00361	Nwonodi, R. I.	L II	M	B.Eng. (UNIPORT) M.Eng. (UNIPORT)	Petroleum Engineering (Drilling waste management, petroleum geomechanics, natural fractures, and optimization in pet Engineering)
20	P.01394	Abdulkareem, M. A.	L II	M	B.Eng. (UNIMAID) M.Eng. (BUK)	Mechanical Engineering (Optimization and maintenance of thermal power plant)
21	P.02506	Pambani, R.	GA	M	B.Eng. (FUTMINNA)	Chemical Engineering
22	P.02342	Zakkiyu, M. S. B.	GA	M	B.Eng. (UNIMAID)	Chemical Engineering
23	P.02501	Adam, U. M.	GA	M	B.Eng.	Chemical Engineering
24	P.02212	Usman, M. M.	GA	M	B.Eng.	Mechanical Engineering

TECHNOLOGIST						
1	P.00448	Mazi Clare Chinenye	Senior Technologist	Female	B.Eng. (FUTO)	Polymer Engineering
2	P.01298	Udom Paul Okon	Senior Technologist	Male	B.Eng. (FUTMINNA)	Mechanical Engineering
3	P.01141	Isaiah Kehinde O.	Senior Technologist	Male	ND (FPA) HND (FPA)	Mechanical Engineering
4	P.01642	Aminu Fatai Ayodeji	Scientific Officer I	Male	B.Eng. (UNILORIN)	Chemical Engineering
5	P.01364	Glory	Scientific	Male	B.Tech	Petroleum

		Chukwu	Officer		(RSUST)	Engineering
6	P.01269	Kalu Chinedu	Technologist I	Male	HND (IMT)	Chemical Engineering
7	P.01296	Godwin Abacha Ayashim	Technologist	Male	B.Eng. (ABU)	Chemical Engineering
8	P.02186	Aminullah Zakkariyyah Abdul	Scientific Officer	Male	B.Eng. (UNIMAID)	Chemical Engineering
9	P.03113	Yunusa Hudu Yunusa	Scientific Officer I	Male	B.Eng. (ABU)	Chemical Engineering
ADMINISTRATIVE STAFF						
1	P.01692	Yahaya Ahmed Dahiru	Admin Officer (AO)	Male	BSc (NSUK)	Psychology
2	P.01615	Angye S. Masa-Ibi	Admin Officer (AO)	Female	ND (KUW) BSc (KUW)	Political science/International relations.
3	P.01070	Esther Emma Dikeh	Assistant Registrar (AR)	Female	BA (UNIPORT)	Theatre art
4	P.01724	Mietuede Dere Teddy	Admin Officer	Male	BA (GHANA)	Human Resource Management
5	P.00564	Onyemaechi, Cordelia Chika	Senior Executive	Female	HND (BSPU) BSc (NOUN)	Entrepreneur & Business Management