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B.SC. CHEMISTRY

The Core Curriculum Minimum Academic Standards (*CCMAS*)

September, 2023.

Overview

B.Sc. chemistry is an all-encompassing study on the nature of chemistry and all it's forms, this includes areas of core analytical, forensic, inorganic and physical chemistry, with courses on material chemistry, spectroscopic methods, computational chemistry and a broad spectrum of organic related chemistry. The chemistry programme is designed to enable graduates acquire broad based knowledge on chemical processes in living and non-living organism which spread through the areas of organic, inorganic, physical and material elements. The first year of the programme is designed to prepare the students to acquire sound background knowledge of relevant science subjects, which would be a foundation to prepare them for specialised knowledge in chemistry. During the second and third year, the programme will expose the students to fundamental constituents in chemistry that constitute the broad and dynamic spectrum of chemical composition and build up. This will prepare them to appreciate the consequences of various deviations from normal chemistry to more robust areas of chemistry during the final year. Chemistry spreads into various multidisciplinary areas forming the basis for the development of areas such as petroleum chemistry, pharmaceutical chemistry, Industrial chemistry, geochemistry, environmental Chemistry etc. The programme provides students with the opportunity to learn the skills necessary to gain access into different areas of chemistry. The course also takes into cognisance natural science which includes courses in Physics, mathematics and computer science.
The course is designed to give students a broad knowledge of both the science and the application of chemistry, to develop problem solving skills and to prepare students for professional life.

Philosophy

The philosophy of Chemistry programme is to foster undergraduate appreciation of the centrality of chemical science to human well-being, as well as its inevitable linkage to, and interactions with, other branches of science.

Objectives

Chemistry programme is specifically designed to:

1. stimulate in the students sustained interest and enthusiasm in chemistry and its applications;
2. build in students a culture of continuing enquiry;
3. provide students with a broad and balanced base of chemical knowledge and practical skills;
4. develop in students a range of skills applied in chemical and non-chemical areas, that can provide confidence for employment;
5. provide students with a solid base of chemical knowledge and skills that are required for postgraduate studies and research, and
6. inculcate in students an appreciation of chemistry in all human endeavours;
7. access and utilize chemical information technology;
8. work as part of a problem- solving team;

9. apply fundamental principles of Chemistry to life sciences, environments, materials, emerging technological fields of chemistry as well as everyday situations; and
10. apply ethical responsibilities to professional conduct.

Employability Skills

The B.Sc. Chemistry programme develop students with excellent laboratory techniques. Its multidisciplinary in nature provide the student skills that are useful in the areas of biology and medicine, physics and engineering, and geology and earth science. Chemistry is also studied in an environmental and social context, student also can gain awareness of its ethical implications and issues relating to environmental impact and sustainability. As well as developing strong mathematical/numerical ability, a chemistry degree empowers the student with transferable skills such as:

1. Analysis and problem solving
2. Time management and organisation
3. Written and oral communication
4. Monitoring/maintaining records and data
5. Teamwork
6. Research and presentation
7. IT and technology.

Unique Features

The unique features of the programme include:

1. Forensic analysis of biological samples, pharmaceutical samples, organic analytes, and macromolecular samples.
2. Theory of Hydraulics, as applied to fuels in pump-pipeline systems.
3. Fundamentals of electricity with emphases on electrical safety in petroleum
4. Lubrication and wear, with importance attached to the physical and chemical properties of lubricants.

21st Century Skills

1. Collaboration
2. Communication
3. Creativity and Innovation
4. Critical Thinking
5. Technology Literacy
6. Information Literacy
7. Teamwork
8. Flexibility

Admission and Graduation Requirements

Admission Requirements

4-year degree programme

Course Contents

The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, Chemistry, Physics and any other relevant science subject at the Senior Secondary School Certificate or its equivalent. In addition, an acceptable pass in the UTME examination with the appropriate combination of subjects is required.

Direct entry mode

Candidates with five SSCE (or equivalent) credit passes with at least two passes in relevant subjects at the GCE Advanced Level or IJMB or JUPEB may be considered for admission into 200 Level.

Graduation Requirements

For a student to be deemed fit to graduate, he/she must have passed a minimum of 120 Units for UTME entrants and 90 Units for Direct Entry students, including all Compulsory courses as well as a CGPA of not less than 1.00.

Course Structure

100 Level

Course Code	Course Title	Unit(s)	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
COS 101	Introduction to Computing Science	3	C	30	45
BIO 101	General Biology I	2	C	30	-
BIO 102	General Biology II	2	C	30	-
BIO 107	General Biology Practical I	1	C	-	45
BIO 108	General Biology Practical II	1	C	-	45
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Chemistry Practical I	1	C	-	45
CHM 108	General Chemistry Practical II	1	C	-	45
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Physics Practical I	1	C	-	45
PHY 108	General Physics Practical II	1	C	-	45
	Total	**29**			

Course Contents

200 Level

Course Code	Course Title	Unit(s)	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	
CHM 210	Physical Chemistry I	2	C	30	
CHM 211	Organic Chemistry I	2	C	30	
CHM 212	Inorganic Chemistry I	2	C	30	
CHM 213	Analytical Chemistry I	2	C	30	
CHM 214	Structure and Bonding	2	C	30	-
Course Code	**Course Title**	**Unit(s)**	**Status**	**LH**	**PH**
CHM 207	General Chemistry Practical III	1	C	-	45
CHM 208	General Chemistry Practical IV	1	C	-	45
STA 202	Statistics for Physical Sciences & Engineering	2	C	30	-
GOU-CHM 201	Food Chemistry and Biotechnology	3	E	45	-
GOU-CHM 202	Instrumentation Chemistry and Analytical Methods	3	C	15	45
	TOTAL	24			

300 Level

Course Code	Course Title	Units	Status	LH	PH
ENT 312	Venture Creation	2	C	15	45
GST 312	Peace and Conflict Resolution	2	C	30	-
CHM 301	Physical Chemistry II	2	C	30	
CHM 302	Inorganic Chemistry II	2	C	30	
CHM 303	Organic Chemistry II	2	C	30	
CHM 304	Atomic & Molecular Structure & Symmetry	2	C	30	-
CHM 312	Analytical Atomic spectroscopy	2	C	30	
CHM 314	Entrepreneurship skill in Chemistry	2	C	30	
CHM 316	Applied Spectroscopy	2	C	30	-
CHM 319	Environmental Chemistry	2	C	30	-
CHM 399	Industrial Attachment II (12 Weeks)	3	C	135	

Course Contents

GOU-CHM 301	Computational Chemistry and Molecular Docking	2	C	15	30
GOU-CHM 302	Colour Chemistry Technology	2	E	30	-
GOU-CHM 303	Corrosion and control Chemistry	2	C	30	-
GOU-CHM 304	Nanoscience and Nanotechnology	2	E	30	-
GOU- CHM 305	Medicinal Chemistry	2	C	30	-
GOU-CHM 306	Natural Local Products Chemistry	3	E	45	-
	TOTAL	36			

400 Level

Course Code	Course Title	Units	Status	LH	PH
CHM 400	Seminar	1	C	-	45
CHM 401	Research Project	6	C	-	270
CHM 406	Reaction Kinetics	2	C	30	-
CHM 410	Analytical Chemistry II	2	C	30	
CHM 423	Organometallic Chemistry	2	C	30	-
CHM 424	Co-ordination Chemistry	2	C	30	-
GOU-CHM 401	Geochemistry	3	C	45	
GOU-CHM 402	Cement and Fertilizer Chemistry	2	E	30	-
GOU-CHM 403	Biochemical Application in Forensic Science	2	E	30	-
GOU-CHM 404	Biochemical Pharmacology and Toxicology	2	E	30	-
GOU-CHM 405	Chemistry of waste management	3	C	45	
GOU-CHM 406	Organic Synthesis	2	C	30	-
GOU-CHM 407	Chemo statistics	3	C	15	45
	TOTAL	32			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English **(2 units C: LH 30)**

Learning Outcomes

Course Contents

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

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

and 7. write simple and technical reports.

Course Contents

Sound patterns in English Language (vowels and consonants, phonetics, and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). Sentence in English (types: structural and functional, simple, and complex). Grammar and Usage (tense, mood, modality and concord, aspects of language use in everyday life). Logical and Critical Thinking and Reasoning Methods (Logic and Syllogism, Inductive and Deductive Argument and Reasoning Methods, Analogy, Generalisation and Explanations). Ethical considerations, Copyright Rules, and Infringements. Writing Activities: (Pre-writing, Writing, Post writing, Editing and Proofreading; Brainstorming, outlining, Paragraphing, Types of writing, Summary, Essays, Letter, Curriculum Vitae, Report writing, Note making etc. Mechanics of writing). Comprehension Strategies: (Reading and types of Reading, Comprehension Skills, 3RsQ). Information and Communication Technology in modern Language Learning. Language skills for effective communication. Major word formation processes. Writing and reading comprehension strategies. Logical and critical reasoning for meaningful presentations. Art of public speaking and listening. Report writing.

GST 112- Nigerian Peoples and Culture (2 units C: LH 30)

Learning Outcomes

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

1. analyse the historical foundation of the Nigerian culture and arts in pre-colonial times;
2. list and identify the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political unit;
4. analyse the concepts of Trade, Economic and Self-reliance status of the Nigerian peoples towards national development;
5. enumerate the challenges of the Nigerian State towards Nation building
6. analyse the role of the Judiciary in upholding people's fundamental rights
7. identify acceptable norms and values of the major ethnic groups in Nigeria; and
8. list and suggest possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and culture; peoples and culture of the ethnic minority groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; Colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; Nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concept of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigeria people; trade, skill acquisition and selfreliance). Social justices and national development (law definition and classification. Judiciary and fundamental rights. Individual, norms and values (basic Nigeria norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts. Cultism, kidnapping and other related social vices). Re-orientation, moral and national values (The 3R's – Reconstruction, Rehabilitation and Re-orientation; Re-orientation Strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline (WAI), War Against Indiscipline and Corruption(WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

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

Learning Outcomes

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

1. explain basic definition of Set, Subset, Union, Intersection, Complements and use of Venn diagrams;
2. solve quadratic equations;
3. Solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using Binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series. Theory of quadratic equations. Binomial theorem. Complex numbers. Algebra of complex numbers. The Argand diagram. De-Moivre's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

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

Learning Outcomes

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

1. identify the types of rules in differentiation and integration;

2. describe the meaning of Function of a real variable, graphs, limits and continuity; and 3. solve some applications of definite integrals in areas and volumes.

Course Contents

Function of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation. Extreme curve sketching; Integration as an inverse of differentiation. Methods of integration, Definite integrals. Application to areas, volumes.

COS 101: Introduction to Computing Sciences (3 Units C: LH 30; PH 45)

Learning Outcomes

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

1. explain basic components of computers and other computing devices;
2. describe the various applications of computers;
3. explain information processing and its roles in the society;
4. describe the Internet, its various applications and its impact;
5. explain the different areas of the computing discipline and its specializations; and
6. demonstrate practical skills on using computers and the internet.

Course Contents

Brief history of computing. Description of the basic components of a computer/computing device. Input/Output devices and peripherals. Hardware, software and human ware. Diverse and growing computer/digital applications. Information processing and its roles in society. The Internet, its applications and its impact on the world today. The different areas/programs of the computing discipline. The job specializations for computing professionals. The future of computing.

Lab Work: Practical demonstration of the basic parts of a computer. Illustration of different operating systems of different computing devices including desktops, laptops, tablets, smart boards and smart phones. Demonstration of commonly used applications such as word processors, spreadsheets, presentation software and graphics. Illustration of input and output devices including printers, scanners, projectors and smartboards. Practical demonstration of the Internet and its various applications. Illustration of browsers and search engines. How to access online resources.

BIO 101: General Biology I (2 Units C: LH 30)

Learning Outcomes

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

1. explain cell structure and organizations;
2. summarize functions of cellular organelles;
3. characterize living organisms and state their general reproduction;

4. describe the interrelationship that exists between organisms; 5. discuss the concept of heredity and evolution; and
6. enumerate habitat types and their characteristics.

Course Contents

Cell structure and organization. functions of cellular organelles. characteristics and classification of living things. chromosomes, genes their relationships and importance. General reproduction. Interrelationships of organisms (competitions, parasitism, predation, symbiosis, commensalisms, mutualism, saprophytism). Heredity and evolution (introduction to Darwinism and Lamarckism, Mendelian laws, explanation of key genetic terms). Elements of ecology and types of habitat.

BIO 102: General Biology II (2 Units C: LH 30)

Learning Outcomes

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

1. List the characteristics, methods of identification and classification of Viruses, bacteria and fungi;
2. state the unique characteristics of plant and animal kingdoms;
3. describe ecological adaptations in the plant and animal kingdoms;
4. explain nutrition, respiration, excretion and reproduction in plants and animals; and
5. describe growth and development in plants and animals.

Course Contents

Basic characteristics, identification and classification of viruses, bacteria and fungi. A generalized survey of the plant and animal kingdoms based mainly on the study of similarities and differences in the external features. Ecological adaptations. Briefs on physiology to include nutrition, respiration, circulatory systems, excretion, reproduction, growth and development.

BIO 107: General Biology Practical I (1 Unit C: PH 45)

Learning Outcomes

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

1. outline common laboratory hazards;
2. provide precautions on laboratory hazards;
3. state the functions of the different parts of microscope;
4. use the microscope and describe its maintenance;
5. draw biological diagrams and illustrations; and 6. apply scaling and proportion to biological diagrams.

Course Contents

Common laboratory hazards: prevention and first aid; measurements in biology. Uses and care of microscope: compound and dissecting microscope. Biological drawings and illustration, scaling, accuracy and proportion. Use of common

laboratory apparatus and laboratory experiments designed to illustrate the topics covered in **BIO 101.**

BIO 108: General Biology Practical II **(1 Unit C: PH 45)**

Learning Outcomes

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

1. describe the anatomy of flowering plants;
2. differentiate types of fruit and seeds;
3. state ways of handling and caring for biological wares; 4. describe the basic histology of animal tissues; and
5. identify various groups in the animal kingdom.

Course Contents

Anatomy of flowering plants, primary vegetative body: stem, leaf and root to show the mature tissues namely parenchyma, collenchyma, sclerenchyma, xylem and phloem. Types of fruits and seeds. Care and use of dissecting kits and other biological wares. Dissection and general histology of animal tissues based on vertebrate forms. Morphology and functions of epithelial, muscular, nervous and connective tissues. Examination of various groups of lower invertebrates under microscopes, identification of various groups of organisms in Animal Kingdom. And any experiment designed to emphasize the practical aspects of topics in BIO 102.

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

1. describe the general laboratory rules and safety procedures;
2. collect scientific data and correctly carrying out Chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify the differences between primary and secondary standards;
5. perform redox titration;

6. recording observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

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

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

Learning Outcomes

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

1. identify the general laboratory rules and safety procedures;
2. collect scientific data and correctly carrying out Chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which includes ignition, boiling point, melting point, test on known and unknown organic compounds;
5. perform solubility tests on known and unknown organic compounds;
6. conduct elemental tests on known and unknown compounds; and
7. conduct functional group/confirmatory test on known and unknown compounds which could be acidic / basic / neutral organic compounds.

Course Contents

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

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

Learning Outcomes

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

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

Courses Contents

Course Contents

Space and time. Units and dimension, Vectors and Scalars. Differentiation of vectors: displacement, velocity and acceleration. Kinematics. Newton laws of motion (Inertial frames, Impulse, force and action at a distance, momentum conservation). Relative motion. Application of Newtonian mechanics. Equations of motion.Conservation principles in physics. Conservative forces. Conservation of linear momentum. Kinetic energy and work. Potential energy. System of particles. Centre of mass. Rotational motion:Torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates. Conservation of angular momentum. Circular motion. Moments of inertia. gyroscopes and precession. Gravitation: Newton's Law of Gravitation. Kepler's Laws of Planetary Motion. Gravitational Potential Energy. Escape velocity. Satellites motion and orbits.

PHY 102: General Physics II (Electricity & Magnetism) (2 Units C: LH 30)

Learning Outcomes

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

1. describe the electric field and potential, and related concepts, for stationary charges;
2. calculate electrostatic properties of simple charge distributions using Coulomb's law, Gauss's law and electric potential;
3. describe and determine the magnetic field for steady and moving charges;
4. determine the magnetic properties of simple current distributions using Biot-Savart and Ampere's law;
5. describe electromagnetic induction and related concepts, and make calculations using Faraday and Lenz's laws;
6. explain the basic physical of Maxwell's equations in integral form;
7. evaluate DC circuits to determine the electrical parameters; and
8. determine the characteristics of ac voltages and currents in resistors, capacitors, and Inductors.

Course Contents

Forces in nature. Electrostatics; electric charge and its properties, methods of charging. Coulomb's law and superposition. electric field and potential. Gauss's law. Capacitance. Electric dipoles. Energy in electric fields. Conductors and insulators, current, voltage and resistance. Ohm's law and analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère's laws. magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz's laws. Step up and step-down transformers: Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, resistance, and combinations.

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

Learning Outcomes

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

1. conduct measurements of some physical quantities;

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

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

200 Level

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

Learning Outcomes

A student who has successfully gone through this course should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;

Course Contents

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

Course Contents

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

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 15; PH 45)

Learning Outcomes

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

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

Course Contents

Concept of Entrepreneurship (Entrepreneurship, Intrapreneurship/Corporate Entrepreneurship,). Theories, Rationale and relevance of Entrepreneurship (Schumpeterian and other perspectives, Risk-Taking, Necessity and opportunity-based entrepreneurship and Creative destruction). Characteristics of Entrepreneurs (Opportunity seeker, Risk taker, Natural and Nurtured, Problem solver and change agent, Innovator and creative thinker). Entrepreneurial thinking (Critical thinking, Reflective thinking, and Creative thinking). Innovation (Concept of innovation, Dimensions of innovation, Change and innovation, Knowledge and innovation). Enterprise formation, partnership and networking (Basics of Business Plan, Forms of business ownership, Business registration and Forming alliances and join ventures).

Course Contents

Contemporary Entrepreneurship Issues (Knowledge, Skills and Technology, Intellectual property, Virtual office, Networking). Entrepreneurship in Nigeria (Biography of inspirational Entrepreneurs, Youth and women entrepreneurship, Entrepreneurship support institutions, Youth enterprise networks and Environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

CHM 210: Physical Chemistry I **(2 Units C: LH 30)**

Learning Outcomes

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

1. state the kinetic theory of gases and solve problems related to ideal and real gases;
2. derive the formula for molecular velocity of gases and use the derived formula to solve problems;
3. describe and explain the fundamental concepts of physical chemistry including those of statistical mechanics, chemical Kinetics, quantum mechanics and spectroscopy;
4. apply simple models to predict properties of chemical systems;
5. define and state type of solutions; define different concentration terms which include molarity, normality etc. explain vapour pressure lowering of the solvent, boiling point elevation of solutions, freezing point depression of solution and measurement of osmotic pressure;
6. apply numerical or computational methods to calculate physical properties of Chemical systems and assess the appropriateness of different computational techniques and numerical approximations for solving chemistry problems;
7. design and plan an investigation by selecting and applying appropriate practical, theoretical, and/or computational techniques or tools; and
8. states Ohms law and describe the electrolytic conduction, states the Faraday's Law and Conductance Law of solution and calculation on electrical conductance on different electrolyte solution.

Course Contents

Kinetic theory of gases; science of real gases; the laws of thermodynamics; entropy and free energy; reactions and phase equilibria; reaction rates; rate laws; mechanism and theories of elementary processes; photochemical reactions; basic electrochemistry.

CHM 211: Organic Chemistry I **(2 Units C: LH 30)**

Learning Outcomes

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

1. describe and solve problems in chemistry of aromatic compounds;
2. describe the structures of simple sugars, starch and cellulose, peptides and proteins and show the difference in their conformation structure;
3. describe and solve problems in chemistry of bifunctional compounds;

Course Contents

4. explain he mechanisms of substitution, elimination, addition and rearrangement reactions;
5. describe stereochemistry and its application;
6. describe condition and pathways of the following organic reactions - Grignard reaction, Aldol and related reactions; and
7. describe simple alicyclic carbon compounds and their synthesis.

Course Contents

Chemistry of aromatic compounds. Structures of simple sugars, starch and cellulose, peptides, and proteins. Chemistry of bifunctional compounds. Energetics, kinetics, and the investigation of reaction mechanisms. Mechanisms of substitution, elimination, addition, and rearrangement reactions. Stereochemistry. Examples of various named organic reactions e.g., Grignard reaction, Aldol and related reactions. Simple alicyclic carbon compounds and their synthesis.

CHM 212: Inorganic Chemistry I **(2 Units C: LH 30)**

Learning Outcomes

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

1. list the first-row transition elements and explain their characteristics and properties;
2. explain crystal field theory (CFT) and draw the diagram to illustrate with examples of coordination compounds;
3. state the advantages of CFT over other bonding theories;
4. discuss the comparative Chemistry of the following elements. (I) Ga, In, Tl (II). Ge, Sn, Pb (III). As, Sb, Bi (IV). Se, Te, Po;
5. define organometallic chemistry;
6. give relevant examples with illustrations;
7. classify organometallic compounds with examples;
8. list the roles of metals in biochemical systems;
9. discuss the concepts of hard and soft acids and bases.
10. list examples of item 9 above;
11. explain oxidation and reduction reaction; and
12. illustrate the above (11) with appropriate reactions.

Course Contents

Chemistry of first row transition metals. Introduction to coordination chemistry including elementary treatment of crystal field theory. Comparative Chemistry of the following elements: (a) Ga, In, TI, (b) Ge, Sn, Pb, (c) As, Sb, Bi (d) Se, Te, Po. Elementary introduction to organometallic chemistry. Role of metals in biochemical systems. Concepts of hard and soft acids and bases. Oxidation and reduction reactions.

CHM 213: Analytical Chemistry I **(2 Units C: LH 30)**

Course Contents

Learning Outcomes

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

1. explain analytical processes which include description of chemist as a problem solver;
2. describe and differentiate forms of error;
3. explain its implication on laboratory analysis;
4. state different statistical tool use in treatment of data;
5. solve practical problems using the statistical tools;
6. define sampling and give reasons for sampling in field work;
7. state and describe different sampling techniques;
8. state different forms of sample collection and processing;
9. describe volumetric method of analysis and solve some practical problems; and
10. describe gravimetric method of analysis and solve some practical problems.

Course Contents

Theory of errors; and statistical treatment of data: Theory of sampling. Chemical methods of analysis including volumetric, gravimetric, data analysis and presentation. and. Physicochemical methods, Optical methods of analysis; separation methods.

CHM 214: Structure and Bonding **(2 Units C: LH 30)**

Learning Outcomes

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

1. explain the idea of quantum states, orbital, shape and energy;
2. explain simple valency theory, electron repulsion theory and atomic spectra;
3. explain Symmetry, molecular geometry and structure, and molecular orbital theory of bonding;
4. sketch to illustrate with specific examples for item (3) above;
5. express how molecular orbital theory of bounding explains the magnetic properties in main group compounds;
6. explain the methods used in the determination of molecular shapes. Bond lengths and angles; and
7. explain with the use model the structure and chemistry of some of the representatives of main group elements.

Course Contents

Idea of quantum states, orbitals, shape; and energy. Simple valence theory, electron repulsion theory, atomic spectra. Symmetry, molecular geometry and structure, molecular orbital theory of bonding. Methods of determining molecular shape, bond lengths and angles. The structure and chemistry of some representative main group element compounds.

CHM 207: General Chemistry Practical III **(1 Unit C: PH 45)**

Course Contents

Learning Outcomes

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

1. describe the measurement of pH;
2. determine the relative molar mass from the colligative properties;
3. demonstrate the partition coefficient of two immiscible solvents;
4. demonstrate temperature measurements and heat of dissolution, heat of neutralization and many others
5. determine the critical solution temperature of water-Phenol system; and
6. measure the molar volume of a gas and universal gas constant.

Course Contents

pH Measurement Determination of Relative Molar Mass from Colligative Properties, Demonstration of Partition Coefficient in two Immiscible Solvents, Temperature Measurement and Heat of Dissolution Heat of Neutralisation, Determination of Critical Solution Temperature of Water-
Phenol System Ideal Gas Law: Measuring the Molar Volume of a Gas and the Universal Gas Constant

CHM 208: General Chemistry Practical IV (1 Unit C: PH 45)

Learning Outcomes

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

1. identify general laboratory rules;
2. explain the preparation of simple organic compounds (esters, aldehydes and ketones);
3. describe the analysis of vinegar;
4. demonstrate A simple experiment on thin layer chromatography;
5. perform an experiment on the dehydration of alcohol; and
6. conduct experiments on qualitative analysis of common functional groups.

Course Contents

The Preparation of Esters, The preparation of Aldehydes and Ketones. Vinegar Analysis, Chromatography, Thin Layer Chromatography, Dehydration of Alcohol Qualitative Analysis of Common Functional Groups

STA 202: Statistics for Physical Sciences and Engineering (2 Units C: LH 30)

Learning Outcomes

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

1. describe the scope for statistical methods in physical sciences and engineering;
2. define the Measures of location, partition, and dispersion;
3. explain the elements of probability. Probability distribution: binomial Poisson, geometric, hypergeometric, negative-binomial, normal Poisson, geometric,

hypergeometric, negativebinomial, normal, Student's t and chi-square distributions;

4. differentiate point from internal estimation and could be able to tests for hypotheses concerning population means proportions and variances;
5. be able to compute for Regression and correlation as well as conduct some Non–parametric tests with reference to Contingency table analysis; and
6. be able to explain the elements of design of experiments and Analysis of variance.

Course Contents

Scope for statistical methods in physical sciences and engineering. Measures of location, partition and dispersion. Elements of probability. Probability distribution: binomial Poisson, geometric, hypergeometric, negative-binomial, normal Poisson, geometric, hypergeometric, negativebinomial, normal, Student's t and chi-square distributions. Estimation (point and internal) and tests of hypotheses concerning population means proportions and variances. Regression and correlation. Non-parametric tests. Contingency table analysis. Introduction to design of experiments. Analysis of variance.

GOU-CHM 201: Food Chemistry and Biotechnology (3 Units; Compulsory; LH = 45; PH= 0)

Senate – Approved Relevance

Food could be a natural product, fresh or processed substance consumed by human beings for nourishment. Foods are composed of various constituents like carbohydrates, proteins, vitamins, minerals and enzymes. Food chemistry is an interdisciplinary field of study. In order to key into the mission and vision Godfrey Okoye University which is aimed at giving quality education and inculcating in the students strong personality that will promote of religions, cultural and epistemological dialogue, the course is designed to expose students of chemistry to the chemical and the biotechnology processes involved in food production and management. This is also in line with the sustainable development goal number 2 (SDG 2) which is aimed at ending hunger, achieving food security and improving nutrition as well as promoting sustainable agriculture.

Overview

The challenge of food shortage in our contemporary society is a very serious problem that needs urgent attention. This is caused by a number of factors which include adverse weather conditions, lack of adequate preservation techniques, lack of improved varieties that could withstand diseases and poor management procedures. To overcome these challenges, deliberate efforts must be put in place to find a solution. The university, being a center of knowledge acquired through cutting edge research, is an ideal environment to proffer such solutions.

The course covers the study of various classes of food like carbohydrates, fats, proteins, vitamins, minerals, water, fibre and other food groups like tubers, cereals, fruits, legumes, meat, fish, and leafy vegetables. It also considers the study of some African traditional foods, especially those found in the south east region of Nigeria. The course will further discuss methods of processing and preservation of these food types. Students will be exposed to the procedures for analyzing the chemical and biological properties of these food stuffs and their nutritional values.

Course Contents

Objectives: The objectives of the course are to:

i. Explain classes of food and describe their processing steps and the chemistry behind them.
ii. Explain food spoilage and food intoxication.
iii. Describe fermentation processes of local foods and ways through which they can be processed biotechnologically for global acceptability.
iv. Mention and explain the techniques of preserving food chemically or biotechnologically.
v. Explain biotechnological production of natural food ingredients and lab-cultured foods.
vi. Explain the methods of analysis of food substances.

Learning Outcomes

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

i. Explain five (5) classes of food.
ii. Describe the chemistry and processing methods of foods mentioned in (i) above.
iii. Explain five ways of preventing the spoilage and intoxication of five (5) different types of food.
iv. Describe the fermentation processes of five (5) local foods and ways through which they can be processed biotechnologically for global acceptability.
v. Mention and explain five techniques of preserving food chemically or biotechnologically.
vi. Explain the biotechnological production of three (3) natural food ingredients and three (3) lab-cultured foods.
vii. Explain five (5) methods of analysis of food substances.

Course Contents

Carbohydrates. Fats. Proteins. Vitamins. Minerals. Water. Fibre. Food Groups. Tubers. Cereals. Fruits. Legumes. Meat. Fish. Leafy vegetables. Fermented African foods and beverages (traditional processing techniques). Palm wine (distillation chemical components and nutritional values). Garri (chemical components and nutritional values). Burukutu (chemical components and nutritional value). Ogiri (chemical components and nutritional values). Food pigments. Confectioneries. Sugar (configuration and conformation). Food contaminants. Toxic substances in foods. Food poisoning and intoxication. Prevention and cure. Chemistry of food processing, preservation and storage. Deterioration and spoilage agents of foods. Chemical and Biotechnological methods to increase shelf lives of food crops. Biotechnological production of natural ingredients for food industry. New applications of biotechnology in food industry - genetically engineered α-amylase. Lipase and condiments. Genetically engineered crops and animals. Ethical, Biosafety and socio-cultural challenges. Promoting local food production and processing for global acceptability. World food problems. Hunger eradication/elimination. Novel sources of proteins. Neglected and underutilized animal and plant protein sources. Laboratory cultured meat. Plant based meat production.

Minimum Academic Standard: As found in 70% CCMAS

GOU-CHM 202: Instrumentation Chemistry and Analytical Methods (3 Units; Compulsory; LH = 15; PH = 45)

Senate-Approved Relevance
This course is meant to expose students to different chemistry analytical instruments in order to gain knowledge and practical skills to solve chemical problems and to contribute their quota to the society. This is in accordance with Godfrey Okoye University mission and vision which lay emphasis on imparting quality education aims at inculcating in the students strong personality that will promote religions, cultural and epistemological dialogue and to produce graduates who will be outstanding in learning, balanced in character and personality and ready to pursue epistemic unity in all ramifications. The course also aligns with SDG 4, which ensures inclusive and equitable quality education and promote lifelong learning opportunities for all.

Overview
The study of chemistry cannot be possible without the use of instruments to carryout chemical analyses. An understanding of instrumentation in chemistry helps chemists to solve analytical and chemical problems. Instruments used in chemical analysis and separation convert information about physical or chemical characteristics of a compound to information that can be integrated by a person. The training and use of instruments for observation, measurement or control is very important for students to be successful in the chemistry profession. The issue of marching practical and theory has always been a very big challenge in the sciences. This is due to so many factors which include no availability of laboratories, standard equipment, lack of trained personnel and funding. The implication is that students graduate from most of the science disciplines with little or no practical knowledge and skill in the laboratory instruments. This affects the students' chances of getting good jobs and even pursuing further studies. In order to address this identified problem, conscious effort would be put in place to expose our students to instrumentation in chemistry.

Instrumentation is the development or use of measurement or tools for the observation, monitoring or control of chemical processes. Research in this area ranges from development of new instrument to novel applications of existing ones for understanding complex and chemical process. This course shall help students to be familiar with the names and uses of different analytical instruments used in chemistry, which include ultra-violet (UV) spectrophotometer, Fourier transform infrared spectrophotometer (FTIR), nuclear magnetic resonance spectrophotometer, High performance liquid chromatography (HPLC) and atomic absorption spectrophotometer, etc..

Objectives:
The objectives of the course are to:

i. Name different types of instruments used in chemical analysis.
ii. Describe UV spectroscopy.
iii. Explain FTIR spectroscopy.
iv. Describe NMR spectroscopy.
v. Explain gas chromatography.
vi. Describe High performance liquid chromatography (HPLC).
vii. Describe Atomic absorption spectroscopy.

Learning Outcomes
On completion of this course, students should be able to;

Course Contents

i. Name six different types of analytical instruments used for chemical analysis.
ii. Operate a UV spectrophotometer and use it to carry out at least three chemical analysis.
iii. Operate an FTIR spectrophotometer and use it to do three (3) chemical analysis.
iv. Prepare TLC plates and use them to monitor chemical reactions.
v. Operate an HPLC machine and use it to carry out three (3) chemical analysis.
vi. Operate an AAS machine and use it to carry out three (3) chemical analysis.

Course content
Fluorescence. Phosphorescence. Electroanalytical methods. Voltammetry. Spectroscopy. UV-spectroscopy. IR- spectroscopy. NMR- spectroscopy. Theory and practices of thin lay and gas chromatography. Thermal methods of analysis. High performance liquid chromatography. Automated analytical methods. Enzymatic methods. Atomic absorption spectroscopy. Spectra interpretations. Practical classes on UV spectroscopy. Practical classes on IR-spectroscopy. Practical classes on Atomic absorption spectroscopy.

Minimum academic standard: Chemistry laboratory, reagents, laboratory equipment (UV, IR, AAS,) machines, library collections. Virtual HPLC and NMR machines.

300 Level

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

Learning Outcomes
At the end of this course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe roles of international organisations, media and traditional institutions in peace building.

Course Contents
Concepts of Peace, Conflict and Security in a multi-ethnic nation. Types and Theories of Conflicts: Ethnic, Religious, Economic, Geo-political Conflicts; Structural Conflict Theory, Realist Theory of Conflict, Frustration-Aggression Conflict Theory. Root causes of Conflict and Violence in Africa: Indigene and settlers Phenomenon; Boundaries/boarder disputes; Political disputes; Ethnic disputes and rivalries; Economic Inequalities; Social disputes; Nationalist Movements and Agitations; Selected Conflict Case Studies – Tiv-Junkun; Zango Kartaf, Chieftaincy and Land disputes etc. Peace Building, Management of Conflicts and Security: Peace & Human Development. Approaches to Peace & Conflict Management --- (Religious, Government, Community Leaders etc.). Elements of Peace Studies and Conflict Resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and Terrorism. Peace Mediation and Peace Keeping. Peace & Security Council (International, National and Local levels) Agents of Conflict resolution –

Course Contents

Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution, ADR. Dialogue b). Arbitration, c). Negotiation d). Collaboration etc. Roles of International Organizations in Conflict Resolution. (a). The United Nations, UN and its Conflict Resolution Organs. (b). The African Union & Peace Security Council (c). ECOWAS in Peace
Keeping. Media and Traditional Institutions in Peace Building. Managing Post-Conflict Situations/Crisis: Refugees. Internally Displaced Persons, IDPs. The role of NGOs in Post-Conflict Situations/Crisis

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

Learning Outcomes

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

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

Course Contents

Opportunity Identification (Sources of business opportunities in Nigeria, Environmental scanning, Demand and supply gap/unmet needs/market gaps/Market Research, Unutilised resources, Social and climate conditions and Technology adoption gap). New business development (business planning, market research). Entrepreneurial Finance (Venture capital, Equity finance, Micro finance, Personal savings, small business investment organizations and Business plan competition). Entrepreneurial marketing and e-commerce (Principles of marketing, Customer Acquisition & Retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, Ecommerce business models and Successful E-Commerce Companies,). Small Business Management/Family Business: Leadership & Management, Basic bookkeeping, Nature of family business and Family Business Growth Model. Negotiation and Business communication (Strategy and tactics of negotiation/bargaining, Traditional and modern business communication methods). Opportunity Discovery Demonstrations (Business idea generation presentations, Business idea Contest, Brainstorming sessions, Idea pitching). Technological Solutions (The Concept of Market/Customer Solution, Customer Solution and Emerging Technologies, Business Applications of New Technologies - Artificial Intelligence (AI), Virtual/Mixed Reality (VR), Internet of Things (IoTs), Blockchain, Cloud Computing, Renewable Energy etc. Digital Business and E-Commerce Strategies).

CHM 301: Physical Chemistry II **(2 Units C: LH 30)**

Learning Outcomes

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

1. describe the general knowledge of Gibbs function;
2. explain the concept of thermodynamics compare to kinetics; and
3. explain the concept of statistical thermodynamics and use statistical equation to solve problems in ideal and non-ideal solution.

Course Contents

A review of Gibbs Function. Chemical thermodynamics. Introduction to statistical thermodynamics. Ideal solutions and non-Ideal solutions. Properties of electrolytes. Colligative Properties. Studies on biochemical systems

CHM 302: Inorganic Chemistry II **(2 Units C: LH 30)**

Learning Outcomes

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

1. analyse inorganic chemistry information;
2. demonstrate and apply knowledge of inorganic Chemistry;
3. explain the electronic structure and general properties of group 1A and Group IIA elements;
4. compare Group IA and Group IIA in terms of the parameters mentioned in 3 above;
5. explain the chemistry of Boron; carbon and Silicon; Nitrogen and phosphorus; Oxygen and sulphur;
6. explain the halogen chemistry;
7. explain the periodic properties of the transition metals and to use these to predict and/or rationalise the chemistry of these metal ions and their complexes;
8. use Crystal Field Theory to explain and understand some of the key features of complexes of the first-row transition metals including their shapes, colours, and magnetic properties;
9. synthesis and characterise a metal coordination compound using practical inorganic chemistry techniques;
10. describe ligand and crystal field theories;
11. draw the diagram showing crystal and ligand field theories with specific examples;
12. list advantages and limitations of these bonding theories;
13. define radioactive decay processes and nuclear radiation;
14. explain the principles of utilizing radioactivity applied to chemistry, chemical processes and adjacent fields where chemistry is an integral part;
15. discuss the principles of radiation hygiene and the interaction of radiation and matter;
16. explain current methods in radiochemistry;
17. define radioactivity;

Course Contents

18. define and describe all three types of radioactivity (alpha, beta, and gamma radiation); and
19. explain the roles of metals in living systems.

Course Contents

The Noble gases. Hydrogen. Electronic structure and general properties and comparative study of Group IA and Group IIA elements. Chemistry of Boron. Carbon and Silicon. Nitrogen and Phosphorus. Oxygen and Sulphur. The halogens. Transition elements. Separation of metals. Introduction to co-ordination chemistry. Introductory organo-metallic chemistry. Ligand and Crystal field theories. Introduction to radiochemistry. Radioactivity and the periodic table. Role of metals in living systems.

CHM 303 Organic Chemistry II (2 Units C: LH 30)

Learning Outcomes

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

1. recognize and distinguish between aromatic and Alicyclic compounds by their structures;
2. identify the properties of aromatic and Alicyclic compounds, and the chemical consequences of aromaticity;
3. recognize and be able to write the mechanism of electrophilic aromatic and Alicyclic substitution;
4. outline the completed electrophilic aromatic substitution reactions of the following types: halogenation, nitration, sulfonation, and Friedel-Crafts acylation & alkylation;
5. explain the chemistry of heterocyclic Chemistry (3,4,5 and 6-membered ring of O, N, S heterocyclic compounds);
6. describe the Reactive intermediates – carbocations, carbanions, carbenes, nitrenes;
7. express the rearrangement reactions e.g., Beckmann, Baeyer-Villiger etc.
8. illustrate with various reaction mechanisms and types; and
9. organize Forensic analysis of biological samples, pharmaceutical samples, organic analytes and macromolecular samples.

Course Contents

Pre –requisite –CHM 211

Aromatic and Alicyclic chemistry. Survey of representative polycyclic compounds. Heterocyclic Chemistry (3,4,5 and 6-membered ring of O, N, S heterocyclic compounds). Reactive intermediates – carbocations, carbanions, carbenes, nitrenes etc. Selected rearrangement reactions such as, Beckmann, Baeyer-Villiger, and many

others to illustrate various reaction mechanisms and types. Forensic analysis of biological samples, pharmaceutical samples, organic analytes and macromolecular samples.

CHM 304: Atomic and Molecular Structure and Symmetry (2 Units C: LH 30)

Learning Outcomes

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

1. illustrate the Schrodinger wave equation for the hydrogen molecule and ion;
2. define the terms in the time-independent Schrodinger wave equation;
3. express equation for the 3D Schrodinger wave equation;
4. define Pauli Exclusion Principle and the Hund's rule;
5. illustrate electron configurations for atoms in either the subshell or orbital box notations;
6. illustrate electron configurations of ions;
7. explain how molecular orbital are formed;
8. draw molecular orbital diagrams for diatomic molecules;
9. define modern valence theory;
10. explain the concept of resonance and configuration interaction;
11. explain Huckel theory;
12. outline Walsh rules;
13. illustrate Walsh rules with specific examples;
14. explain the theory of electronic spectroscopy; and
15. explain Franck-Condon Principle;
16. use Franck-Condon Principle to account for the vibrational structure of electronic transitions' 17. explain Russel- Saunders coupling, orbital and spin angular momentum; and
18. use of symmetry in chemistry.

Course Contents

Prerequisite –CHM 214

Schrödinger equation. Helium atom, ground and excited states, Spin and Pauli Exclusion Principle. Hydrogen molecule; Comparison of molecular orbital and valence bond theory, concept of resonance and configuration interaction. Coulson Fischer function. Molecular orbitals for diatomic molecules. Simple pi electron theory, Huckel theory. Walsh rules. Rotational, vibrational and electronic spectra. Applications for determining bond lengths and angles. Atomic spectra, Russell Saunders coupling, orbital and spin angular momentum. Use of symmetry in Chemistry.

CHM 312: Analytical Atomic Spectroscopy (2 Units C: LH 30)

Learning Outcomes

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

1. explain the concept of interaction of atoms with electromagnetic radiation;

Course Contents

2. explain the principles of atomic absorption spectrometry; atomic fluorescence spectrometry; X-ray fluorescence;
3. explain the procedure and use of these instruments in analytical chemistry and industries; and
4. discuss the preparations of standard solution for these instruments.

Course Contents

Introduction of concept of interaction of atoms with electromagnetic radiation, atomic absorption spectrometry; atomic emission spectrometry; atomic fluorescence spectrometry and X-ray fluorescence spectrometry.

CHM 314: Entrepreneurship skill in Chemistry (2 Units C: LH 30)

Learning Outcomes

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

1. demonstrate the entrepreneurial skills;
2. Identify international entrepreneurship opportunities;
3. develop competency in identification of new business ventures;
4. identify legal issues and business environments;
5. discuss marketing strategies; and
6. identify Cost accounting.

Course Contents

Entrepreneur perspectives and strategies. International entrepreneurship opportunities, identification, pursuit of new ventures (Water treatment, production of bio -renewable plastics such as polylactic acids PLA, textile and clothing: medical textiles, military and industrial textiles, electronics: semiconductors, food and drinks, packaging, drug designs, soap and hand sanitizers etc), marketing strategies in business ventures, creativities and the business ideas, legal issues and business environment, and cost accounting. Field trips.

CHM 316: Applied Spectroscopy (2 Units C: LH 30)

Learning Outcomes

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

1. characterize spectroscopical molecules and materials with the infrared; UV; NMR and mass spectrometry;
2. discuss the general principles of the analytical instruments listed above;
3. describe the applications of spectroscopy, such as the study of the atmosphere; cultural heritage, astrophysics, and materials;
4. describe the theoretical principle of GC-MS; LC-MS; LC-NMR;
5. study and characterise molecules and materials with the listed instruments in (4) above; and
6. list the application of these instruments in Industry and medicine.

Course Contents

Course Contents

Principles and applications of UV, IR, NMR and Mass spectroscopy in the determination and elucidation of structures of organic compounds. Brief mention of hyphenated systems: GC-MS, LC-MS and LC-NMR, and diagnostic use of NMR in medicine.

CHM 319: Environmental Chemistry (2 Units C: LH 30)

Learning Outcomes

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

1. explain the elementary circle of the following element oxygen, nitrogen, sulphur and many others;
2. describe the stratification of the earth atmosphere and state characteristics of each strata;
3. state and describe different sources of environmental pollution;
4. state and describe different types of environmental pollution and their effect on the environment;
5. describe water and state qualities that define the uses of water;
6. describe and explain different sources of water contamination and its impact on agricultural land crops and many others;
7. state and describe different methods use in treatment of waste water – chemical, biological and physical methods;
8. state and justify chemical and physical instrumentation in environmental chemistry;
9. describe environmental impact assessment; and
10. state and describe twelve principles of green chemistry and its practical applications.

Course Contents

Concepts of elementary cycles. Characteristics of the atmosphere. Sources, types and effects of environmental pollution. Wastewater treatment. Composition of domestic/industrial wastes and waste management. Water chemistry and analysis. Chemical and physical instrumentation in environmental sciences. Introduction to Environmental Impact Assessment. Twelve principles of green chemistry.

CHM 399: Industrial Attachment (3 Units C: PH 135)

Learning Outcomes

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

1. use various analytical equipment for quality control;

Course Contents

2. apply basic knowledge acquire in the classroom to solve practical problems in the laboratory; 3. give a seminar presentation of new knowledge gain during the industrial training; and
4. demonstrate the use of multimedia for seminar presentation.

Course Contents

Students should be attached to some industrial organizations for additional 12 Weeks at the 300 Level preferably during the long vacation for more industrial experience. Students to be assessed based on seminar presentation, their reports and assessment by supervisors.

GOU-CHM 301: Computational Chemistry and Molecular Docking (2 Units; Compulsory; LH = 15; PH=30)

Senate-Approved Relevance

The field of computational and molecular docking is a rapidly growing area of molecular modelling and drug discovery. This course is designed to provide students of chemistry with a comprehensive understanding of the principles and practices of molecular docking. The course is designed to equip students with knowledge in the use of computer soft wares and applications for drug designing and drug discovery which would make them relevant in the society. This is in line with the mission and vision of Godfrey Okoye University which positions itself to give its graduates quality education that equips them for the labor market. The importance of the course also aligns with the sustainable development goal number 4 (SDG 4) which ensures inclusive and equitable quality education and long-life learning opportunities for all.

Overview

Computational chemistry is currently attracting serious attention from the scientific and industrial community. It is the application of computer simulation in the designing of drug molecules and predicting their pharmacological properties. It is also known as *in silico* studies. It is therefore very important for chemistry undergraduates to acquire adequate knowledge and skills in computational chemistry and to be relevant in this field of study.

Molecular docking is a method which analyses the conformation and orientation of molecules into the binding site of a macromolecular target. The students is trained to use the software to search algorithms and to generate data, which are ranked by scoring functions. Several softwares were developed during the last decades, amongst which were AutoDock, AutoDockVina, DockThor, GOLD, FlexX and Molegro Virtual Docker. The course is designed to address the challenge of drug of discovery by equipping students with knowledge and skills in computational chemistry and how this knowledge can be used to develop new technologies.

Objectives: The objectives of the course are to:

i. Explain the concepts of computational chemistry and molecular docking.
ii. Describe coding formats and organizational structure of chemical databases interactions with such databases.
iii. Identify and explain potential lead molecules for drug development.
iv. Draw and explain the structure of biomolecules and more importantly link the structure and dynamics together.

v. Describe the structure and dynamics in a quantitative way which enables rational drug discovery.
vi. Compute and explain the binding energies and other pharmacological properties of ligands using Autodock softwares.

Learning Outcomes

On completion of this course students should be able to:

i. Describe correctly the meaning and concepts of computational chemistry and molecular docking.
ii. Determine and explain the formats and organizational structure of chemical databases and state their interactions with such databases.
iii. Locate and identify twenty (20) compounds that are potential lead as drug molecules.
iv. Draw the structures of twenty (20) ligands and optimize them, using discovery studio.
v. Download protein twenty (20) targets from protein data bank (PDB) and prepare them for molecular docking.
vi. Compute and evaluate the binding energies of ten (10) docked molecules.
vii. Generate a library of chemical compounds and develop their associated pharmacological properties.

Course Content

Definition of molecular Docking. Conventional methods to modern drug design. Molecular docking techniques. Types of docking. Modes of docking. Sampling algorithms. Pose selection. Docking targets. Target preparation. Retrieving ligand molecules from data bank. Autodock. Preparation of protein targets. Molecular docking for identification of potential targets for drug design. The use of machines and learning of algorithms in molecular docking. Application of molecular docking for the degradation of organic pollutants in the environmental remediation. Molecular modeling and ligand docking for solute carrier (SLC) transporters. Improvements, trends, and new ideas in molecular docking. Interpretation of molecular docking results.

Minimum academic standard: Computational Chemistry laboratory, computers sets installed with molecular docking soft wares, computational chemistry library collections.

GOU-CHM 302: Colour Chemistry Technology (2 Units; Compulsory; LH = 30; PH = 0)

Senate – Approved Relevance

Colour Chemistry and Technology is an emerging field of industrial Chemistry because all substances around us have different colours that make them appealing to sight and acceptable or not. The clothes we wear have colours, the houses we live in are painted with coloured substances called paints. The soaps, and detergents we use on a daily basis have colours as well as the food we consumed. Since the first synthetic dye was discovered by Mauveine Perkin in 1856, a lot of researches have been going on and different types of dyes and pigments are developed by chemists. Our environment especially the south east of Nigeria is blessed with so many grasses and trees which are very good sources of dyes and pigments that can be of industrial importance if well harnessed with improved technologies. This course is designed to provide students with the basic knowledge of preparing dyes and pigments from the locally available raw materials like grasses, trees as well as chemical methods of synthesis of dyes and pigments for commercial and industrial purposes. This will help them to fit in very well for the labour market after graduation or by setting up their own industrial outfits and become employers of labour as contained in the mission and vision of Godfrey Okoye University. It also aligns with the sustainable development goal number 9 (SDG 9) which is aimed at building resilient infrastructure, promoting inclusive and sustainable industrialization and fostering innovation.

Overview

Innovation and creativity is very important in every area of life. However, creating a colour that could be applied and can also remain on a substrate for long without causing any harm or fading away is a major challenge in the colour industry. Many industries that make use of coloured substances like textile, photography, printing and painting industries are in need of different types of colours which are products of dyes and pigments. These pigments and dyes can be obtained from local materials readily available in plants but the major challenge is that they are needed in large quantities and the only way to augment the supply is by chemical synthesis which can only be carried out by a trained chemist.

This course is designed to equip the students with basic knowledge and practical skills of identifying, sourcing and producing good pigments and dyes from local raw materials for commercial and industrial purposes. Emphasis would also be laid on chemical synthesis and analysis of colours, dyes and pigment; on how fibres and related polymers are produced from natural sources and synthetic forms. In addition to the above, the applications of colours, dyes and pigments in fibres and polymers will also be discussed. New challenges and economic importance of these chemical materials in our emerging economy will also be looked into.

Objectives:

The objectives of the course are to:

1. Explain the concept of color, pigments, dyes and related materials.
2. Identify and explain each of the colours, dyes and pigments, their properties and uses.
3. Explain the production processes of colours, dyes and pigments.
4. Explain the relationship and differences between colours, dyes and pigments.
5. Describe the challenges in the production of colours, dyes and pigments.
6. Demonstrate the basic mechanism and processes involved in dyeing.

Learning Outcome

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

i. Explain in details the concepts of colours, pigments, dyes and related materials.
ii. Identify and explain five (5) colours, dyes and pigments.
iii. List and explain five (5) properties and uses of colours, dyes and pigments.
iv. Describe two (2) production processes of colours, dyes and pigments.
v. List and explain three (3) challenges in the production of colours, dyes and pigments.
vi. Describe with three (3) examples the basic mechanisms and processes involved in dyeing.

Course Content

Definitions of colours. Pigments. Chemical compositions and structures of pigments. Extraction of pigments from local sources. Dyes. Chemical composition and structures of dyes. Types of colours (pigments and dyes). Application of colours. Applications of pigments and dyes. Classification of dyes. Natural dyes and dyeing processes. Synthetic dyes and fibres. Synthetic fibre. Polymer fibres. Dyeing mechanisms. Textile dyeing. Dyeing machines. Chemical analysis of pigments. Chemical analysis of dyes.

Minimum academic standard: As found in the 70% CCMAS

GOU-CHM 303: Corrosion Chemistry and Control (2 Units; Compulsory; LH = 30; PH= 0)

Senate–Approved Relevance
Corrosion is a very serious problem that effects the surfaces of most of the metallic items in our environment. When a metal is attacked by substances such as moisture, acids etc. it said to corrode and the process is called corrosion. An example is the rusting of iron. Corrosion is a very serious challenge that needs attention because the deterioration and disintegration of vital structures, pipelines and other productive assets affect the safety and reliability of industries and the economy. Therefore this problem must be addressed for safety reasons and also to minimize environmental consequences. This could be achieved through a systematic study of chemistry of corrosion to help students to acquire basic knowledge which will help them to identify and control corrosion. This area of study will open opportunities for a graduate of Chemistry to carry out the maintenance of structures and further research to improve the qualities of materials used for construction, especially iron and its alloys. The acquisition of such knowledge is in tandem with Godfrey Okoye University mission to produce graduates that are outstanding in learning, balanced in character and personality and ready to pursue epistemic unity in all ramifications. This goal is stipulated in sustainable development goal number 9 (SDG 9) which is aimed at building resilient infrastructure, promoting inclusive and sustainable industrialization and fostering innovation

Overview
Corrosion is the degradation of a materials usually metals and their alloys as a result of interaction with the surroundings, which can occur at any point or at any time. It is a natural and a chemical process. As a reverse extractive metallurgy, it depends on the concentration of environmental stress, erosion and temperature. It accounts for 1-5% of GNP economic losses per year for any nation. In addition, corrosion does not only increase the cost of component but it is responsible for life losses and safety hazards. Efforts must be put in place to tackle corrosion.

Consequently, in this course we shall address the chemistry of corrosion with emphasis on the distinct types of corrosion, causes, nature of corroding environment. The chemistry of oxygen and moisture (water) which are the major factors responsible for corrosion shall be studied extensively. Efforts would also be geared toward looking at different ways of preventing corrosion of materials In order to gain better understanding of some the issues related to corrosion, the subject of electrochemistry shall be handled to give student a clear picture of oxidation-reduction reactions.

Objectives: The objectives of the course are to:

i. Define corrosion.
ii. Explain the causes of corrosion.
iii. List and explain the factors affecting corrosion.
iv. Describe the nature of corroding environment.
v. Explain the role of oxygen in corrosion.
vi. Explain types of corrosion and corrosion mechanism.
vii. Describes methods of corrosion prevention.
viii. Define chemical equilibra, ionic equilibra, and conductance.

ix. Define electrode potentials.
x. Define electromotive force and state its measurements.

Learning Outcomes
On completion of this course, students should be able to:
i. State the correct definition of corrosion.
ii. Explain and list four (4) causes of corrosion.
iii. List three (3) factors affecting corrosion.
iv. State three (3) components of a corroding environment.
v. Illustrate the role of oxygen in corrosion with three (3) examples.
vi. List and explain five (5) types of corrosion and their mechanisms.
vii. List and explain three (3) methods of preventing corrosion.
viii. State the correct meaning of electrochemistry, equilibra, ionic equilibra, and conductance.
ix. List and explain two (2) types of electrode potentials.
x. Define and calculate mathematic problems involving electromotive force of cells.

Course outline
Meaning of corrosion. Causes of corrosion. Factors affecting corrosion (nature of metals, purity of metals and nature of surface films). Nature of corroding environment (temperature, humidity and p^H). The role of oxygen in corrosion. Oxidation and reduction reactions. Corrosion mechanism. Types of corrosion. General and localized corrosion. Pitting and crevice corrosion. Stress and cracking corrosion. Inter granular corrosion. Galvanic corrosion. Waterline corrosion. Corrosion prevention. Electrochemical cells. Chemical equilibra. Ionic equilibra, Conductance. Acids and bases in relation to corrosion.

Minimum academic standard: As found in the 70% CCMAS

GOU-CHM 304: Nanoscience and Nanotechnology (2 Units; Compulsory; LH = 30; PH = 0)

Senate-Approved Relevance
Nanotechnology as an emerging field of modern research deals with the designing, synthesis, and manipulation of particle structures ranging from approximately 1-100 nm in size. Nanoparticles (NPs) have wide applications in areas like health care, cosmetics, food and feed, environmental health, mechanics, optics, biomedical sciences, chemical industries, electronics, space industries, drug-gene delivery, energy science, optoelectronics, catalysis, single electron transistors, light emitters, nonlinear optical devices, as well as photo electrochemical

applications. This course has been designed to expose students to this emerging area of research in order to enable them follow the current trend in chemistry. This aligns with the mission and vision of Godfrey Okoye University which is to impart quality education aims at inculcating in the students strong personality that will promote religions, cultural and epistemological dialogue and to produce graduates who will be outstanding in learning, balanced in character and personality and ready to pursue epistemic unity in all ramifications. The goal of the course is in tandem with the (SDG 9) which is aimed at building resilient infrastructure, promoting inclusive and sustainable industrialization and fostering innovation.

Overview

One of the main factors in nanoscience is the synthesis of these nanomaterials since they exhibit properties which differ from those of bulk materials. It has been discovered that optical, magnetic and electrical properties are sensitive to size effects. In addition, nanosized particles are also very efficient especially in the field of catalysis due to the high ratio of surface to the volume they possess. In order to tackle the issue of size control, morphology, structure and chemical composition, different methods of synthesis have been designed. Being an emerging area of research in sciences, it would benefit Godfrey Okoye University students if they are exposed to it at this stage of their studies.

The synthesis of nanomaterials is an important milestone in the pursuit. A lot of significant developments have been made in the improvement of methods of synthesis of nanomaterial by chemists, materials scientists and engineers. In this course various methods of fabricating nanomaterials will be discussed. They include Mechanical ball milling, mechanochemical method, etching techniques, sputtering, laser ablation, gas condensation, vacuum deposition and vaporization, chemical vapor deposition (CVD) and chemical vapor condensation (CVC), electrodeposition, chemical precipitation, sol-gel techniques, sonochemical method, theromolysis of metal complexes, microwave synthesis, electrochemical method and biological method. The equipment used for the characterization of nanoparticle will also be discussed.

Objectives:

The objectives of the course are to:

i. Define nanoscience and nanotechnology.
ii. Explain the meaning of nanoparticles.
iii. List and explain examples of nanoparticles.
iv. Explain top down and bottom up approaches of synthesizing nanoparticles.
v. List different methods of producing nanoparticles.
vi. Describe the methods of producing nanoparticles.
vii. List the instruments used for the characterization of nanoparticles.

Learning Outcomes:

On completion of the course students should be able to:

i. State and explain the correct meanings of nanoscience.
ii. State and explain the correct meanings of nanotechnology.
iii. Describe five (5) nanoparticles.
iv. Mention and explain five (5) examples of nanoparticles.

v. Describe with three (3) examples top-down and bottom-up approaches of synthesizing nanoparticles.
vi. Enumerate five (5) methods of producing nanoparticles.
vii. State and explain five (5) examples of instruments for characterization of nanoparticles

Course Content:
Concept of nanoscience and nanotechnology. Types of nanostructured materials. Types of nanoparticles. Top-down and bottom up approaches of synthesizing nanoparticles. Mechanical ball milling. Mechanochemical method. Etching techniques. Sputtering. Laser ablation. Gas condensation. Vacuum deposition and vaporization. Chemical vapor deposition (CVD). Chemical vapor condensation (CVC). Electrodeposition. Chemical precipitation. Sol-gel techniques. Sonochemical method. Theromolysis of metal complexes. Microwave synthesis. Electrochemical method. Biological method. Applications of nanoparticles.
Minimum academic standard: As found in the 70% CCMAS

GOU-CHM 305: Medicinal Chemistry (2 Units; Compulsory; LH = 30; PH = 0)

Senate –Approved Relevance
The importance of good health for the actualization of life ambitions and set goals cannot be overemphasized. There is a popular statement which says "health is wealth". Virtually everything we consume either as food substance or medicine are made of chemical substances. One of the importance of the Chemistry Programme is to equipment graduates with the knowledge of drug development from the natural plants available in our environment. With the emergence of different and new type of diseases affecting human beings, the incorporation of Medicinal Chemistry into the Chemistry Programme is very important. This is in alignment with the mission of Godfrey Okoye University to produce graduates who contribute to societal development. It also aligns with SDG 3 which targets at ensuring healthy lives and promote well-being for all at all ages.

Overview:
Enugu state and Nigeria as a whole is blessed with different species of plants. Most of these plants have medicinal compounds known as phytochemicals or secondary metabolites that can be extracted and used directly as drugs for the treatment of different diseases. These compounds could further be isolated, characterized and purified in order obtain their exact chemical structures so as to understand their mechanisms in the systems. Modifications could also be made on the existing structures in order to improve their chemical and biological activities.

This course would help graduates of chemistry to be familiar with the medicinal plants around them. It will focus on methods of extraction, purification, formulation of drugs and their uses. The scope of this course covers the following, the historical background of traditional or native

medicine, Medicinal plants in Enugu states, uses and their advantages and disadvantages. The development of drug, classes of drugs, their syntheses and pharmaceutical effects. Emphases shall be laid on drugs like analgesics, antacids, antibiotics, antihistamine, anti-inflammatory agents, anti-obesity drugs (anorectics), anti-nauseants, cardiovascular agents, contraceptives, cold and cough preparations, diuretics, laxatives, psychopharmacological agents, sedatives and hypnotics.

Objectives: The objectives of the course are to:

i. Describe the historical, traditional or native medicine.
ii. Identify and explain some medicinal plants in Enugu State.
iii. Explain drug development from plants.
iv. Identify therapeutic classes of drugs, their syntheses and pharmaceutical effects.
v. Describe with examples analgesics, antacids, antibiotics, antihistamine, anti-inflammatory agents.
vi. Explain with examples anti-obesity drugs (anorectics), anti-nauseants, cardiovascular agents, contraceptives, cold and cough preparations, diuretics, laxatives.
vii. Describe psychopharmacological agents, sedatives and hypnotics, chemotherapeutic agents, vaccines and vitamins.
viii. Explain structure-activity relationships (SAR).
ix. Describe drug formulation and manufacturing processes.

Learning Outcomes

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

i. Narrate the historical background of traditional or native medicine.
ii. Explain the emergence of drug formulation from plants.
iii. List and explain five (5) therapeutic classes of drugs
iv. Describe the synthesis and pharmaceutical effects of drugs mentioned in (iii) above.
v. State and explain three (3) examples of each of analgesics, antacids, antibiotics, antihistamine, anti-inflammatory agents
vi. State and explain three (3) examples of anti-obesity drugs (anorectics), anti-nauseants, cardiovascular agents, contraceptives.
vii. Describe how to formulate cold and cough preparations, diuretics and laxatives.
viii. Explain structure-activity relationships (SAR).
ix. Explain the formulation and manufacturing processes of aspirin and other analgesics.

Course Content:

Historical aspects of traditional or native medicine. Medicinal plants. Uses of medicinal plants advantages and disadvantages. Drug development. Therapeutic classes of drugs. Syntheses and pharmaceutical effects of some local drugs. Analgesics. Antacids. Antibiotics. Antihistamine. Anti-inflammatory agents. Anti-obesity drugs (anorectics). Anti-nauseants. Cardiovascular agents. Contraceptives. Cold and cough preparations. Diuretics and laxatives. Psychopharmacological agents. Sedatives. Hypnotics. Chemotherapeutic agents. Vaccines. Vitamins. Structure-activity relationships (SAR). Drug formulation and manufacturing processes.

Minimum Academic Standard: As found in the 70% CCMAS

GOU-CHM 306: Local Natural Products Chemistry (3 Units; Compulsory; LH = 45; PH = 0)

Senate–Approved Relevance:
Mother Nature has blessed mankind with different types of products. These products are either organic or inorganic with tremendous importance, if fully discovered and harnessed. Many of these products are found beneath the earth, in water bodies, animals and plants. It is expected that graduates of the Chemistry Programme would be equipped with practical skills and knowledge to identify natural products of importance; isolate and convert them to useful products that can improve the quality of life when used directly or converted to other forms of supplement. This is in line with SDG 3 which targets at ensuring healthy lives and promoting well-being for all at all ages. It also aligns with the mission of Godfrey Okoye University to produce graduates who promote the three arms of dialogue – religious, cultural and epistemic, and who are equipped for the labor market.

Overview:
Natural products are found everywhere around, but the challenge is that their very nature and uses of most them have not been fully explored. Many organisms, plants and animals contain natural products that are very useful to humans. Some of these include terpenes, steroids, alkaloids, Flavonoids, tannins, sapoonins and many other products of pharmaceutical importance. The challenge encountered with these is identification, extraction and purification which require the basic knowledge of chemistry and organic synthesis. This knowledge can be gained through a systematic and empirical study of natural products.

In this course, efforts will be made to expose students of Chemistry to the general methods of isolation, purification, structure determination and syntheses of natural products. Students will be expected to be at home with the meaning and importance of natural products as well as the importance of natural product chemistry. The course will also expose students to the different classes of natural products available in plants and animals and how to detect and identify them. These includes alkaloids, terpenes, steroid, flavonoids, etc. Students will also be guided to understand the general methods of isolating alkaloids, terpenes, steroids, flavonoids etc. from their natural sources and methods of purification as well as their uses and importance.

Objectives:
The objectives of the course are to:

i. Explain the meaning of natural products.
ii. List and explain examples of natural products.
iii. Explain the general methods of isolating natural products.
iv. Explain the general methods of purifying natural products.
v. Explain the general methods of synthesis of natural products.
vi. State the uses of natural products.
vii. Describe the spectroscopic methods of determining their structures.

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

i. Explain in details the meaning of natural product.
ii. Explain the meaning of natural product chemistry.

Course Contents

iii. List and explain three (3) types of natural product found in plants and animals.
iv. Explain the meaning of alkaloids and give three (3) examples.
v. Explain the meaning of terpenes, steroids and flavonoids and list four (4) examples of each.
vi. Describe the methods of isolating alkaloids, steroids, terpene and flavonoids.
vii. List and explain fours (4) uses of each the above natural products.
viii. Describe with three (3) examples different methods of structural elucidation of these natural products.

Course Content:
Meaning and importance of natural products. Meaning and importance of natural product chemistry. Classes of natural products. Natural products found in plants and animals. Alkaloids (meaning, examples and types). Terpenes (meaning, examples and types). Steroids (meaning, examples and types). Flavonoids (meaning, examples and types). General method of isolation alkaloids. Isolation of terpenes. Isolation of steroids. Isolation of flavonoids. Chemical test for alkaloids, steroids, flavonoids etc. Methods of purification of alkaloids. Methods of purification of terpenes. Methods of purification of steroids. Methods of purification of flavonoids etc. Chemical structure and synthesis of alkaloids. Chemical structures and synthesis of terpenes. Chemical structures and synthesis of steroids. Chemical structures and synthesis of flavonoids. Natural products of pharmaceutical importance.

Minimum Academic Standard: As contained in the 70 CCMAS

CHM 400: Seminar **(1 Unit C: PH 45)**

Learning Outcomes
At the end of this course, students should be able to:
1. demonstrate basic knowledge of report writings;
2. identify basic elements of research which includes: Introduction, literature reviews, methodology/experimentation/materials and methods, results and discussion, conclusion, recommendations and referencing;
3. identify various types of referencing such as, APA, Chicago, Harvard and many others.
4. identify Spacing and paragraph used in presentation writings;
5. identify the use of multimedia in seminar presentations; and
6. demonstrate assessment and grading of the written and oral presentation.

Course Contents
Student reports on an assigned or chosen current topic in chemistry. Review of literature on the assigned topic should be included. Assessment to be on written report and oral presentation.

CHM 401: Research Project **(6 Unit C: PH 270)**

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

Course Contents

1. demonstrate basic knowledge of report writings;
2. identify a chemistry related Topic for the final year project;
3. identify basic elements of research which includes Introduction, literature reviews, methodology/experimentation/materials and methods, results and discussion, conclusion, recommendations and referencing;
4. identify various types of referencing e.g., APA, Chicago, Harvard and many others.
5. identify Spacing and paragraph used in presentation writings;
6. express the use of multimedia in project seminar presentations; and 7. demonstrate assessment and grading of the written and oral presentation.

Course Contents

Research projects into selected topics in chemistry. Students will be expected to carry out literature survey on chosen topics, perform experiments and produce reports. Students will be subjected to both seminar and oral examinations on their projects.

CHM 406: Reaction Kinetics (2 Units C: LH 30)

Learning Outcomes

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

1. identify the first, second and third order rate equations.;
2. use the coefficients of a balanced chemical equation to express the rate of reaction in terms of the change in concentration of a reactant or product over time;
3. distinguish between instantaneous rates and average rates from a graph; and
4. determine the rate law from initial rate data and be able to determine:
    - the order of reaction with respect to each reactant; • the overall order of reaction; and
    - the rate constant with units.
5. recognise the integrated rate laws and be able to:
    - use integrated first-order and second-order rate laws to find the value of one variable, given;
    - values of the other variables;
    - explain the concept of reaction half-life and describe the relationship between half-life and rate;
    - constant for first order and second-order reactions;
    - determine the order of the reaction from plots of concentration versus time, ln (concentration);
    - versus time, and 1/(concentration) versus time.
6. use Collision Theory to explain how reactions occur at the molecular level, and
    - explain the concept of activation energy and how it relates to the variation of reaction rate with temperature;
    - be able to interpret potential energy profiles and use them to determine the activation energy;
    - potential energy changes for a reaction;

Course Contents

- be able to use the Arrhenius equation to calculate a rate constant, activation energy, and
- frequency factor.

7. define a catalyst and
    - give a reaction mechanism, identify the reaction intermediate(s) and catalyst(s), write the overall;
    - and determine the molecularity of each step;
    - describe the effect of a catalyst on the energy requirements for a reaction;
    - sketch a potential energy profile showing the activation energies for the forward and reverse;
    - reactions and show how they are affected by the addition of a catalyst;
8. explain how enzymes act as biological catalysts and how they interact with specific substrate molecules.
9. explain why enzymatic reactions respond differently to temperature changes compared to nonenzymatic processes.
10. chemical warfare:
    - recognize selected classes of toxic agents of military importance: blister agents, (mustard,
    - lewisite), nerve agents (sarin, VX), choking agents (chlorine, phosgene), blood agents (HCN), riot.
    - control agents
11. explain the mechanism by which sarin inhibits acetylcholinesterase ; and
12. identify photochemical reaction mechanism.

Course Contents

Review of first, second and third order rate equations. Rate constants and equilibrium constants. Collision theory. Transition state theory. Reaction co-ordinates. Unimolecular reaction mechanisms. Bimolecular reaction mechanisms. Chain reaction mechanisms. Chemical warfare, Catalysis and heterogeneous reactions. Photochemical reaction mechanisms.

CHM 410: Analytical Chemistry II **(2 Units C: LH 30)**

Learning Outcomes

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

1. describe different thermal methods of analyses: TG, DTG, DTA, DSC;
2. describe the potentiometric method of analysis using pH;
3. describe the conductometric method analysis;
4. describe the colorimetric method analysis;
5. describe the polarography methods analysis;
6. explain and perform calculation using chromatography principles;
7. explain principles of different chromatographic technique; and
8. explain the principle of radiochemical method in environmental analysis.

Course Contents

Course Contents

Potentiometric and pH methods. Conductometric, electroanalytical, amperometric, colorimetric methods of analysis. Coupled methods of analysis e.g. GC-MS, LC-MS. Radio-chemical methods, Chromatography.

CHM 423: Organometallic Chemistry (2 Units C: LH 30)

Learning Outcomes

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

1. identify the classifications of organometallic compounds by bonding and ligands;
2. explain Preparation, structure and reactions including abnormal science of organometallic compounds;
3. identify electron rule, bonding, chemistry of ferrocene and related compounds; and
4. explain the roles of organometallic compounds in some catalytic reaction;

Course Contents

Classification of organometallic compounds. Preparation, structure and reactions including abnormal science of organometallic compounds. Synthetic utility of organometallics. Introduction to organometallic compounds of the transition elements. Classification of ligands, electron rule, bonding, preparation of organic transition metal compounds. Reaction and structures of organometallic compounds of transition elements. The organic chemistry of ferrocene and related compounds. The role of organometallic compounds in some catalytic reaction.

CHM 424: Coordination Chemistry (2 Units C: LH 30)

Learning Outcomes

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

1. define coordination compounds;
2. recognise coordination compounds and their application;
3. identify the nomenclature, coordination formula and isomerism in complexes;
4. explain the stereochemistry of complex molecules;
5. identify theories of bonding: Werner, valence bond, crystal field/ligand field and molecular bond theories;
6. discuss their advantages, disadvantages, and their limitations;
7. discuss the physiochemical methods for structural elucidation of coordination compounds;
8. identify spectrochemicalseries, nephelauxetic series and Jahn- Teller distortions;
9. identify stabilization of unusual oxidation states by complex formation, thermodynamic stability of complex compounds, the stability constant, the chelate effect;
10. discuss Preparation and reactions of complexes. Kinetics and mechanisms;
11. discuss Domain structures, magnetostrictions, magnetic relaxation, magnetohydrodynamics and many others; and
12. identify Technological applications of magnetohydrodynamics.

Course Contents

Prerequisite –CHM 302

Definition, recognition and applications of co-ordination compounds. Nomenclature, co-ordination formula and isomerism in complexes. Stereochemistry of complex molecules. Theories of structure and bonding. Physical methods of structural investigation. Magnetic properties. Absorption and vibrational spectra. The spectrochemical series. The Nephelauxetic series and the Jahn-Teller distortions. Stabilisation of unusual oxidation states by complex formation. Thermodynamic stability of complex compounds, the stability constant, the chelate effect. Preparation and reactions of complexes. Kinetics and mechanisms.

GOU-CHM 401: Geochemistry (3 Units; Compulsory; LH = 45; PH = 0)

Senate – Approved Relevance

The study, sourcing and management of natural resources for the wellbeing and development of any society is a very important aspect of human endeavor. It requires the training of chemists and other scientists to acquire the needed skills for exploration of those resources. In order to shift emphasis from petroleum which is now considered as the major source of revenue in Nigeria today and diversify to other available resources especially coal which is found in larger deposit in Enugu state, the department through the chemistry programme is committed to producing chemists that would be able to carry out the study of the chemistry of coal, its bye products as well as the methods of transforming them into useable source of energy and products of industrial importance in Enugu state and its environs. This is in accordance with the SDG 7 which is aimed at ensuring access to affordable, reliable, sustainable and modern energy for all. The acquisition of knowledge in this courses is in line with the mission and vision of Godfrey Okoye University to promote societal development through education.

Overview

The neglect of coal which was one of the main sources of energy supply in the South Eastern State of Nigeria is a thing of concern. Many people do not know that the chemical constituents that are present in petroleum are also present in coal. Some countries depend entirely on coal not only as a source of energy but also as a source of raw materials that feeds their chemical industries.

This course is designed to address the challenge faced by the coal industry in Enugu state, and to produce chemists with sound knowledge of coal chemistry by undertaking an in-depth study of coal, and to train man power who are capable of converting the bye products to useful materials for domestic and industrial uses. The course covers areas like the concept of geochemistry, isotope geochemistry, introductory mineralogy, physical and chemical properties of coal, methods of analyzing coal samples, Pyrolysis of coal and fire chemistry, purification and concentration of coal products, introduction to water chemistry and analysis of water sample in coal related areas. Other topics to be handled include measures of pollution control in coal exploration sites, analysis of soil samples in Enugu and the South Eastern States and some aspects of organic geochemistry mineral processing.

Objectives:

The objectives of the course are to:

i. Explain what geochemistry entails in the context of coal production.
ii. Describe the physical and chemical properties of coal.
iii. Identify and explain the methods of coal extraction.

iv. Explain the chemistry of transformation of coal to its constituent products.
v. Identity and explain the chemical components present in coal.
vi. Identify and explain the various uses of the chemical components of coal.
vii. List and explain equipment that can be used for destructive distillation of coal to obtain its bye products.
viii. Identify and describe ways to prevent environmental pollution caused by the exploration.

Learning Outcomes

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

i. Explain the concept of geochemistry as related to coal.
ii. List and explain five (5) physical and chemical properties of coal.
iii. Identify and explain three (3) methods of coal extraction.
iv. Describe the chemistry involved in the transformation of coal to its products.
v. List and explain five (5) different chemical components found in coal.
vi. Explain the chemistry involved in combustion and fire making and fire-fighting.
vii. List and explain three (3) uses of each of the components of coal above.
viii. Explain destructive distillation of coal and the equipment used.
ix. Explain measures taken to prevent environmental pollution from coal exploration.
x. Explain the effects of coal on water.
xi. Explain the analysis of three (3) different soil samples in Enugu state and its environment to determine their mineral composition.

Course Content

The concept of geochemistry. Some aspects of isotope geochemistry. Introductory mineralogy. Coal and its abundance in Enugu state. Geochemical classification of coal. Occurrence of coal in selected locations in Enugu state. Physical and chemical properties of coal. Chemical analysis of coal samples. Destructive distillation of coal. Combustion and fire chemistry. Purification and concentration of coal products. Introduction to water chemistry. Analysis of water sample in coal related areas. Measures of pollution control in coal exploration sites. Analysis of soil samples in Enugu and the South Eastern States. Some aspects of organic geochemistry mineral processing.

Minimum Academic Standard: As contained in 70% CCMAS

GOU-CHM 402: Cements and Fertilizer Chemistry (2 Units; Elective; LH = 30; PH = 0)

Senate–Approved Relevance

Shelter, food and clothing are the three basic needs of man. Any activity that can promote the knowledge and skills to actualize these three basic needs is very important to be engaged in. The chemistry of cement is very important because the uses of cement cannot be overemphasized as a component of architectural buildings which include houses, bridges, roads, poles etc. Fertilizers, on the other hand, help in the improvement of the soil to boast crop production. Undertaking a course in the chemistry of cement and fertilizers places a graduate of Chemistry on an advantage of acquiring skills and practical knowledge to pursue career in industries, and contribute to the society in the area of shelter and food. This target is in line with the SDG 2 which is aimed at ending hunger and achieving food security; and with SDG 11 which lays emphasis on making cities and human settlements inclusive, safe, resilient and sustainable. Knowledge and skills acquisition in this courses is also in line with the mission of Godfrey Okoye University to produce graduates who will be outstanding in learning, balanced in character and personality and ready to contribute to the development of human society.

Overview

Food and shelter are basic needs of life and by implication cement used for buildings structures like houses, bridges, roads and fertilizers meant for crops growth and production need to be given attention as a research area for improvement. Recently, there have been reports of building collapse as a result of the use of substandard building materials, amongst them is cement. The composition of cement from the point of manufacturing, packaging, storage and usage must be given serious attention. Poorly formulated cement products will constitute danger when used for the construction of structures. It is therefore very important for students in the Chemistry Programme to be trained in the processes of cement production so as to acquire the needed knowledge and skills that will enable them pursue careers in cement related chemical industries.

In another development, food supply would be enhanced when crops are provided with the correct and adequate formulated fertilizer products. A good training given to students in understanding of fertilizer and soil chemistry would position them to build promising career life in agriculture and related industries. Therefore this course is designed to engage students of this programme on the chemistry cement and fertilizers with emphasis on formulation, analyses, uses and pollution control. The course covers the following areas: meaning, composition of cement and types of cements, basic chemistry of cement and the raw materials of cement. A survey of sources and locations where the raw materials could be obtained would be discussed as well as the manufacturing processes. Pollution control in cement production, analysis of cement samples and a survey of cement factories in Nigeria shall be considered also. Other topics to be covered also include the meaning, compositions of fertilizers and types of fertilizers, chemistry and analysis of fertilizers and raw materials of fertilizers.

Objectives: The objectives of the course are to:

i. Describe cement.
ii. Enumerate the types of cement.
iii. Describe the chemistry of cement.
iv. List and explain the raw material used for cement production and their sources.
v. Describe the manufacturing processes of cement.
vi. Describe fertilizers.
vii. Identify and describe the types of fertilizers.
viii. List and explain the raw materials used for fertilizers production.

ix. Mention and explain ways of preventing environmental pollution in cement and fertilizers production.

Learning Outcome

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

i. Explain what cement is all about.
ii. List and explain the types of cement.
iii. Identify and explain four (4) raw materials used in cement production.
iv. Describe with examples the manufacturing processes of cement.
v. List and describe three (3) cement factories in the South East region of Nigeria.
vi. Explain what fertilizers are all about.
vii. List and explain three (3) uses types of fertilizers.
viii. Describe with examples the production of fertilizers.
ix. Mention and explain four (4) ways of preventing pollution caused by cement and fertilizers production.

Course Content

Meaning and composition of cement. Types of cements. Chemistry of cement. Raw materials of cement. Types of cement. Sources and locations of raw materials. Manufacturing processes of cement. Pollution control in cement production. Analysis of cement samples. A survey of cement factories in Nigeria. Meaning and compositions of fertilizers. Types of fertilizers. Chemistry of fertilizers. Raw materials of fertilizers. A survey of fertilizer industries in Nigeria. Methods of production of fertilizers. Applications of fertilizers and soil chemistry. Pollution control in fertilizer production.

Minimum academic standard: As found in the 70 CCMAS

GOU-CHM 403: Biochemical Application in Forensic Science (2 Units; Elective; LH = 30; PH = 0)

Senate-Approved Relevance

Forensic science is the application of natural and physical science to matters of criminal and civil law. The training of chemistry graduates who are knowledgeable in the field of forensic science will acquaint them with techniques of crime scene investigation. This is in line with the mission of Godfrey Okoye University, which is to foster entrepreneurial ecosystem in the university that would facilitate unity along with the development of talents, skills, knowledge and confidence.

Overview

This course is designed to expose students to the latest scientific investigation procedures and the basic scientific principles underlying the applied methods in forensic analysis of evidence and samples for clues to solve crimes. The constitution of Nigeria through its various articles strives to ensure the security and safety of its citizens in accordance with the principles of universal declaration of human rights.

However, crime is a violation of these principles. The crime rate is increasing exponentially in the country especially in metropolitan cities such as Enugu. If we have to create a condition conducive to harmonious development, we must mitigate the crime rate. This course is designed to effectively address this challenge. The objectives of the course, learning outcomes and the course contents are provided to address this need.

Objectives

The objectives of the course are to:

i. State and explain the fundamental concepts and principles of forensic science and their significance.
ii. State and explain the importance of health and safety protocols in sample collection and analysis.
iii. State and explain the theory and application of the basic biochemical processes such as body fluid identification in forensic context.
iv. Identity and explain individuals by fingerprints, footprint, DNA analysis etc.
v. Describe the basic scientific principles and techniques underlying various applied methods used in analyzing biological evidences.
vi. Describe basic scientific principles and techniques used in analyzing chemical evidence.
vii. Explain the principles and technique of DNA profiling technology employed in crime laboratories.

viii. Identify and explain the challenges and explore the limitations involved in deploying biochemical techniques in forensic science.

Learning Outcomes

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

i. State and explain at least five (5) principles of forensic science and their significance.
ii. Describe the application of body fluid identification in forensic context.
iii. Describe three (3) methods to establish the identity of an individual.
iv. Describe at least three (3) basic scientific techniques underlining various applied methods used in analyzing biological evidences.
v. Describe basic scientific techniques used in analyzing chemical evidences.
vi. Explain the DNA profiling technology employed in crime laboratories.

Course Contents

Principles of forensic science. History and development of forensic sciences. Defining the scene of investigation. Collection, packaging, labelling and forwarding of biological exhibit to forensic laboratory. Presentation of biological evidence. Importance of health and safety protocols in sample collection and analysis. Biochemical analysis of various biological evidences like blood, semen and other biological fluids. Establishment of identity of individuals - fingerprints, blood and DNA. Forensic entomology. Biochemical basis for the determination of cause of death. Narcotic analysis; theory and forensic significance. Qualitative analysis of evidence using spot testing and microscopy. Polygraph as forensic investigating tool. Challenges and limitations of the biochemical techniques. Obtaining and interpreting toxicology reports. Study of body fluids using separation analyses and optical methods. Tracing the origin of specific materials or substances using chemical and biochemical techniques.

Minimum Academic Standards

As found in 70% CCMAS.

GOU-CHM 404: Biochemical Pharmacology and Toxicology (2 Units; Elective; LH = 30; PH = 0)

Senate-Approved Relevance

Students who are trained in this course will be well qualified to pursue entry-level scientific career employment in the industry (e.g., biomedical; biotechnology; consumer products; contract research organizations; regulatory affairs; pharmaceutical), in academic basic science and clinical research laboratories, or in various agencies of government focused on science, health, or the environment. The program's depth and breadth has proved to be an excellent foundation for graduate work in pharmacology, toxicology, or other related biomedical sciences, as well as for medical school, veterinary medicine, and other health professions schools (e.g., pharmacy, dental, optometry, and public health). Knowledge of this course is in tune with SDG 3 whose aim is to achieve universal health coverage, and provide access to safe and affordable medicines and vaccines for all.

Overview

Drug development plans need to incorporate innovative techniques such as preclinical models to study therapeutic strategies, and shift from sequential enrolment of subgroups, to more rational designs. They also stimulate appropriate research plans, illustrations of specific pharmacokinetic/pharmacodynamics-related as well as drug safety-related challenges during drug development.

Both subjects (pharmacology and toxicology) integrate multiple scientific disciplines and rely on cutting-edge biotechnological approaches to gain insight into drug and toxicant action at the molecular level. Pharmacology and toxicology are related biomedical science disciplines. Pharmacology is the study of the sites, properties, effects, and mechanisms of drug action—the interactions of chemicals with biological systems. Toxicology addresses adverse effects of chemicals on humans and animals and includes exposure assessment, hazard identification, dose response assessment, and risk characterization. The following objectives and outcomes are developed to meet the goals of the course.

Objectives

The objectives of the course are to:

i. Explain critical concepts of pharmacology and toxicology.
ii. Describe the relevance of pharmacology and toxicology to human beings and the society.
iii. Discuss bioanalytical techniques used in pharmacology and toxicology.
iv. Explain drug metabolism, pharmacokinetics, and toxicology.
v. Describe carcinogenesis, mutagenesis and biochemical mechanisms of drug action.
vi. Illustrate routes of drug administration.
vii. Describe mechanisms of drug toxicity.

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

i. Explain the concepts of pharmacology and toxicology.
ii. Describe the biochemical basis of the pharmacology of foreign substances.
iii. State and explain the behaviour of the drug from its administration until its removal from the body.
iv. Explain general and systemic Pharmacology and its application to therapy.
v. Explain at least three (3) theories of the mechanism of drug action.
vi. Explain drug efficacy, drug resistance and drug toxicity.
vii. Describe three (3) metabolic factors affecting chemotherapeutic agents.

Course Contents

Introduction to pharmacology. Origin and classification of drugs. Drug nomenclature. Drug modalities. Routes of Drug Administration. Drug Absorption. Distribution. Elimination. Mechanisms of drug action. Drug receptor and theories. Drug dosage and dose response curves. Relationship between drug efficacy and chemical structure. Drug screening, bioassay and toxicity. Drug resistances and other factors affecting drug efficacy. Pharmacogenetics. Toxic and lethal dosing. Mechanisms of drug toxicity. Drug discovery and design. Preclinical drug development. Clinical drug development. Measurement of some pharmacological parameters.

Minimum Academic Standards
As found in 70% CCMAS.

GOU-CHM 405: Chemistry of Waste Management (3 Units; Compulsory; LH = 45; PH = 0)

Senate – Approved Relevance
The study of our environment is very important for our survival. Activities carried out in our environment affect us directly or indirectly. Emissions discharged from industrial plants and effluence released by chemical and allied industries have adverse effect on the environment. This course is designed to produce graduates who can mitigate the problems of pollution in our environment through the knowledge and skills acquired as environmental chemists. They should be able to carry out impact assessment on the environment and solve problems of pollution caused by different factors using their knowledge of chemistry. The importance of this course lies in the fact that our environment is filled with a lot waste materials that need urgent attention. The aim of this course aligns with SDG 7 which targets access to affordable, reliable, sustainable and modern energy for all. It is also in agreement with the mission of

Godfrey Okoye University to produce graduates who are well equipped to address the challenges of the environment and to contribute to societal development.

Overview

The quality of our lives depends on the type of environment that surrounds us. A clean and healthy environment would lead to a healthier and wealthier live because health is wealth. A polluted and dirty environment would bring outbreak of sicknesses and diseases.

The emphasis of this course shall be on the concepts of elementary cycles and characteristics of the atmosphere, sources, types and effects of environmental pollution. It shall also touch aspects of heavy metal and pesticides as pollutants and mutagenic and other effects of pollutants. The composition of different domestic wastes shall also be treated. More importantly, water chemistry and analysis shall be carried out on some of the water bodies around Enugu. The chemical and physical methods in environmental pollution analysis would also be dealt with.

Objectives: The objectives of the course are to:

i. Explain the meaning of environment in the context of chemistry.
ii. Explain the meaning of environmental chemistry.
iii. Describe the concept of elementary cycles.
iv. State the characteristics of the atmosphere.
v. Mention the sources, types and effect of environmental pollution.
vi. Describe heavy metals and pesticides as pollutants.
vii. Outline mutagenic and other effects of pollutants.
viii. Identify the composition of domestic waste and their management.
ix. Describe the chemistry of water and analyze water samples.
x. Discuss the physical and chemical method of pollution analysis in our environment.
xi. Explain industrial pollution.

Learning Outcome

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

i. State the correct meaning of environment in the context of chemistry.
ii. Explain correctly the meaning of environmental chemistry.
iii. Describe with three (3) examples the concept of elementary cycles.
iv. State and explain five (5) characteristics of the atmosphere.
v. Mention and explain three (3) sources, types and effects of environmental pollution.
vi. List and explain three (3) examples of heavy metals and pesticides that could pollute the environment.
vii. Describe three (3) mutagenic effects of pollutants.
viii. Identify and explain three (3) components of domestic waste and three method they could be managed.
ix. Explain the analysis of three (3) of water samples.
x. List and explain three (3) physical and chemical methods of pollution analysis.
xi. Mention and explain types of industrial pollutions.

Course Content

Meaning of environment and meaning of environmental chemistry**.** Concepts of elementary cycles. Characteristics of the atmosphere. Sources of environmental pollution. Types of

environmental pollution. Effects of environmental pollution. Heavy metal as pollutants. Pesticides as pollutants. Mutagenic and other effects of pollutants. Composition of domestic wastes. Water chemistry. Water analysis. Chemical methods in environmental pollution analysis. Physical methods in environmental pollution analysis. Meaning of industrial pollution**.** Types of industries and their waste products (dust and gas emitting industries) e.g. Cement, Metallurgical, Automobile and Mining, Solid waste industries (such as sugar, paper, food and rubber). Liquid and gaseous chemical wastes from chemical industries. Gas and oil spillage from petrochemical industries. Effects of industrial wastes on the environment. Effects pollution on soil and water, plants and animals. Emission control technology. Electrostatic precipitators and efficiency. Cyclones, filters and wet scrubbers etc. Emphasis on cement. Metallurgical and mining industries. Solid waste treatment. Water as a medium for transport and distribution of solid waste. Characteristics of industrial wastewater. Treatment of industrial wastewater including products from sewage sludge, oil spillages etc.

Minimum Academic Standard: As found in the 70% CCMAS

GOU-CHM 406: Organic Synthesis (2 Units; Compulsory; LH= 30; PH = 0)

Senate – Approved Relevance

Some organic chemical compounds of domestic and industrial importance can be obtained from nature but the challenge is in the quantity and quality of such compounds. To solve this challenge, the field of organic synthesis becomes very vital. This involves the production of organic compounds from simple commercially and readily available starting materials by a careful planning, following laid down synthetic procedures and processes. Drugs, detergents, soap, paints and pigments etc. are all produced through synthesis. Students in the Chemistry Programme will be equipped with the knowledge and skills to carry out the synthesis of chemical compounds and their characterization. This will positioned them to be gainfully employed in chemical industries or to set up their own businesses and become employers of labour. The goal of this course is in line with the mission of Godfrey Okoye University to graduates who will be outstanding in learning, balanced in character and personality and ready to contribute toward the growth and development of the economy.

Overview

The challenge of sourcing product of industrial importance from natural source has been a very serious issue due to the limited supply of such materials. However organic synthesis has been developed as technique that can carry out mass production of materials that are short in supply. Though it is a very tedious process that needs careful planning and application of known organic reactions, chemists cannot do without it. Organic synthesis is all about the transformation of simple starting materials into more complex and useful organic compounds via simple organic reactions.

The course will exposes students to the fundamentals of organic reactions that are very important in the building up of chemical compounds of domestic and industrial importance. Discussions will include reduction methods, metal reductions, and oxidation methods. The stereochemistry of chemical compounds shall also be taught in addition to treatment of cyclic compounds, allenes and spiranes; optical activity of diphyenyl and conformational analysis with emphasis on stabilities of isomers, rates and course of reaction in acyclic, cyclic and fused ring systems.

Objectives:

The objectives of the course are to:

i. Define organic synthesis and the steps involved.
ii. Explain reduction processes used in organic synthesis.
iii. Discuss metal reduction in organic synthesis.
iv. Explain oxidation methods in organic synthesis.
v. Describe the stereochemistry of organic compounds.
vi. Highlight on the synthesis of cyclic compounds allene and spiranes.
vii. Describe optical activity of diphenyl compounds.
viii. Explain conformational analysis with emphasis on isomerism, rates and reaction courses.

Learning Outcome

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

i. State the correct definition of organic synthesis.
ii. Outline four (4) steps involved in organic synthesis.
iii. Explain four (4) reduction processes in organic synthesis.

iv. Discuss three (3) metal reduction processes used in organic synthesis.
v. Explain four (4) oxidation processes used in organic synthesis.
vi. Describe the stereochemistry of five (5) named organic compounds.
vii. Highlight on the synthesis of three (3) cyclic, allenes and spirane compounds.
viii. Explain the structures of five (5) compounds using conformational analysis.

Course content
Reduction methods. Catalytic hydrogenation. Reduction with boron and aluminum hydrides and their analogues and derivatives. Metal reductions. Selective reduction in polyfunctional compounds. Oxidation methods: Epoxidation. Hydration and Hydroxylation of alkenes. Oxidative cleavage of glycol. Organoboranes. Hydroboration and its oxidative applications in organic chemistry. Stereochemistry. Treatment of cyclic compounds. Allenes and spiranes. Optical activity of diphyenyl. Conformational analysis with emphasis on stabilities of isomers. Rates and course of reaction in acyclic, cyclic and fused ring systems.

Minimum academic standard: As found in the 70% CCMAS

GOU-CHM 407: ChemoStatistics (3 Units; Compulsory; LH=15; PH = 45)
Senate-Approved Relevance

The course aims to expose Chemistry students to the basic principles and methods of Biostatistics and to enable them to use different statistical and bio statistical analysis and packages for biological sciences and data interpretations and interference. Since the beginning of the century, the field of Biostatistics has become an indispensable tool in biological and medical sciences. The relevance of this course is to help chemistry graduates from Godfrey Okoye University to acquire knowledge and expertise which will enable them to effectively address various challenges encountered in biological and medical sciences as well as in public health practices. Chemostatics, as a field in information and communication technology, is crucial to achieving sustainable development and empowering our students (SDG 9).

Overview

Chemostatistics is the application of statistical techniques to scientific research in the health related fields, including public health, medical and chemical sciences. The purpose of this course is to teach Chemistry students the fundamental concepts and techniques of descriptive and inferential statistics with applications in chemical and medical sciences and public health.

The training of students in this field will enable them to acquire knowledge and skills that will be needed to transform data into useful information. Knowledge of chemostatistics is essential for understanding and interpretation of modern scientific literatures and active participation in the global research enterprise. Data is so crucial in the research field and processing that data spurs innovations in new treatments and medicines. It also helps the researcher to better predict the outcomes of public health issues and could even teach on how to see the beginnings of problems before they become a public health crisis. Chemostatisticians are at the forefront of using big data to the advantage of human health.

Objectives:

The objectives of the course are to:

i. State and explain the principles of Chemostatistics.
ii. Explain the concepts of frequency distribution sampling and experimental design.
iii. Determine the level of confidence in a given chemical data.
iv. Compute correlation and regression.
v. Define analysis of variance (ANOVA) and test statistical hypothesis using ANOVA
vi. Explain the application of statistical methods and tools in chemical, biological and medical sciences.

Learning Outcomes

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

i. Explain the principles of Chemostatistics.
ii. Describe the appropriate application and limitations of hypothesis testing and regression methods.
iii. Describe the appropriate graphical or tabular display for a given data set.
iv. Explain which statistical methods is/are most appropriate to analyze a given data.
v. Analyze a given data using fundamental statistical methods.
vi. Draw conclusions from statistical analysis and place them into the appropriate public health concepts.

Course Content

Course Contents

Introduction to statistical methods used in biological and medical research. Basic principles of Biostatistics. Frequency distribution and sampling. Experimental design. Analysis of variance. Estimation and hypothesis testing. Correlation and regression. Elementary probability theory. Basic concepts of statistical inference. Regression and correlation. Level of confidence in biological data. Methods and sample size estimation. Statistical methods most appropriate to analyze a given data. Graphical or tabular display for a given data set. Biostatics applications to medical problems. Use of statistical packages. Conclusions from statistical analysis into the appropriate public health concepts.

Minimum academic standard: Classroom**s,** computer sets installed with SPSS applications, library collections.

Minimum Academic Standards

Equipment

Every university teaching laboratory should be equipped with a wide range of specialist facilities including:
State-of-the-art synthetic labs for project work.
Dedicated NMR spectrometer for exclusive use by undergraduates.
A suite of dedicated analytical instrumentations.
The undergraduate teaching labs should also have HPLC and HPLC-MS instruments to help in learning the fundamentals and applications of measurement and of separation science. UV Spectrophotometers and a suite of infra-red spectrometers for measuring solids, liquids and gases.
Students should also have access to:
Open access research laboratories for Separations, EPR, NMR and Mass Spectrometry.
Cutting-edge X-ray diffractometers, Susceptibility Machines, Elemental Analysis machines, Analytical weighing balances, Electrochemical Impedence spectroscopy, Overhead tanks, Fume cupboards and glasswares.
Research Computing Facility to support teaching & learning in computational and theoretical science.

List of Equipment

Item	Quantity
Calorimeter Model: C 200	1
Differential Scanning Calorimeter (DSC) Model: DSC 1| -150 … 700 °C	1
Digital Laboratory Hot Plate Magnetic Stirrer Model: RET basic IKAMAG®	10
Digital Refractometer Model: ATR-B TOUCH	1
Distillation Unit Apparatus Model: UDK 149 - Automatic steam distillation system	1

Course Contents

Drying Oven Model: Turbo-Fan Drying Oven 230V	10
Electronic Balance Model Number: JA103H	10
f2271 Ice-making machine	2
Fourier Transform Infrared (FTIR) Spectrometer	1
Freeze Dryer Model: Christ Beta 2-8 LD Freeze Dryer	3
Fume Chamber, Laboratory Fume Hood	1
Laboratory pH Meter -2 ... 20 pH, ± 2 000 mV | PP series	10
Melting Point Apparatus Model: VMP–PM	10
Multiskan™ GO Microplate Spectrophotometer with cuvette	1
Polarimeter Model: AUTOPOL VI	1
Rotary Evaporator Model: R-210/R-215	3
Soxhlet Extraction Apparatus with Energy Regulator	3
TLC adjustable spreader	20
TLC Chromatographic Tanks	20

Laboratories

Preparation room, store and technologists' office are to be provided in all conventional laboratories.

Instrumentation Laboratory - conventional laboratory with full complement of utilities and adequate workstations to accommodate 30-50 persons

General Chemistry Laboratory - conventional bench laboratory with full complement of utilities and adequate workstations to accommodate 100 persons

Physical Chemistry Laboratory - conventional bench laboratory with full complement of utilities and adequate workstations to accommodate 50-100 persons.

Research Laboratory - conventional bench laboratory with full complement of utilities and adequate workstations to accommodate 25-50 persons.

Inorganic Chemistry Laboratory - conventional bench laboratory with full complement of utilities and adequate workstations to accommodate 50-100 persons.

Organic Chemistry Laboratory - conventional bench laboratory with full complement of utilities and adequate workstations to accommodate 50-100 persons.

Integrated Laboratory - conventional bench laboratory with full complement of utilities and adequate workstations to accommodate 200- 300 peoples.

Staffing

Academic Staff

The guidelines on academic staff/student ratio of 1:20 for Science Programmes shall apply. To start any programme in science, there should be a minimum of six

academic staff. There is need to have a reasonable number of staff with PhD degrees accounting for at least 70% of the total number and having adequate teaching experience for every programme in the Discipline.

Administrative Support Staff

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

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshops, are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance.

Classrooms, Laboratories, Workshops and Office Space The NUC recommends the following physical space requirements:

Description		**Size m^2**
Professor's Office	-	18.50
Head of Department's Office	-	18.50
Tutorial Teaching Staff's Office	-	13.50
Other Teaching Staff Space	-	7.00
Technical Staff Space	-	7.00
Secretarial Space	-	7.00
Research Laboratory	-	16.50
Seminar Space/per student	-	1.85
Laboratory Space per FTE	-	7.50
Conference Room	-	37.0

Library

Universities should leverage on available technology to put in place rich databases and other electronic/digital library and information resources. In addition, well stock and current hardcopies of reference and other textual materials should be provided centrally at the level of the faculty. A well network digital library should serve the entire university community. Availability of wireless facilities (Wifi) with adequate bandwidth should enhance access to these electronic resources.

In any case, there should be internet ready workstations available in the library for least 25% of the total student enrolled in each academic programme. The funding of the library should be in line with NUC guidelines.