GODFREY OKOYE UNIVERSITY
ENUGU, ENUGU STATE, NIGERIA
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B.S. ED CHEMISTRY EDUCATION

The Core Curriculum Minimum Academic Standards (*CCMAS*)

September, 2023.

Overview

The B.Sc. Ed. Chemistry Core Curriculum and Minimum Academic Standards (CCMAS) was designed for use in all Nigerian universities for the training of digitally sound and 21st century compliant Chemistry teachers. Benefitting from available textual materials and resources from the chemical environment and in tandem with global curriculum trends, the current programme promises to produce effective Chemistry teachers for schools. The B.Sc. Ed. Chemistry CCMAS is made up of General Studies courses, core faculty courses and departmental courses, all organized into four academic sessions of a two-semester arrangement per session. The individual course learning outcomes and contents are also laid out to guide instructional delivery. It is hoped that each university will generate other relevant courses based on their peculiar needs and mandate, to make up for the minimum 120 units required for students' graduation.

Philosophy

The philosophy of the B.Sc. Chemistry Education programme is to produce chemistry teachers who have sound content knowledge and pedagogical skills for the effective and efficient teaching and learning of the subject in secondary schools. Emphasis is placed on scientific skills in such a way that procedural knowledge and conceptual knowledge are treated as compliments, not as opposites. To this end, the development of both theoretical and practical knowledge of chemistry is considered vital for a holistic knowledge of chemistry education.

Objectives

The objectives of the B.Sc. Chemistry Education programme are to:

1. impact in students the necessary teaching and practical skills for teaching Chemistry;
2. develop effective and reflective chemistry teaching skills in students;
3. inculcate necessary chemistry laboratory practical skills in students;
4. mentor students towards becoming effective and efficient classroom teachers in chemistry;
5. expose students to industrial applications of chemistry;
6. equip teachers with skills for student exposure to industrial applications of chemistry;
7. facilitate in students, acquisition of the ethics of teaching as a profession;
8. produce professional science teachers;
9. build students' capacities for disseminating information in Chemistry education to the society;
10. develop positive values and attitudes for efficient discharge of duties as chemistry teachers.
11. provide pre-service teachers with knowledge in national discourses as they relate to the chemical environment, effective utilization of chemical resources and conservation. 12. provide students with skills for disseminating chemical information to the society;
14. inculcate in students, efficient skills for the communication of the nature of science and its relationships with technology and society.
15. develop positive values and attitudes for efficient discharge of duties as chemistry teachers.

Unique Features of the Programme

The unique features of the programme include:

1. increase in the proportion of students' chemical subject matter knowledge in relation to teaching skills;
2. development of higher capacity for practical skills in the graduates;
3. inculcation of digital skills in graduates for planning and managing virtual instruction;
4. facilitation of pre-service teachers' entrepreneurial knowledge, attitudes and skills; 5. development of science process/manipulative skills in the pre-service teachers; and
6. inculcation of scientific literacy in the graduates for solving societal problems.

Employability Skills

The graduate of B.Sc. Ed. Chemistry should be equipped with the following employability skills, among others:

1. chemistry Teaching: Graduates would acquire necessary content knowledge and pedagogical shills for the effective teaching of Chemistry in schools;
2. skills for Establishment and Management of Schools: Graduates would be able to establish and effectively manage secondary schools;
3. design and Management of School Laboratory: Skills for the design, equipment and management of school science laboratory would be sharp in the graduates;
4. IT Skills: Graduates would acquire necessary skills for the development of e-resources for effective chemical education in this world of information and communication technology;
5. skills for Instructional Material Development: Students' capacity would be developed for locally sourcing and designing of instructional materials for chemistry and science teaching;
6. capacity for Waste Management: Environmental and waste management services could be provided by graduates. They would be able to set up business ventres for collection, sorting, reuse and recycling of wastes and turning waste to wealth;
7. skills for Cleaning and bleaching solutions: Chemistry education graduates would have capacity to establish and successfully run cleaning business outfits for institutions, companies and homes; and
8. manufacture of Sundry Chemical Products: Graduates would be able to manufacture potable water, distilled water, pomade, shoe polish, school chalk from gypsum as well as ethanol and paints from local materials.

21st Century Skills

The B. Sc. Ed. Chemistry CCMAS would develop the following 21st century skills:

1. quantitative reasoning ability;
2. problem solving skills;
3. digital skills;
4. self-reliance and ability to take initiative;
5. critical and creative thinking abilities;
6. research and interrogative questioning skills; 7. creativity, curiosity, imagination, innovation skills; and
8. health and safety skills.

Admission and Graduation Requirements

Admission Requirements

Four Year Programme

In addition to acceptable scores in UTME, candidates must have obtained five Senior Secondary Certificate (SSC) credit passes which must include English Language, and Mathematics, Chemistry and Physics with credit in one other relevant science subject. Agricultural Science and Geography at not more than two sittings.

Direct Entry Mode

Five SSC (or equivalent) credit passes in relevant subjects, two of which are at the Advanced Level such like:

A pass at merit level in a relevant Diploma Programme (provided the O/L requirements are satisfied).

Passes in Chemistry and any of Biology, Physics, Agricultural Science or any other science subject at the Advanced level.

Passes in Chemistry and any of Biology, Physics, Integrated Science or any other science subject at the NCE.

Passes in Chemistry and any of Biology, Agriculture, Physics or any other science subject at the IJMB (Interim Joint Matriculation Board) examination or Cambridge Moderated Schools of Basic Studies Terminal Examinations or International Baccalaureate from a recognized institution.

Graduation Requirements

In addition to the general requirements for graduation at the University, students must offer and pass courses totalling 120 credit hours, 60 of which must come from the relevant option areas in Chemistry and Science Education for the four-year programme. They must also complete and receive a pass grade in teaching practice and a research project report on a topic approved by the Department.

Global Course Structure

100 LEVEL

Course Code	Course Title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Logic, Philosophy and Human Existence	2	C	30	
EDU 101	Introduction to Teaching and Foundations of Education	2	C	30	
BIO 101	General Biology I	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
MTH 101	General Mathematics I	2	C	30	-
MTH 102	General Mathematics II	2	C	30	-
COS 101	Introduction to Computer Science	3	C	30	45
PHY 101	General Physics I	2	C	30	-
PHY 107	General Physics Practical I	1	C	-	45
GOU-EDU 103	Sociology of Education in South East Nigeria	2	C	30	0
GOU-SED 121	Basic Science Education 1	2	C	15	45
GOU-SED 122	Basic Science Education II	2	C	15	45
GOU-SED 123	Foundation & Perspective in Chemistry Education	2	C	30	0
	TOTAL	**34**			

200 LEVEL

Course Code	Course Title	Units	Status	LH	PH
GST 212	Nigerian Peoples and Culture	2	C	30	
ENT 211	Entrepreneurship and Innovation	2	C	15	45
EDU201	Curriculum, Curriculum Delivery and Teaching Methods	2	C	30	
STA 202	Statistics for Physical Sciences & Engineering	2	C	30	-
CHM 207	General Chemistry Practical III	1	C	-	45
CHM 208	General Chemistry Practical IV	1	C	-	45
CHM 210	Physical Chemistry I	2	C	15	45
CHM 211	Organic Chemistry I	2	C	15	45
CHM 212	Inorganic Chemistry I	2	C	15	45
CHM 213	Analytical Chemistry I	2	C	15	45
CHM 214	Structure and Bonding	2	C	30	-
GOU-EDU 202	Innovative Approaches to microteaching in Enugu	2	C	15	45
GOU-EDU 211	Career Guidance on job opportunities for learners living	2	C	30	0
GOU-SED 222	Introduction to Chemistry Education	2	C	15	45

GOU-SED223	Theoretical Consideration in Chemistry Education	2	C	15	45
	TOTAL	28			

300 LEVEL

Course Code	Course Title	Units	Status	LH	PH
GST 312	Peace and Conflict Resolution	2	C	30	
ENT 312	Venture Creation	2	C	15	45
EDU 301	Teaching Practice I	3	C		135
EDU 302	Educational Measurements, Tests, Research Methods and Statistics	2	C	30	
CHM 301	Physical Chemistry II	2	C	15	45
CHM 302	Inorganic Chemistry II	2	C	15	45
CHM 303	Organic Chemistry II	2	C	15	45
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		
GOU-EDU 303	Psychology of Teaching and Learning	2	C	30	0
GOU-EDU 305	Local Educational Resources for Teaching and Learning	2	C	30	0
GOU-SED 321	Laboratory Techniques in Chemistry Education	2	C	15	45
GOU-SED 322	Research designs in Chemistry Education	2	C	15	45
	TOTAL	36			

400 LEVEL

Course Code	Course Title	Units	Status	LH	PH
EDU 400	Project	3	C		135
EDU 401	Teaching Practice II	3	C		135
CHM 406	Reaction Kinetics	2	C	30	-
CHM 410	Analytical Chemistry II	2	C	15	45

CHM 423	Organometallic Chemistry	2	C	30	-
CHM 424	Co-ordination Chemistry	2	C	30	-
GOU-EDU 403	Ethno Pedagogy and curriculum of non- school environment	2	C	30	0
GOU-SED 421	Media in Chemistry Education	3	C	45	0
GOU-SED 422	Out of classroom /laboratory Chemistry	2	C	15	45
GOU-SED 423	Environmental Contamination and Waste Management for Chemistry Education Students	3	C	45	0
GOU-SED 424	Curriculum in Science Education	2	C	30	0
	TOTAL	24			

Course Contents and Learning Outcomes

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

Learning Outcomes

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

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

Course Contents

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 and Note making. 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

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 Nigerianpolitics; Nigerian Civil War). Concept of trade and economics of selfreliance (indigenous trade and market system; indigenous apprenticeship system among Nigeria people; trade, skill acquisition and self-reliance). 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. Reorientation 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.

EDU 101: Introduction to Teaching and Foundations of Education
(2 Units C: LH 30)

Learning Outcomes

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

1. state the important roles of teaching as a profession;
2. raise and judge some ethical issues in education;
3. list the intellectual and practical competencies required by the teacher;

4. justify the need for education in the development of a nation,
5. give an account of the history of education from ancient times to the present day modern education in nigeria;
6. present an overview of the National Policy on Education;
7. identify the stages of child and adolescent development;
8. state the behaviourist, cognitive and socio-cultural perspectives of learning;
9. enumerate historical and current developments in sociology of education; and
10. highlight the historical and current developments in philosophy of education.

Course Contents

Teaching as a profession. Ethics of the teaching profession. Intellectual and practical competencies required by the teacher. Link between education and development. Educational development from ancient times to the present with particular reference to the evolution of modern education in Nigeria. The National Policy on Education. Brief treatment of learning theories from the behaviourist, cognitive and sociocultural perspectives. Child and adolescent development. Historical and current developments in philosophy of education. Historical and current developments in sociology of education

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

Learning Outcomes

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

1. explain cells 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 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.**

CHM 101: General Chemistry I (3 Units C: LH 45)

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 Le Chatelier'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 (3 Units C: LH 45)

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 reaction;
7. identify classes of organic functional group with brief description of their chemistry; 8. discuss comparative chemistry of group 1a, IIa and IVa elements; and
9. describe basic properties of transition metals.

Course Contents

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

CHM 107: General 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. tell 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.

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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. execute solubility tests on known and unknown organic compounds;
6. execute 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

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

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precession. Gravitation: Newton's Law of Gravitation. Kepler's Laws of Planetary Motion. Gravitational Potential Energy. Escape velocity. Satellites motion and orbits.

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 and others, 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.

MTH 101: Elementary Mathematic I (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to

1. present 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 (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to

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1. explain types of rules in Differentiation and Integration;
2. give 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.

COC 101 Introduction to Computer Science (3 Units C: LH 30; PH 45)

Learning Outcomes

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

1. trace historical development of computing to the current programmes in the discipline;
2. distinguish the salient characteristics of the different programmes of the computing discipline;
3. identify the roles and applications of computers and computing in different areas of human endeavor;
4. identify and explain the basic components of a computer system;
5. develop basic literacy on the use of computer systems;
6. develop competence on the use of common office productivity applications; and
7. make purposeful use of the Internet for information gathering, learning and continuous professional development.

Course Contents

History of computing sciences leading to the different programmes in the discipline. Characteristics of each programme in computing sciences. Hardware, Software; and human resources; Integration and application in business and other segments of society. Information processing and its roles in society. Students will be required to complete lab assignments using the PC's operating system, and several commonly used applications, such as word processors, spreadsheets, presentations, graphics and other applications. Internet and on-line resources, browsers and search engines.

GOU-SED 121: Basic Science Education I (2 Units; Compulsory; LH=15; PH = 45)

Senate–Approval Relevance

A good teacher is expected to be sound in knowledge of the content in his chosen field of specialization as well as being versed in pedagogical competencies needed for effective instructional delivery. It is therefore important that students of Chemistry Education and, indeed, all science subjects be given adequate training in the course of their University Education to enable them discharge their duties creditably when employed as teachers. This

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includes, but not limited to exposing them to the various methods and strategies for effective teaching of Chemistry. This is actually in line with the mission of Godfrey Okoye University which is the production of graduates with the knowledge, skills and competencies that will enable them to fit into the world of work and also be useful to themselves in self-employment, as the need arises.

Overview

Effective science teaching entails the science teacher's procession of knowledge of subject matter as well as the pedagogical competencies needed for instructional delivery. It is however worrisome to note that in the Chemistry Education Programme of GO-University students, on graduation, have adequate knowledge and practical skills in Chemistry, but do not seem to possess the pedagogical skills needed for effective teaching of Chemistry at the secondary school level arising from insufficient exposure to both traditional and innovative methods of teaching the subject.

In view of the foregoing, the need arises for inclusion of the course, "Special Methods in Science Education" in the Chemistry Education Programme of the University. This will help in filling the identified gap in the training given to the students which will ultimately lead to their improved performance as teachers when they get employed after graduation.

Objectives

The objectives of the course are to;

1. Explain science teaching methods.
2. Explain the following innovative teaching strategies, describing vividly how best to apply each of them in teaching/learning process.
3. Discuss Concept mapping.
4. Explain Cooperative learning.
5. Discuss Computer Assisted Instruction (CAI).
6. Explain Target Task Approach.
7. Distinguish between traditional teaching methods and innovative teaching strategies.

Learning Outcomes

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

1. Explain two science teaching methods.
2. Explain the following innovative teaching strategies.
3. Describe Concept mapping.
4. Explain Cooperative learning.
5. Discuss Computer Assisted Instruction (CAI).
6. Explain Target Task Approach.
7. Distinguish between traditional teaching methods and innovative teaching strategies.

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Course Content

Traditional Science Teaching Methods: Lecture method-its features and application. Demonstration method – features and application. Discussion method – features, merits and demerits. Project method – features, merits and demerits. Inquiry method. Laboratory method. Discovery method. Field trips – planning, implementation, merits and demerits. Innovative Teaching Strategies: Concept mapping – meaning, organization, merits and demerits. Cooperative learning – features, merits and demerits. Computer – Aided Instruction (CAI). Simulation/Animation. Target Task Approach. Scaffolding. Challenges associated with the use of traditional science teaching methods. Challenges associated with the use of innovative science teaching strategies. Comparison between traditional and innovative teaching methods/strategies.

Minimum Academic Standard

- Exposure of students to micro-teaching
- Chemistry laboratory of the department of industrial chemistry of GO-University

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GOU – SED 122: Basic Science Education II (2 Units; Compulsory; LH = 15; PH = 45)

Senate – Approved Relevance

The production of sound graduates in any field of study requires that a very solid foundation be put in place for the students so as to prepare them for higher and more rigorous studies in their various discipline. This is actually in tandem with the philosophy of Godfrey Okoye University which is the production of high quality graduates with requisite skills and competencies needed for their optimal performance either as employees or employers of labour. This also agrees with Sustainable Development goal of No. 2 which is geared towards production of well-educated citizens who are grounded in Science Technology and Innovation (STI).

Overview

The need to provide adequate foundation for undergraduates in various disciplines cannot be overemphasized. Doing so will make it possible for students to seamlessly pursue their courses of study without any missing link.Related to this is the fact that Chemistry Education students of Godfrey Okoye University lack the foundation needed for them to make steady progress in their course of study and subsequently be enabled to distinguish themselves as chemistry educators on graduation.

Experience, over the years, has also shown that Chemistry Education students of the University, in their penultimate and final years, do not do well in Teaching Practice simply because they lack the necessary foundation for effective teaching of chemistry at the secondary school level. The inclusion of the course, "Basic Science Education" in the Chemistry Education Curriculum of the university is, therefore, an attempt to fill the identified gap in the training programme presently being provided for the students.

Objectives

The objectives of the course are to:

1) Explain the concepts of mater, kinetic theory of matter, Gas Laws.
2) Explain molecular and empirical formulae of compounds and molecules and carry out related calculations.
3) Determine oxidation numbers of elements in compounds.
4) Explain Avogadro number/Avogadro constant and the mole concept and perform allied calculations.
5) Explain the concepts of rates of chemical reactions and chemical equilibrium.
6) Demonstrate the concept of isomerism in relation to hydrocarbons.
7) Solve some mathematical problems relating to the gas laws.

Learning Outcomes

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

1. State at least three postulates of the kinetic theory of matter.
2. Write the electronic configuration of a named element using the orbital method.
3. Determine the molecule or compound that is oxidized in a given redox equation using changes in the oxidation numbers of some of the constituent elements.
4. State a given gas law and stating the appropriate equation for the law and showing its graphical illustration and solve a numerical problem relating to a given gas law.
5. Solve at least two mathematical problems relating to a named gas law.
6. Define the term "homologous series", giving at least two examples.
7. Define the term "isomersion" as it relates" to organic compounds.

Course Content

Concept of matter and particulate nature of matter. Kinetic theory of matter and its postulates. Gas laws – Introduction. Boyles law and Charles law, mathematical expression or equation and graphical illustration for each of them. General gas law and derivation of its formular from Boyle's and Charles laws. Calculations involving Bayle's law, Charles law and general gas law. Avogadro's law, Gay Lussa's law and Grahams; law and their allied calculations. Concepts of oxidation and oxidation number. Rules guiding the determination of oxidation number and their application. Concept of periodic table and periodicity of properties down a group and across a period in the periodic table. Chemical bonding – meaning and types. Using the atomic numbers of elements to determine their electronic configurations using the orbital system. Determining the type of bond that should exist between elements based on their electronic structures. Avogadro number/Avogadro constant and stoichiometric calculations involving Avogadro's constant. Concept of rates of chemical reaction and chemical equilibrium (simply treated). Concept of equilibrium constant and its determination. Carbon and its allotropes. Hydrocarbons – types (aliphatic and cyclic) their formulae and molecular structures. Concept of homologous series as it relates to hydrocarbons. Characteristics of a homologous series. Isomerism – meaning and types, as well as nomenclature of isomers using the IVPAC system.

Minimum Academic Standard

- Periodic table of elements.
- Charts showing graphical illustration of some gas laws.
- Molecular models of some alkanes, alkenes and alkynes.

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GOU-SED I23: Foundations and Perspectives in Chemistry Education (2 Units; Compulsory; LH = 15; PH = 45)

Senate – Approved Relevance

As chemistry educators, we should constantly reflect on the central concepts and ideas that we want our students to understand, and on the best ways in which such understandings can be developed and demonstrated. However, engaging in critical reflection and action in chemistry education may be challenging in the face of strong traditions on how courses should be taught. In this rather conservative environment, alternative educational perspectives are often marginalized but are sorely needed to motivate discussion and diversify the views of those who approach teaching as an exploration rather than as a prescription. This aligns with the mission of Godfrey Okoye University to produce graduates who engage in critical dialogue with the environment and society.

Overview

The importance of science education involves the teaching of students at all levels have given rise to a lot of problem in human activities arising from homes, schools' industries and other commercial ventures

The need, therefore, raises the worry to impart Chemistry Education Students of the higher institutions and universities very well as to give society successfully also.

Objectives

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

1. Explain the role and importance of science education.
2. Explain the difference between science and science education.
3. Explain the difference between science curriculum and science education.
4. Explain how to prepare lesson plan in science education.
6 Describe the process of preparing lesson plan.
7 Discuss the problems of Science Education.

Learning Outcomes

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

1. Differentiate between science teacher and non-science teacher.
2. Define Curriculum.
3. Write effective lesson plan.
4. Explain the difference between science and science education.
5. Explain what is meant by course content.
6. Explain the term curriculum evaluation.
7. Explain the problems of science education.

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Course Content

Meaning of science, Science Education. Science instruction. Scientific method. Aspiration of science. Limitations of science. The scientists. History of science education in Nigeria. Objectives of teaching science. Objective of learning science. Scientific process, Science technology. Science laboratory Science inventory. Science Fair. Science exhibition. Scientific principles. Science corner. Science process skill.

Minimum Academic Standard

- Visit to Science laboratory.
- Visit to Science exhibition
- Visit to Science Fair.

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;
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.

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

Learning Outcomes

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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. analyze 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). 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.

EDU 201: Curriculum, Curriculum Delivery and Teaching Methods (2 Units C: LH 30)

Learning Outcomes

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

1. explain at an appropriate level of confidence the meaning and types of curriculum;
2. describe the process of curriculum development;
3. analyse and critque the Nigerian Core curricula as guide to curricula delivery;
4. use different methods in the delivery of curriculum content;
5. identify local context and the use of CTCA in the Nigerian context;
6. plan and schedule lessons as well as monitor and evaluate the outcome of each lesson; 7. identify and use learning resources and media and improvise, whenever necessary;

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8. manage classrooms under different conditions and address the needs of individual students, especially, those with special needs including the gifted; and
9. demonstrate skills in ICT, set up and manage online classes.

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Course Contents

Definition and types of curriculum. The curriculum development process. The Nigerian core curricula. Curriculum delivery to include general teaching methods and strategies: lecture, class discussion, demonstration, problem-solving, cooperative learning and guided-discovery, concept mapping, metacognition, argumentation, project-based learning, competency-based learning, culturo-techno-contextual approach (CTCA). Developing the lesson plan/note. Assessment of learning. Resources for teaching, improvisation. General classroom management. Teaching in a 21st century classroom. Setting up and managing online classes. Attending to students with special needs.

SED 202: Chemistry Methods I (2 Units C: LH 15; PH 45)

Learning Outcomes

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

1. distinguish among aims, goals and objectives in science education;
2. briefly trace the history and development of chemistry education in schools;
3. justify the relevance of the study of chemistry;
4. describe the layout, guiding principles, organisation and the contents of the SSS chemistry curriculum;
5. define and explain the concepts of pre-active and interactive teaching and how these contribute to teaching effectiveness;
6. write lessons plans on chemistry concepts;
7. state the roles of the laboratory in effective chemistry education;
8. use a variety of contemporary methods to teach chemistry;
9. define basic terms used in the evaluation of chemistry students' learning;
10. list and use resources for chemistry teaching and learning;
11. improvize instructional materials required for chemistry teaching;
12. discuss challenges of science teaching generally and the problems confronting chemistry education in Nigeria specifically; and
13. participate in micro-teaching sessions for the demonstration of teaching skills and teaching methods.

Course Contents

Aims, goals and objectives in science teaching. The teaching of chemistry in schools and the relevance of the subject. Critical analysis of the SSS chemistry curriculum. Pre-active and interactive teaching in chemistry. Lesson planning and preparation. Laboratory innovations in chemistry teaching. Contemporary methods of teaching chemistry. Test, measurement and evaluation of chemistry learning. Resources for chemistry teaching and learning. Improvisation of instructional materials. Challenges of science teaching and problems confronting chemistry education in Nigeria. Micro-

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teaching sessions for the demonstration of teaching skills and teaching methods learnt.

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. be able to understand 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, negative-binomial, 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, negative-binomial, 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.

CHM 207: General Chemistry Practical III (1 Unit C: LH 15; PH 45)

Learning Outcomes

After completing the 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 others;
5. determine the critical solution temperature of water-Phenol system; and
6. measure the molar volume of a gas and universal gas constant.

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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: LH 15; PH 45)

Learning outcomes

After completing the course, the students will be able to

1. identify general laboratory rules;
2. describe the processes involved in 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.

CHM 210: Physical Chemistry I (2 Units C: LH 15; PH 45)

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 and others, 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;

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7. design and plan an investigation by selecting and applying appropriate practical, theoretical, and/or computational techniques or tools; and
8. state 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

Pre-requisite –CHM 101

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 15; PH 45)

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;
4. explain he mechanisms of substitution, elimination, addition and rearrangement reactions.
5. v. 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

Pre-requisite – CHM 102

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 such as Grignard reaction, Aldol and related reactions. Simple alicyclic carbon compounds and their synthesis.

CHM 212: Inorganic Chemistry I (2 Units C: LH 15; PH 45)

Learning Outcomes

After completing the course, the students will 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. given 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. give examples of 9 above;
11. explain oxidation and reduction reaction; and 12. illustrate the above (11) with appropriate reactions.

Course Contents

Pre-requisite – CHM 101; CHM 102
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 15; PH 45)

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

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Pre-requisite CHM 101 and 102

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

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

Learning Outcomes

After completing the 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

Pre-requisite CHM 101 and 102

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.

GOU-EDU 202: Innovative Approaches to Micro-teaching in Enugu Socio-cultural Milieu (2 Units; Compulsory; LH = 15; PH = 45)

Senate-Approved Relevance

Proper preparation of professional teachers with adequate and useful knowledge, skills methods, values and initiative is important in Enugu socio-cultural environment. Godfrey Okoye University exists in this socio-cultural milieu to impart quality knowledge to the teeming youths in this part of the country who are desirous of education. This course is meant to help student teachers to acquire the right method, techniques and confidence which will enable them to teach their students effectively. This is in line with the epistemic dialogue that Godfrey Okoye University is anchored on. Therefore, student teachers who acquire skills, confidence and knowledge in this course can easily impact knowledge to secondary school students using various and relevant methods in teaching any topic and can easily give extra classes (that is as lesson teachers). This is also in line with the entrepreneurial mindset of Godfrey Okoye University, Enugu, Nigeria.

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Overview
Poor performance of students in almost all standardized examinations in both primary and secondary schools call for the need for the development of the course. Recently there is an outcry from the public about this falling standard of education and it is believed that if student teachers acquire confidence and effective methods of teaching it will improve their efficiency in imparting knowledge. This creates the need for proper attention on the teaching methods acquired by student teachers.

The course includes topics such as innovative pedagogy, peer and microteaching. During the course, students will be guided on innovative ways of preparing lesson plan and lecture notes; to develop their educational potentials and desired learning outcomes. The course will expose the student teachers to peer teaching and self-appraisal that will lead them to become effective professional teachers.

Objectives
The objectives of this course are to:

1. Justify the relationship between innovative pedagogy, peer teaching and microteaching.
2. Discuss the concept of peer teaching.
3. Explain the concept of micro-teaching.
4. Describe the process of teaching in a micro-teaching laboratory.
5. Outline the role of instructional methods and instructional materials in micro-teaching.
6. Explain how to write a lesson plan/note.
7. Recognize the different skills in micro-teaching.
8. Analyze supervisory skills and their usefulness in teaching and learning.
9. Illustrate a micro-teaching practicum.
10. Apply pedagogy of peer and micro-teaching in extra classes.

Learning Outcomes
By the end of this course, the student should be able to:

1. Define innovative pedagogy.
2. Give the meaning of peer teaching.
3. Explain the concept of micro-teaching.
4. Discuss micro-teaching and its relevance to teacher education
5. Describe ten importance of peer teaching and micro-teaching.
6. Select five teaching skills involved in teaching objectives
7. Draw out micro-teaching practicum.
8. Describe five teaching methods.
9. Discuss the preparation of a lesson plan.
10. Describe micro-teaching supervisory skills.
11. Explain professionalism in relation to extra classes.

Course Content
Definition of innovative pedagogy. Meaning of peer teaching. Explanation of the concept of micro-teaching. Micro-teaching procedure. Explanation of micro-teaching. Relevance of micro

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teaching to teacher education. Importance of micro-teaching to student teacher education. Teaching skills involved in teaching objectives. Teaching methods relevant to teachers' education. Instructional materials. Lesson plan. Lesson note. Classroom control. Classroom management. Micro-teaching supervisory skills. Micro-teaching practicum. Laboratory activities. Teaching as a profession in Nigeria.

Minimum Academic Standards

1. Micro-teaching Laboratory.
2. Video tape.
3. Projectors.
4. Computers (1:1 student).
5. Other NUC-MAS requirement facilities.

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GOU-EDU 211: Career Guidance for Learners in Enugu Socio- Cultural Environment (2 Units; Compulsory; LH = 15; PH = 45)

Senate -Approved Relevance
Sufficient training of professional career guidance teachers with deep knowledge, skills and positive attitudes is a need in this local environment; Enugu State, where Godfrey Okoye University is situated. This course is meant to help prospective teachers to reach out to those living on the margins, and help them attain their full career potentials or fulfilment in life. Therefore, apart from teaching in formal classroom setting, student teachers who acquire skills and knowledge in this course can easily become home career guidance and own their career guidance centres eventually. This is in consonant with the entrepreneurial mindset of Godfrey Okoye University.

Overview
The intellectual climate from which guidance emerged as an important activity in education is based on the continuous poor performance of students in examinations in both primary and secondary education, social ills, and lack of employment opportunities. More, so, the inability of the education sector to attain to the career guidance needs of those living on the margins in Enugu socio-cultural environment. This calls for the need of the design of this course. Many a time, parents have no time to oversee the academic assignments of their children. This creates the need for proper career guidance in the educational needs of their wards.

This course is designed to enable the prospective teachers to acquire the needed knowledge and skills that will help them to develop their educational potentials, and acquire the desired learning outcomes in guidance and counselling with special emphasis on career guidance to their students and to those living on the margins in Enugu socio-cultural environment. It will give the prospective teachers the opportunity to reach out to many young people on the margins who have no opportunity for proper career guidance. In addition, it will expose the student teachers on the need to own and manage their own guidance and counselling centres and become employers of labour.

Objectives
The objectives of this course are to:
1. Explain the concept of career guidance.
2. Discuss different careers in Enugu socio-cultural environment.
3. Justify different methods of counselling.
4. Outline the role of different methods of counselling.
6. Explain the concept “living on the margins.”
5. Describe how counselling leads people to be self-reliant.
7. Identify the need for innovation in counselling that will lead to student teachers being self- reliant.

Learning Outcomes
By the end of this course, the student should be able to:
1. Define career guidance.
2. Identify at least four career opportunities in Enugu socio-cultural environment.
3. Discuss the relationship between guidance and counselling.
4. Justify the concept of counselling.

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5. Discuss at least two methods of counselling
6. Draw out the relationship between marginalisation and counselling.
7. State the need for career guidance and counselling in schools.
8. Organize group career guidance and counselling in at least five schools.

Course Content

Meaning and Definition of Guidance. Meaning and Definition of Counselling. Meaning of Guidance and Counselling. Relationship between Guidance and Counselling. History of the Introduction of Guidance and Counselling in Schools. Philosophical roots of Guidance and Counselling. Rational for counselling in schools. Careers in Enugu Socio- Cultural environment. Scope of counselling. Methods of Counselling. Various guidance services rendered in schools. . Various counselling services rendered in schools. Marginalisation and counselling. Types of guidance. Types of counselling. Approaches to guidance. Approaches to counselling.

Minimum Academic Standards

1. Guidance and Counselling Laboratory.
2. Videos.
3. Other NUC – MAS requirement facilities.

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GOU-SED 222: Introduction to Chemistry Education (2 Units: Compulsory; LH = 15; PH = 45)

Senate – Approved Relevance

Science Education is that area of knowledge that empowers man to have control over course of events and by so doing is able to avoid or solve the problems he encounters in his day to day interactions with his environment. It is a systematic and formulated knowledge governed by rules and theories derived from experiments. Science Education is a discipline that differs from non-science disciplines in a number of ways. A large percentage of implementers of science education curricula (teachers) are incompetent. The competent ones are few and inadequate. Training in science is different from training in science education. This means that the assumption that a Ph.D. in experimental science for instance is adequate preparation for science teacher is wrong. The experimental scientist is trained in science while a trained science teacher is trained in both science and pedagogy. The science teacher is trained to make correct choice of method, media and how to apply them to (students) to learn successfully. The relevance of this course lies in its agreement with the mission of Godfrey Okoye University's commitment to produce graduate teachers who are competent and equipped for the teaching profession.

Overview

The importance of science education involves the teaching of students at all levels have given rise to a lot of problem in human activities arising from homes, schools' industries and other commercial ventures

The need, therefore, raises the worry to impart Chemistry Education Students of the higher institutions and universities very well as to give society successfully

Objectives

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

1. Explain the place of Chemistry Education in science education.
2. Discuss two unique relevance of chemistry education.
3. Explain difference between science and science education
4. Explain the difference between chemistry education curriculum and the curriculum of other sciences.
5. Explain how to prepare lesson plan in chemistry science education
6. Describe the process of preparing lesson plan
7. Explain how the specific objective is needed in a lesson plan
8. Describe the importance of specific objective in a lesson plan.

Learning Outcomes

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

1. List the distinctive character of a chemistry education teacher.

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2. 2.Define the concept chemistry education Curriculum
3. Write a curriculum in chemistry education.
4. Explain what is meant by course content
5. Explain the term curriculum evaluation
6. Discuss the problems of science education
7. Explain the importance of specific objectives in a lesson plan.

Course Content

Meaning of science, Science Education. Chemistry Education and other sciences. Importance of Chemistry Education. Science instruction. Scientific method. Aspiration of science. Limitations of science. The scientists. The chemistry education teacher. History of science education in Nigeria. Objectives of teaching chemistry education. Objective of learning science. Scientific process, Science technology. Science laboratory Science inventory. Science Fair. Science exhibition. Scientific principles. Science corner. Science process skill.

Minimum Academic Standard

- Visit to Science laboratory.
- Visit to Science exhibition
- Visit to Science Fair.

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GOU-SED 223: Local Resources in Chemistry Teaching (2 Units; Compulsory; LH = 15, PH = 45)

Senate – Approval Relevance

As is the case with every other science subject, the teaching of chemistry should be activity-oriented, involving the use of various chemicals and equipment, most of which are very expensive and often lacking. This underscores the need for pre-service chemistry teachers to be groomed on how to improvise the unavailable instructional resources from their immediate environment or locality in order to be entrepreneurial and self-employed. This is in line with the mission of Godfrey Okoye University which is to ensure the production of highly skilled graduates who are not only employable within their locality, but can also become self-employed as budding entrepreneurs and employers of labour.

Overview

Chemistry, being a science subject, should be taught through minds-on and hands-on activities. For students to fully understand any topic or concept being taught, they have to be actively involved in practical activities. The reality on guard in mist secondary schools in Nigeria, Enugu State inclusive, is that most of the standard equipment and chemicals need for effective teaching and learning of chemistry are either inadequate or grossly lacking.

This course – local resources for chemistry teaching, is therefore an attempt to bridge the gap created by paucity of essential standard instructional resources. The need for use of such locally sourced materials becomes more compelling when one realizes that they are not only efficacious, but are relatively cheaper than the standard instructional materials.

Objectives

The objectives of the course are to;

1. Explain the need for use of local resources in chemistry teaching.
2. Explain the term improvisation, especially as it relates to chemistry instructions.
3. State the factors to consider before embarking on improvisation of standard instructional materials for chemistry teaching.
4. Enumerate the challenges associated with improvisation of resources for chemistry teaching.
5. State the procedures involved in improvisation of some named standard instructional materials.
6. State the chemistry topics that can be effectively taught using named locally sourced materials.
7. Enumerate ways of overcoming the challenges associated with improvisation of standard instructional materials for chemistry teaching.

Learning Outcomes

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

1. State at least two reasons why local resources should be employed in chemistry teaching.
2. Define the term improvisation as it relates to chemistry teaching and learning.
3. State any three factors that have to be considered by a resourceful chemistry teacher in the course of improvising materials for chemistry teaching.
4. List at least two constraints to effective use of improvised resources for chemistry teaching and learning.
5. Mention any two steps involved in the process of improvisation of instructional materials.
6. Product at least two improvised instructional materials from their immediate environment.
7. State at least two uses of a given improvised instructional materials in chemistry instructions.
8. Name at least three standard instructional materials and the improvised version of each.

Course Content

Meaning of local resources for chemistry teaching. Rationale for use of local resources. Meaning of improvisation. Types of improvised equipment for chemistry teaching. Improvisation of expendables for chemistry teaching. Improvisation involving modification of existing materials. List of standard equipment and materials that are difficult to improvise. Challenges associated with use of local resources in chemistry teaching. Overcoming the constraints to use of improvised resources. Skills needed for successful application of improvisation in chemistry teaching. Factors to consider before embarking on improvisation. Procedures in construction of improvised resources for chemistry teaching. Practical demonstration of procedures for improvisation of some modified equipment for chemistry teaching. Practical demonstration of steps needed for production of unmodified equipment. List of some locally sourced equipment and the chemistry topics they can be used to teach. Some locally sourced expendables and the chemistry topics they can be used to teach. Demerits associated with use of local resources.

Minimum Academic Standard

- Samples of one standard equipment and chemicals, such as beakers, reagent bottles, measuring cylinder, funnel, indicators, Bunsen burners, alkalis, acids (organic and inorganic), spatula, wash bottle, etc.
- Some local materials for improvisation of the standard instructional materials listed above; e.g. plastic water bottle, unripe orange, children's feeding bottle, spoon, malt bottle, etc.

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

Learning Outcomes

At the end of the 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; ZangoKartaf,
Chieftaincy and Land disputes. Peace Building, Management of Conflicts and Security: Peace & Human Development. Approaches to Peace & Conflict Management - (Religious, Government, Community Leaders and others). 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 – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution, ADR. Dialogue b). Arbitration, c). Negotiation d). Collaboration. 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;

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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, E-commerce business models and Successful E-Commerce Companies,). Small Business Management/Family Business: Leadership & Management, Basic book keeping, Nature of family business and Family Business Growth Model. Negotiation and Business communication (Strategy and tactics of negotiation/bargaining, Traditional and modern business communication methods). Opportunity Discovery Demonstrations (Business idea generation presentations, Business idea Contest, Brainstorming sessions, Idea pitching). Technological Solutions (The Concept of Market/Customer Solution, Customer Solution and Emerging Technologies, Business Applications of New Technologies - Artificial Intelligence (AI), Virtual/Mixed Reality (VR), Internet of Things (IoTs), Blockchain, Cloud Computing, Renewable Energy and others. Digital Business and E-Commerce Strategies).

EDU 301: Teaching Practice I (3 Units C: PH 135)

Learning Outcomes

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

1. knowledge of the subject matter;
2. the necessary pedagogical skills;
3. acquired understanding of child psychology;
4. the needed attitude towards teaching;
5. proper use of instructional facilities;
6. knowledge of individual differences in actual classroom situations and how
   to use this knowledge to assist children in real time; and

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7. effective classroom management skills.

Course Contents

Effective and responsive teaching practices and interactions are key for all learning in professional teacher preparation. The importance of teaching practice is to provide the students with an opportunity to apply their pedagogical knowledge and skills in practice. Therefore, the practical implementation of teaching and learning strategies in the classroom, as applied to the subject area, should be taught through micro-teaching before students embark on the exercise.

EDU 302: Educational Measurements, Tests, Research Methods and Statistics (2 Units C: LH 30)

Learning Outcomes

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

1. measure and assess learning outcomes and use the results in decision making and judgments;
2. identify the different domains of learning; develop and use appropriate instruments for measuring each;
3. identify the different kinds of data that can be yielded in different contexts and the appropriate statistical tool for analyzing each type of data;
4. explain the meaning, aim, types, role and processes of research in educational settings;
5. acquire communication skills and skills in reporting of research;
6. carry out hypothesis testing, and employ the knowledge of critical values and error in interpretation of results and making of inferences;
7. gain skills in the use of IBM-SPSS and other relevant packages in the analysis of data; and
8. judge and address ethical issues in research.

Course Contents

Types of educational measurements. Types of tests. Development of tests, test blueprint, item analysis, reliability and validity of instruments. Domains of learning and taxonomy of cognitive outcomes. Meaning of research. Types of research with focus on descriptive and experimental research. The research process. Writing a research proposal. Research designs. Theoretical/conceptual framework and review of literature. Sample and sampling techniques. Types of data, data gathering, data processing, data analysis and interpretation. Probability, critical values and error and their place in inferences. Ethical considerations (political, economic religious and cultural) in research. Data analysis using IBM-SPSS. in educational data analysis. Reporting educational research.

SED 302: Chemistry Methods I I (2 Units C: LH 15; PH 45)

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Learning Outcomes

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

1. present the nature of chemistry as a subject;
2. identify the physical, inorganic and organic concepts in the SSS chemistry curriculum; 3. succinctly describe the chemistry curriculum;
4. appreciate best practices in chemistry teaching;
5. discuss the merits and demerits of various innovative methods of teaching chemistry and use them;
6. identify the supporting theories for methods of teaching;
7. demonstrate practical skills for practical work in chemistry;
8. list the laboratory equipment, facilities and common reagents used for chemistry practicals;
9. organise practical lessons based on past WASSCE examination questions;
10. identify difficult concepts in SSS chemistry and suggest practical solutions; and
11. use ICT facilities for planning and delivery of chemistry lessons.

Course Contents

Chemistry as a discipline. Physical, inorganic and organic concepts in the SSS chemistry curriculum. Organisation of the chemistry curriculum. The thematic approach and spiral nature of the curriculum. Best practices in chemistry teaching. Innovative methods of teaching chemistry and the supporting theories. Practical skills in chemistry teaching. Practical work in chemistry. Laboratory equipment, facilities and common reagents used for practicals. Practical sessions using past WASSCE examination papers. Difficult concepts in SSS chemistry. Review of research solutions and recommendations. ICT and chemistry teaching. Micro-teaching sessions for the demonstration of teaching skills, best practices and organisation of practical classes.

SED 303: Entrepreneurship in Chemistry Education (2 Units C: LH 15; PH 45)

Learning Outcomes

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

1. define entrepreneurship, chemistry entrepreneurship and entrepreneurship education;
2. appreciate the role of entrepreneurship in chemistry education;
3. discuss entrepreneurship knowledge, skills and attitudes and their roles in successful chemistry education;
4. formulate and present business ideas from different aspects/topics of chemistry;
5. identify specific societal needs of business interests to chemistry students;

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6. enumerate the economic benefits of entrepreneurship in chemistry;
7. discuss the strategies for developing entrepreneurship skills in chemistry education;
8. list and discuss with possible solutions the barriers to entrepreneurship in Chemistry and chemistry education;
9. present individual proposals for entrepreneurship ventures in chemistry and chemistry education;
10. participate in group work on entrepreneurship proposals and projects; and
11. exhibit products from entrepreneurship projects carried out.

Course Contents

Concepts of entrepreneurship, chemistry entrepreneurship and entrepreneurship education. Rationale for entrepreneurship. Entrepreneurship knowledge, skills and attitudes. Business Ideas from different aspects/topics of chemistry. Specific societal needs of business interests to chemistry students-Education, water, health, food and drinks, farming, packaging, textiles, electronics, waste management. Economic benefits of entrepreneurship in chemistry. Strategies for developing entrepreneurship skills in chemistry education. Barriers to entrepreneurship in Chemistry and chemistry education. Individual and group works on entrepreneurship proposals and projects. Exhibition of products from entrepreneurship projects.

CHM 301: Physical Chemistry II (2 Units C: LH 15; PH 45)

Learning outcomes

After completing the course, the students will be able to

1. explain Gibbs Energy;
2. explain and discuss the relationship between the sign of Gibbs free energy change and the spontaneity of a process;
3. determine of Gibbs free energy using standard free energies of formation;
4. describe what information the first law of thermodynamics provides about directionality or tendency of physical and chemical changes;
5. describe spontaneous process;
6. describe the difference between spontaneous and non-spontaneous process;
7. describe what enthropy is and what it is not;
8. describe position entropy and why it si an oversimplification of true entropy;
9. predict the sign of entropy change for the system (ΔSsys) for physical and chemical changes;
10. describe why the entropy of a gas is greater than that of a liquid and a solid, and why the entropy of a liquid is greater than that of a solid;

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11. state the Third Law of Thermodynamics and describe its significance;
12. calculate the standard entropy change (ΔSo) for a physical or chemical process given standard entropy values, So , for reactants and products;
13. state the Second Law of Thermodynamics and describe its significance;
14. describe what information is obtained from the Second Law of Thermodynamics about speeds of chemical and physical changes;
15. use the Second Law of Thermodynamics to predict the spontaneity of physical and chemical changes;
16. quantify entropy changes using a “statistical” approach and (2) “heat changes”;
17. describe the “obstructions” to the Second Law of Thermodynamics that make life possible;
18. describe the meaning of a positive value, a negative value, and a value of zero, for ΔSuniv. ! To describe the change in free energy of the system for a physical or chemical process in terms of the changes in enthalpy and entropy of the system;
19. describe the meaning of a positive value, a negative value, and a value of zero, for ΔG (ΔGo);
20. describe the relationship between the change in free energy and the maximum amount of work that can be done by the system;
21. describe why a physical or chemical change is spontaneous only if ΔG is negative;
22. calculate standard free energy changes by using: ΔGo = ΔHo – TΔSo
23. predict the summation of two reactions standard free energies of formation;
24. predict whether a physical or chemical change is spontaneous given the temperature and the enthalpy and entropy changes;
25. describe why a system is at equilibrium if ΔG is equal to zero;
26. describe why wmax is equal to zero at equilibrium;
27. describe the difference between ΔG and ΔGo ;
28. use the equation, ΔG = ΔGo + RTlnQ, to calculate free energy changes under nonstandard state conditions;
29. use the equation, ΔGo = -RTlnK, to calculate equilibrium constants or standard free energy changes;
30. explain why chemical reactions occur and the driving force(s) that are responsible for physical and chemical change;
31. describe and apply the principles of probability to predict molecular behaviour;
32. describe and explain the concept of the Boltzmann distribution law, molecular partition function and partition function of a system;
33. predict some macroscopic properties from atomic and molecular structures using statistical mechanics;
34. describe the molecular interpretation of macroscopic properties such as energy, entropy, temperature and heat capacity;

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35. predict gas-phase chemical reaction equilibria from atomic structures;
36. describe and explain phase equilibria based on the concept of chemical potential;
37. describe the molecular properties of regular mixtures and predict phase separation in liquid mixtures;
38. analyse physical kinetics phenomena in terms of non-equilibrium statistical mechanics;
39. predict, using a statistical thermodynamic approach, how the rate of a chemical reaction depends on the molecular structures involved;
40. combine the laws of electrostatics and thermodynamic equilibrium (i.e. PoissonBoltzmann equation) to predict equilibria in solutions containing charged species;
41. describe the intermolecular interactions that hold liquids and solids together;
42. interpret phase transition diagrams in statistical thermodynamic terms;
43. describe the processes of binding and adsorption to a surface;
44. describe the anomalous thermodynamic properties of water and describe the origin of the hydrophobic effect;
45. explain the molecular thermodynamic properties of simple macromolecules in solution;
46. explain ideal and non- solutions; and
47. list the properties of electrolytes. I

Course Contents

Pre-requisite –CHM 210

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 15; PH 45)

Learning Outcomes

After completing the course, the 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;

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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. synthesize 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. enumerate the principles for 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. enumerate current methods in radiochemistry;
17. define radioactivity;
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

Pre-requisite –CHM 212

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 15; PH 45)

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
3. consequences of aromaticity;
4. recognize and be able to write the mechanism of electrophilic aromatic and Alicyclic substitution;

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5. outline the completed electrophilic aromatic substitution reactions of the
6. following types: halogenation, nitration, sulfonation, and Friedel-Crafts acylation & alkylation. expain the chemistry of heterocyclic Chemistry (3,4,5 and 6-membered ring of O, N, S heterocyclic compounds);
7. describe the Reactive intermediates – carbocations, carbanions, carbenes, nitrenes;
8. express the rearrangement reactions such as, Beckmann, Baeyer-Villiger and others;
9. illustrate with various reaction mechanisms and types; and
10. 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 and others. Selected rearrangement reactions such as Beckmann, Baeyer-Villiger and 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, the 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;

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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 305: Petroleum Chemistry (2 Units C: LH 30)

Learning Outcomes

After completing the course, the students will be able to

1. give an overview of the chemical composition and physical properties of petroleum, petroleum products and renewable motor fuels;
2. specify quality criteria for petroleum products and renewable motor fuels;
3. present the chemistry of the most important refinery processes;
4. give an overview of the resource base for petroleum and renewable alternatives;
5. find information and perform individual evaluations of questions pertaining to production and use of petroleum from different sources and renewable motor fuels;
6. use geophysical and geological knowledge to interpret and map data for identification of potential prospects;
7. contribute to development of geo-based technology for exploration and improved recovery of petroleum resources;
8. explain the theory of hydraulics applied to fuels in pump-pipeline systems;
9. explain the fundamentals of electricity with emphases on electrical safety in petroleum; and
10. list lubrication and wear with importance attached to physical and chemical properties of lubricants.

Course Contents

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Petroleum in the contemporary energy scene. Nature, classification and composition of crude petroleum and natural gases. Natural product chemical markers of petroleum and geological sediments. Distribution of petroleum and natural gas resources (the global and Nigerian situations). Petroleum technology, survey of refinery products and process. Petrochemicals in industrial raw materials. Prospects for the petrochemical industry in Nigeria. Aviation fuels; present and future. Formulation of Lubricants. Theory of Hydraulics, as applied to fuels in pump-pipeline systems. Fundamentals of electricity with emphases on electrical safety in petroleum. Lubrication and wear, with importance attached to the physical and chemical properties of lubricants.

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

Learning Outcomes

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

1. explain the elementary circle of the following element oxygen, nitrogen, sulphur and 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;
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.

EDU 400: Project (3 Units C: H 135)

Learning Outcomes

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

1. identify researchable project topics on contemporary problems in relevant subject specialization in education;
2. search and review literature pertinent to identified topical issues;
3. conceptualize and design a research study to address an identified problem;
4. develop valid and reliable tests, questionnaires and other relevant research instruments for research project;
5. plan and implement a scheme for selection of study sample;
6. determine statistical tools for analyzing data collected based on research objectives;
7. write a coherent report on research conducted;
8. cite and reference sources of information used in their research report; and
9. work independently to accomplish a research project with the guidance of the research supervisor.

Course Contents

Application of knowledge and skills acquired in research methods, statistics and evaluation in identifying and proffering solutions to educational problems. Working independently under the guidance of a Project Supervisor. Planning and execution of a well-conceptualized research and presenting a written report on the study conducted.

GOU-EDU 303: Psychology of Education in South-East Nigeria (2 Units; Compulsory; LH = 15; PH = 45)

Senate-Approved Relevance

Adequate preparation of professional teachers with useful knowledge, skills, values, initiatives and understanding and application of human knowledge to the principles of teaching and learning is important in Enugu, Nigeria, where Godfrey Okoye University, is located. This course is meant to help student educators to acquire the right techniques which is important for understanding the learner, his/her socio-economic environment and which will enable the student educators to teach their students effectively. This is in line with the epistemic dialogue that Godfrey Okoye University is anchored on. Therefore, during the course of teaching and learning, the student educators who acquired skills and knowledge in this course can easily find out individual differences among the students and guide the students to put in their best thereby preventing students in their studies dropping out of school.

Overview

The concept of student dropout in educational system has aroused interest of many professional academics and the public in general. Students may drop out of schools with or without the consent of the school either to another school or to sit at home. Some of the reasons for dropout from school are poor academic performance, lack of sufficient individualized attention and conflict between school and household duties. If student educators acquire the psychological skills that will make them understand the individual differences and needs of their students' they will teach more effectively, and dropout from schools will reduce or curbed entirely. This

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creates the need for proper attention on the application of principles and techniques of psychology to the solution of problem in the classroom.

This course is designed to enable the student educators acquire skills to understand human behaviour in relation to teaching and learning and the environment in which education takes place. It will give the student teachers the opportunity to understand the learner, apply the learning theories of motivation and memory processing in effective teaching and learning. It will expose the student educators to the need for home teaching and manage their own learning centres and become employees of labour.

Objectives

The objectives of this course are to:

1. 2. Justify the need for psychology of teaching and learning.
3. Discuss various theories of learning and their implications for the classroom teacher.
4. Examine the concept of dropout.
5. Identify the development patterns that influences the learners' behaviour.
6. Describe the theories of motivation and their application to the classroom.
7. Explain memory processing, encoding and retrieval process.
8. Analyze forgetting and remembering
9. Discuss the transfer of learning and its implications for the classroom.
10. Apply psychology of teaching and learning to home studies.

Learning Outcomes

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

1. Define psychology of teaching and learning.
2. Discuss theories of learning and their implications to the classroom teacher.
3. Describe the relevance of motivation to classroom learning.
4. Select at least five adequate learning experiences and materials for school and home learners.
5. Draw out the relationship between learning and individual differences and fashioning appropriate techniques for solving the problems resulting from such differences.
6. Demonstrate how learning process can be effectively guided and preserved.
7. Distinguish developmental characteristics of the learners and fashion a way of solving certain problems resulting from such characteristics.
8. Discuss professionalism in relation to the study.

Course Content

Meaning of psychology. Meaning of educational psychology. Critical analysis of developmental patterns. Characteristics of individuals. Theories of learning. Implication learning theories to the classroom teacher. Concept of dropout from school. Theories of motivation. Motivational problems encountered in the classroom. How to solve the motivational problems. Issues of dropout from school. Enugu experience. Memory processing. Forgetting. Remembering. Classroom management. Need for home study. Professionalism in home school teaching. Learning establishment of a study centre. Students' attitudes. Students' aptitudes. Students' interest.

Minimum Academic Standards

1. Projectors.
2. Other NUC-MAS requirement facilities.

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GOU-EDU 305: Indigenous Educational Resources for Curriculum Implementation (2 Units; Compulsory; LH = 15; PH = 45)

Senate-Approved Relevance

This course is designed for the training of highly skilled and knowledgeable education graduate teacher on local educational resource for teaching and learning in Enugu, Nigeria which aligns properly with the mission and vision of Godfrey Okoye University, Enugu to produce graduate teachers that could contribute maximally to high quality education entrepreneurship, and sustainable socio-economic human development. This is also in agreement with Nigeria SDG for equitable, inclusive and sustainable education.

Overview

Presently students of education are not made to learn about skills for production of instructional materials from local resources like palm trees and other forest trees and soil for teaching and learning various school subjects. In terms of impacting the knowledge, these skills would enable graduate teachers to utilize the local environmental resources to produce instructional materials for schools here and outside Enugu.

The course therefore is designed to adequately expose graduate education teachers of Godfrey Okoye University to look inward in the production of various educational instructional materials from local resources for Enugu and Nigerian schools.

Objectives

The objectives of the course are to:

1. Define the concept curriculum.
2. Discuss problems encountered in defining curriculum.
3. Explain the aim and scope of curriculum.
4. Describe the different programs in education curriculum.
5. Define resources in education curriculum.
6. Outline the different types of resources in education curriculum.
7. Describe improvisation of instructional materials in education curriculum.
8. Describe the various local educational resources for teaching and learning in Enugu.
9. Discuss the merits and demerits of utilizing local educational resource in production of instructional materials.
10. Describe the main qualities of a good instructional material.

Learning Outcomes

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

1. Define the concept curriculum in three different ways.
2. Explain at least five problems encountered in defining education curriculum.
3. Describe at least five aims and scope of education curriculum.
4. Describe the three main programs of education curriculum.
5. Explain at least five local educational resources in education curriculum.
6. Differentiate at least five local educational resources in education curriculum.

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7. Describe the meaning of improvisation of instructional materials in teaching and learning.
8. Explain at least five local educational resources for producing teaching and learning materials.
9. Describe at least five merits and demerits of using local educational resource in production of instructional materials.
10. Describe at least five qualities of good instructional materials.

Course Content

Definition of terms. An overview of the course. Aim of the course. Objective and Contents. Learning experiences. Scope of the course. Education and curriculum. Curriculum programmes. Programme of studies. Program of guidance. Program of activity. Resources in education curriculum. Human and material resource from plant, soil etc. Meaning of instructional materials. Improvisation of instructional materials. Qualities of good instructional material: durable, clarity cost etc. Advantages of local educational resources.

Minimum Academic Standard

a) Micro teaching laboratory.

b) Computers (1:5 students).

c) Other NUC – MAS requirement facilities.

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GOU-SED 321: Laboratory Organization and Management (2 Units; Compulsory; LH = 15; PH = 45)

Senate – approval Relevance

There is underscores the need for Chemistry Education students to be adequately exposed to the rudiments of organization and management of chemistry laboratories so that on graduation and subsequent employment as teachers, they will not be found wanting in the discharge of their duties Having been sufficiently equipped with the skills of laboratory organization and management, such graduate chemistry educators can be hired by the managers of the secondary schools in Enugu and its environs to render professional services in establishment of chemistry laboratories in their schools, thereby helping them to generate income. This is actually in agreement with the mission of Godfrey Okoye University which is to produce professionally competent graduates equipped with entrepreneurial skills needed for both paid and self-employment. It is also in sync with Sustainable Development Goal No. 2 which is to produce well-educated and skilled citizens who are versed in Science, Technology and Innovation (STI).

Overview

Teaches of chemistry are, by their training, expected to be conversant with the essential features of a chemistry laboratory, its effective use, maintenance and overall management. Experience has shown that most chemistry education graduates, on employment, find it difficult to operate effectively in already established chemistry laboratories, not to talk of helping their schools to establish new ones.

This situation arises mainly from the deficient training such newly employed chemistry teachers obtained while in the university. This course is therefore geared towards equipping chemistry students with the knowledge and competencies needed for them to make effective use of chemistry laboratories in facilitating chemistry instructions.

Objectives

The objectives of the course are to:

1) State the major considerations in the location, shape and design of a chemistry laboratory;
2) List and explain the major compartments in an ideal chemistry laboratory and the activities that go on there;
3) Enumerate the various types of laboratory accidents, their causes and measures to guard against them;
4) State the rules and regulations that should guide the use of the chemistry laboratory by both staff and students;
5) Explain the need for First Aid and First Aiding in the chemistry laboratory, stating the appropriate first aid for each laboratory accident;

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Learning Outcomes

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

1. List any two factors that must be considered in the process if siting and design of a chemistry laboratory;
2. State any two procedures, each for ordering, procurement and arrangement of chemicals and equipment in the chemistry laboratory;
3. Mention any three types of accidents that can occur in the chemistry laboratory;
4. State any four rules and regulations that should guide the use of the chemistry laboratory;
5. State any two laboratory accidents and the appropriate First Aid for them;

Course Content

Meaning and importance of the school chemistry laboratory. Location, shape of a chemistry laboratory. Design of a standard chemistry laboratory. Chemistry laboratory complex and its appurtenances. The laboratory hall. Effective use of the preparatory room in the lab. Conduct of science instruction in the laboratory. Ordering and procurement of laboratory chemicals and equipment. Stocking of laboratory chemicals and equipment. Laboratory records. First Aid and its importance, First Aid kit, its contents, and applications. Protective devices against laboratory accidents. Laboratory Accidents and recommended First Aid treatments for them. Rules and Regulations for safe use of the chemistry laboratory. Minimum working space allowed per student. Protective devices used in the chemistry laboratory. Duties of the chemistry teacher in the chemistry laboratory. Roles of laboratory attendant and laboratory

Minimum Academic Standard

Chemistry laboratory in the department of chemistry of the University.

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GOU-SED 322: Laboratory Techniques in Chemistry Education (2 Units; Compulsory; LH = 15; PH = 45)

Senate – Approval Relevance

The training of chemistry educators should be very comprehensive, incorporating both the theoretical and practical aspects of their job expectations so that they would not be found wanting in the discharge of their duties on graduation. This is in consonance with the mission of Godfrey Okoye University which includes the production of sound graduates with employable skills that will impact positively on their environment and beyond, thereby contributing to Nigeria's overall national development. This is also in line with Sustainable Development Goals No. 2 which seeks to produce well-educated citizens and skills revolution underpinned by Science, Technology and Innovation (STI).

Overview

On graduation, holders of B.Sc. in Chemistry Education are deemed to possess all the skills and competencies they need for effective teaching of both theoretical and practical aspects of chemistry. This is not often the case as experience has shown in Enugu State, for instance, that such graduate chemistry teachers generally shy away from teaching the practical aspect of chemistry, mainly because they were not adequately groomed in the practical aspect of the subject.

The course, "Laboratory Techniques in Chemistry Education" seeks to fill the gap in the curriculum for Chemistry Education Programme of the University so that the students, on graduation, will possess the competencies and skills needed for the discharge of their duties as instructional facilitators especially in the practical aspects of secondary school chemistry curriculum.

Objectives

The objectives of this course are to:

1. Prepare standard solutions of acids and bases as well as bench reagents.
2. Identify the errors that often committed by students in qualitative and quantitative analysis.
3. Perform simple experiments on titrimetric analysis using some named acids and bases.
4. Perform some experiments on identification of common cations and anions.
5. Carry out some computations based on results obtained from titrimetric analysis named some named acids and bases.
6. Prepare a good report showing results of volumetric analysis as well as qualitative analysis.

Learning Outcomes

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

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1. Prepare standard solutions of an acid and a base for use in volumetric analysis.
2. Prepare at least two bench reagents following laid down procedures.
3. Identify at least four common errors, each, that are made by students in quantitative and qualitative analysis.
4. Present a good report showing results obtained from a given volumetric analysis, as well as a qualitative analysis for identification of the caution and anion present in a given salt sample.
5. Perform a simple titration involving a reaction between a named acid and a bases;
6. Perform simple tests for identification of at least two cations and two anions;

Course Content

Equipment needed for volumetric analysis. Equipment and materials needed for qualitative analysis. Correct ways of using the equipment for volumetric and qualitative analysis. Preparation of standard solutions of acids. Preparation of standard solutions of bases. Preparation of percentage solutions of acids. Bench reagents for qualitative analysis. Preparation of some bench reagents. Common errors in volumetric analysis. Common errors in volumetric and qualitative analysis and their remediation. Suitable indicators for volumetric analysis and their colours in different media. Presentation of reports of volumetric analysis. Presentation of results of qualitative analysis. Sample experiments on titrations involving named acids and bases. Identification of common anions and citations. Calculation based on volumetric analysis. Calculations based on results volumetric analysis. Determination of percentage purity and percentage impurity of substances. Poisonous and inflammable substances in the chemistry laboratory. Safety measures in handling of poisonous and inflammable chemicals in the laboratory.

Minimum Academic Standard

- Equipment for carrying out qualitative analysis, such as test tubes, petri dishes, test tube holders, spatula, deflagrating spoons, Bunsen burner etc.
- Some expendables (materials) for carrying out quantitative and qualitative analysis.
- Equipment for volumetric analysis, such as burettes, pipettes, conical flasks, weighing balance, measuring cylinder, beakers, volumetric flask, etc.

EDU 401: Teaching Practice II (3 Units C: PH 135)

Learning Outcomes

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

1. knowledge of the subject matter;
2. the necessary pedagogical skills;
3. acquired understanding of child psychology;
4. the needed attitude towards teaching;
5. proper use of instructional facilities;

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6. knowledge of individual differences in actual classroom situations and how to use this knowledge to assist children in real time; and
7. effective classroom management skills.

Course Contents

Effective and responsive teaching practices and interactions are key for all learning in professional teacher preparation. The importance of teaching practice is to provide the students with an opportunity to apply their pedagogical knowledge and skills in practice. Therefore, the practical implementation of teaching and learning strategies in the classroom, as applied to the subject, area should be taught through micro-teaching before students embark on the exercise.

SED 402: School Science Laboratory (2 Units C: LH 15; PH 45)

Learning outcomes

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

1. discuss the purpose and importance of laboratory in science teaching;
2. implement safety in the laboratory and outline waste disposal procedures in the science laboratory;
3. discuss the various hazards associated with the science laboratories;
4. describe the design and organization of the prep. Room and store in the science laboratory;
5. outline the roles of different personnel with regards to the school laboratory;
6. plan and conduct experiments as well as evaluate the results of these experiments;
7. acquire skills in simulating experiments;
8. develop and improvise simple laboratory equipment;
9. facilitate the establishment of a laboratory in new and older schools;
10. manage a school science laboratory including procurement, storage and maintenance of laboratory equipment and materials; and
11. use the computer in the laboratory and navigate virtual laboratories in remote learning.

Course Contents

Concept of the School Science Laboratory as an instructional facility. Objectives of school science teaching achievable through the use of the laboratory. Laboratory design, organization and management. The students' work space, preparatory room, the store. Skill description in aspects of laboratory work and construction of basic teaching resources. Roles of different personnel in the laboratory. Safety and first aid in the laboratory. Rules, regulations and hazards in the school laboratory. Computers in the

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school laboratory, simulating experiments, virtual laboratories, experiments and practical classes.

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

Learning Outcomes

At the end of this course, the 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;
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. recognize 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;
   - determine 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; and
   - 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;
   - interpret potential energy profiles and use them to determine the activation energy and potential energy changes for a reaction; and
   - use the Arrhenius equation to calculate a rate constant, activation energy, and frequency factor;
7. define a catalyst and given a reaction mechanism, identify the reaction intermediate(s) and catalyst(s), write the overall reaction, 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;

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10. 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

Pre-requisite –CHM 301

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; catalysis and heterogeneous reactions. Photochemical reaction mechanisms.

CHM 410: Analytical Chemistry II (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the 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

Pre-requisite – CHM 301

Potentiometric and pH methods. Conductometric, electroanalytical, amperometric, colorimetric methods of analysis. Coupled methods of analysis such as GC-MS, LC-MS. Radiochemical 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;

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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, the students should be able to

1. define coordination componds;
2. recorgnise coordination compounds and their application;
3. understand 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 others; and
12. identify Technological applications of magnetohydrodynamics.

Course Contents

Prerequisite –CHM 302

Definition, recognition and applications of co-ordination compounds. Nomenclature, coordination 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

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stability constant, the chelate effect. Preparation and reactions of complexes. Kinetics and mechanisms.

GOU-EDU 403: Ethno-Pedagogy and Curriculum of Non-School Environment (2 Units; Compulsory; LH = 30; PH = 0)

Senate-Approved Relevance

Adequate formation of professional teachers with sustainable knowledge, skills, values, and positive attitudes is a need in the local environment of Enugu where Godfrey Okoye University is located. This course is meant to help student teachers to reach out to every learner in their homes and help them to achieve their educational needs. This is in line with the epistemic dialogue that Godfrey Okoye University is anchored on. Therefore, apart from teaching in the formal classroom setting, students who acquire skills and knowledge in this course can easily become home teachers and own their own study centres. This is also in line with the entrepreneurial mind-set of Godfrey Okoye University Enugu, Nigeria.

Overview

Continuous poor performance of students in formal school setting in almost every standardised examination in both primary and secondary education calls the need for the development of this course. In recent times, parents are always busy with work. Many a time, they find it difficult to look at the academic work of their wards. This creates the need for proper attention on the educational needs of their children.

This course is designed to enable the student teachers acquire the required knowledge and skills to help learners to develop their educational potentials and desired learning outcomes. It will give the student teachers the opportunity to manage home lessons. More so, it will expose the student learners on the need to own and manage their own learning centres and become employers of labour.

Objectives

The objectives of this course are to:

1. Justify the relationship between ethno-pedagogy and curriculum.
2. Explain the concept of non-school environment.
3. Discuss curriculum as a process for transferring knowledge into application.
4. Analyse the relevance of curriculum based on the national policy on education.
5. Explain selection of objectives and learning experiences in curriculum.
6. Outline the role of instructional methods and materials in curriculum.
7. Explain evaluation processes in curriculum.
8. Identify the need for curriculum innovation in Enugu.
9. Apply ethno-pedagogy at home schools.

Learning Outcomes

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

1. Define ethno-pedagogy.
2. Give the meaning of curriculum.
3. Discuss the relevance of curriculum based on the national policy on education.
4. Draw out the relationship between curriculum and instruction based on the three domains of learning.
5. Select adequate learning experiences and materials for home school learners.
6. Identify at least five scaffolding activities for home school teaching and learning.
7. Explain curriculum innovation in the subject area.
8. Name three instruments used in evaluating learners' performance in home school teaching and learning.
9. Discuss professionalism in relation to home school teaching and learning.
10. Identify five ways of public relations regarding home school teaching and learning.
11. Suggest three methods of establishing study centres.

Course Content

Concept of ethno-pedagogy. Meaning of curriculum. Concept of non-school environment. Critical analysis of curriculum in terms of their relevance and national goals. Relationship between curriculum and instruction in terms of objectives specification. Selection of learning experiences. Learning materials. Methods and media of instruction. Scaffolding activities. Evaluation. Curriculum innovation in a subject matter area with particular reference to Enugu experience. Professionalism in home school teaching and learning. Public relations in home school teaching and learning. Establishment of study centres. Application of ethno-pedagogy at home schools.

Minimum Academic Standards

1. Microteaching Laboratory.
2. Computers (1 computer per student).
3. Other NUC-MAS requirement facilities.

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GOU-SED 421: Media in Chemistry Education (3 Units; Compulsory; LH = 45; PH= 0)

Senate – Approval Relevance

The role of media in fostering students' understanding of school subjects cannot be underemphasized, moreso, in chemistry which is activity oriented and demands teachers' use of hands – on activities in instructional delivery. It is, therefore, important that chemistry education students be sufficiently exposed to different kinds of instructional media to enable them to discharge their duties creditability when they get employed after graduation. This is in sync with the mission of Godfrey Okoye University which is to produce students with the necessary skills and competencies that will enable them to fit into the world of work and consequently make valuable contributions to the education sector, especially in the area of Science, Technology and Innovation, as contained in the Sustainable Development Goals 2

Overview

Effective science teaching, especially in the area of chemistry, occurs when teachers are able to demonstrate sufficient knowledge of the content, as well as the skills and competencies needed for imparting such knowledge to learners. Thus, a good and resourceful chemistry teacher should not only be conversant with the appropriate media for teaching different chemistry topics, but should also know when and how to use such media for effective instructional delivery.

Experience has shown that during teaching practice, a good number of student teachers in chemistry do not make effective use of instructional media. Thus, the inclusion of the course, media in Chemistry Education, is an attempt to expose trainee chemistry educators to all the instructional media that could be utilized to make their chemistry teaching more effective when they eventually graduate from the university and get employed as science/chemistry teachers.

Objectives

The objectives of the course are to:

1. Outline and explain the functions of media in science/chemistry instructions.
2. List and explain the functions of instructional media.
3. Enumerate and explain the criteria for selecting instructional media for chemistry.
4. Explain how instructional media can be created and modified.
5. Evaluate created and modified instructional media.
6. List and explain the merits and demerits of modifying instructional media.

Learning Outcomes

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

1. State at least three functions of media in chemistry teaching and learning.
2. State at least three qualities of good media for chemistry instructions.

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3. Mention and explain at least two criteria for selecting media for chemistry instructions.
4. State two major classifications of instructional media.
5. State at least two ways in which media can be created and modified for chemistry teaching.
6. State any two ways of evaluating created and modified media to ensure their efficacy in chemistry instructions.

Course Content

Concept of media as it relates to chemistry teaching. Types of media. Classification of media. Functions of media in chemistry instructions. Qualities of good instructional media. Criteria for selecting instructional media. Sourcing of media from the three alternatives. Creating instructional media. Modifying instructional media. Evaluation of created instructional media. Evaluation of modified instructional media. Merits of modifying instructional media. Demerits of modifying instructional media. Role of technology in locating instructional media. Role of technology in adapting instructional media. Technology and its role in creating instructional media. Role of technology in evaluation of instructional media.

Minimum Academic Standard

- Equipment for chemistry teaching in the university's chemistry laboratory.
- Models of some organic molecules
- Models of some crystalline substances and some giant molecules
- While board for chemistry teaching.

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GOU-SED 422: Out of Classroom/Laboratory Chemistry (2 Units; Compulsory; LH = 30; PH = 0)

Senate – Approval Relevance

In the course of their professional training, chemistry education students should be made to appreciate the fact that a lot of chemistry could be learnt outside the confines of the classroom or chemistry laboratory. This way, the students, on graduation, will not be found wanting in the discharge of their pedagogical duties as facilitators of chemistry instructions in their various schools. This comprehensive preparation/training is actually in tandem with the mission of Godfrey Okoye University which includes the production of graduates with employable skills that will make them fit properly into the world work and thus, become major contributors to the educational advancement and sustainable development of the Nigerian nation which is in line with Sustainable Development Goals No. 8 which seeks to promote full and productive employment, among others.

Overview

There is need to expose Chemistry Education students to be exposed to a comprehensive programme chemistry that encompasses the whole gamut of chemical knowledge and practical skills which can be acquired both in normal classroom and laboratory settings, as well as outside the confines of the school.

Experience has, however, shown that the curricula of Chemistry Education Programme of many universities in Nigeria are deficient in aspects of chemistry that go on outside the normal classroom/ laboratory settings, thereby giving rise to the production of half-baked and incompetent graduates who can hardly fit into the world of work as chemistry teachers.

Objectives

The objectives of the course are to:

1. Explain the rationale for mounting the course "out of classroom/laboratory chemistry in the Chemistry Education Programme of the university.
2. Describe what Chemistry Club is all about and the benefits students can derive from it.
3. Explain what is meant by "home chemistry set, listing the essential components of an ideal home chemistry set, as well as the importance of the chemistry set.
4. Explain what chemistry exhibitions are all about; how to organize a successful chemistry exhibition, as well as the items that could be exhibited.
5. State the meaning of chemistry bulletin board and the likely information that should be pasted on it.

Leaning Outcomes

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

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1. State at least two benefits derivable from the course, out of classroom/laboratory chemistry.
2. Explain briefly what chemistry club is all about.
3. State the organizational structure of the chemistry club and what the members stand to benefit from being members of the club.
4. State at least four items that should be components of the home chemistry set and the chemistry concepts that could be learnt from them.
5. Mention any three types of information that should be pasted on the bulletin board.

Course Content

Introduction and justification for out of classroom/laboratory chemistry. Chemistry Club. Guidelines on formation of chemistry club. Benefits of chemistry club. Chemistry museum. Items that can be showcased in a chemistry museum. Chemistry exhibition. Guidelines for organization of a successful exhibition in chemistry. Role of students during chemistry exhibitions. Home chemistry set. Chemistry Bulletin Board. Types of information expected in the Chemistry Bulletin Board. Guidelines on production, use and maintenance of the chemistry bulletin board. Field trips. Planning for a field trip. Implementation guidelines for a successful field trip. Role of the school authority and teachers during field trips. Benefits of field trips to students.

Minimum Academic Standard

- Samples of bulletin board
- Samples of improved instructional materials for chemistry teaching
- List of places of interest for field trips, etc.

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GOU-SED 423: Environmental Contamination and Waste Management (3 Units; Compulsory; LH = 45; PH = 0)

Senate–Approved Relevance

Enugu, being a state capital and indeed, the regional capital of south east, Nigeria, is very thickly populated, with a lot of human activities (domestic, commercial and industrial) all of which generate wastes on daily bases, thereby contaminating the environment. When students become environmentally conscious and are sufficiently equipped with the requisite skills involved in waste management, they will not only strive to always live in a healthy environment, but can also, on graduation, set up business ventures for collection, disposal and recycling of wastes, thereby turning waste to wealth. This is in line with the mission of Godfrey Okoye University which includes, but not limited to production of entrepreneurially equipped graduates that will not only be employable within the locality and beyond, but can also be wealth creators through self-employment. This is also in line with Sustainable Development Goals No. 8 which is to promote sustained inclusive and sustainable economic growth and productive employment.

Overview

The high population density in Enugu has given rise to a lot of human activities arising from homes, industries and other commercial ventures, all of which generate wastes of different kinds that tend to contaminate the environment, thereby making it unhealthy for human existence, as well as other animals and plants in man's ecosystem. The need, therefore, arises for Chemistry Education Students of the University to be taught to have the awareness and also methods of managing wastes arising from such human activities.

The course is thereby designed to teach students to always live in environments that are devoid of contamination or pollution and to also seek ways and means of managing the wastes generated in such environments. The knowledge and skills gained in waste management can also be put to good use by such students, on graduation, in income generation through the establishment of small business concerns for wastes collection and disposal, as well as waste recycling, thereby enabling them to generate personal incomes, thereby contributing to environmental sustainability and national development.

Objectives

The objectives of the course include the following;

1. To explain the term "contamination" of the environment and state the various types of contamination or pollution.
2. To explain air pollution and list the pollutants.
3. To explain water pollution and list the pollutants.
4. To explain and list land pollution and pollutants

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5. To explain the concept of waste management and describe the process of collection and sorting of waste.
6. To describe the treatment practices for solid wastes and the process of reuse and recycling of waters.

Learning Outcomes

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

1. Explain what is meant by contamination or pollution of man's environment.
2. Explain the term "Air pollution and "pollutants" respectively, listing at least three (3) air pollutants.
3. Explain the term "water pollution and "pollutants", stating at least three (3) water pollutants.
4. Explain the term "land pollution" and "pollutants", listing at least (3) of them;
5. Explain the concept of waste management and state one treatment practice for solid wastes.
6. To describe the treatment practices for solid wastes and the process of reuse and recycling of waters.

Course Content

Nature of man's environment. Safety of the environment. Contamination or pollution of man's environment – meaning and types. Air pollution and pollutants. Biochemical Oxygen Demand (BPD) in water. Purification of contaminated water for Town Water Supply. Land pollution and pollutants. Treatment processes for land pollutants. Concept of waste management. Rural and Industrial effluents and their disposal methods. Treatment practices for solid wastes. Reuse and recycling of solid wastes.

Minimum Academic Standard

- Visit to some waste dumpsters to see various types of solid wastes
- Water purification or treatment column
- Samples of polythene bags for waste collection.

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GOUNI-SED 424: Curriculum Development In Science Education (2 Units; Compulsory; LH = 30; PH = 0)

Senate – Approved Relevance

Curriculum development in science education. Curriculum is a comprehensive documented plan developed with the intension that science instruction involves both human and non-human components of teaching and learning process. The human components include the learner, the teacher and any other relevant person or persons while the non-human components are the curriculum methods, media, skills and strategies. The action plan (which is more of the teacher's mental construct) which indicates how these components work together in a coordinated manner in the teaching learning environment is the science instruction is dependent on the appropriateness or otherwise of the choice, application and integration of these components of teaching-learning process in relation to the learner who is the principal focus and target. The teacher moderates, facilitates and provides guidance. His function require that he strategizes as the needs arise. He requires adequate and appropriate initial training and regular retraining as well as on-the-job experiences to be able to do the job of science teaching effectively.

Overview

Curriculum development is an integral part of the training programme for science education students in Nigerian universities. Graduates of chemistry education are only expected to be able to implement already developed curriculum in chemistry but should also be able to develop new ones as the need arises since curriculum development is a dynamic process.

Experience has shown that some chemistry teachers, unemployment, are unable to develop curriculum as well as syllabus and scheme of work for effective teaching of the subject. This underscores the need for inclusion of the course-Curriculum development in science education in the chemistry education programme of the university.

Objectives

The objectives of the course are to:

1. Explain Curriculum development.
2. Explain the components of the Curriculum.
3. Explain the Human components of the curriculum.
4. Explain the nonhuman components of the curriculum.
5. Explain how each of the components work together.

Learning Outcomes

1. Explain Curriculum development
2. Explain the components of the Curriculum
3. Explain the Human components of the curriculum

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4. List and briefly explain the non-human components of the curriculum
5. Explain how each of the non-human components of science education curriculum work together.

Course Content

Meaning of curriculum in science. Scope of Curriculum in Science. The place of science in the primary school curriculum. The place of science in secondary school curriculum. Curriculum development. Curriculum implementation in Nigeria with particular reference to the sciences. The role of science teachers in the development of science curriculum. Teachers' role in innovation of science curriculum. Examination of role of STAN in science curriculum development. NERDC and curriculum development in science. CESAC and curriculum development in science. CUDIMAC and curriculum development in tertiary institutions. Role Federal and State Governments in innovation of science curriculum. Examination of selected curriculum development projects – BPSP APSP. SERA. NSSSP. NISP. The role of universities in science and curriculum development. Science text books as resource. curriculum material. Readability of science textbooks. Suitability of some recommended science textbooks for secondary education.

Minimum Academic Standard

- Visit to Primary and Secondary Schools
- Visit to state Curriculum Centers
- Visit to National Curriculum

Minimum Academic standard

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:30 for Education departments shall apply. It is expected that all academic staff should possess Ph.D degree. However, the proportion of academic staff with PhD degree should not be less than 70%, with a minimum of 6 full-time equivalent of staff (including full time staff from Faculty of Science), staff should have a maximum of 15 contact hours per week for lectures, tutorials, practicals and supervision of projects. The staff mix by rank should be in the ratio of 20:35:45 for Professors and Readers:Senior Lecturers:Others. However, where the ratios are distorted by virtue of a high percentage of Professors, that can be accepted.

Academic and Non-academic

The established academic staff/students ratio of 1:30 for the social sciences should be met.

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Training and retention of academic staff and students should be pursed vigorously.

All academic staff should be computer literate and possess computational skills.

75% of the academic staff should hold the PhD.

At least 20% of the academic staff should be Professors, Readers and 35% Senior Lecturers. The department should be headed by on Professorial cadre to ensure good leadership and effective administration. Such a Professor should not be a sabbatical staff.

The academic to non-academic staff ratio in the department should be 1:2 maximum.

All administration, secretarial and clerical staff should have computing skills.

Provision should be made for at least 20 PCs for teaching students in a computer room with internet facilities and laptops.

Each academic staff should have a PC in his/her office with internet facilities

Administrative Support Staff

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

Senior non-teaching (administrative and secretarial) staff should constitute 3.4% of the total student population.

senior secretarial staff should constitute not more than 40% of the total senior administrative staff junior staff should constitute 20% of the total student population

Technical Support Personnel

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

Library

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

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In any case, there should be internet ready workstations available in the library for at least 25% of the total student enrolled in the programme.

There should be Faculty/Departmental Library in addition to the university main library. Current basic textbooks, reference books, journals, newspapers, periodicals and other relevant textual and non-textual materials should be readily available in the libraries. A virtual/automated library is also needed.

Classroom, laboratories, workshops, and offices

1. Four (4) Standard Classrooms
2. One (1) Science Laboratory for Demonstration
3. Ten (10) Offices for Staff
4. Standard office for the Head of Department
5. One (1) Departmental Secretary's Office
6. Two (2) Administrative Staff Offices

Spaces

The NUC recommends the following physical space requirement:

		m^2
Professor's Office	-	18.50
Head of Department's Office	-	18.50
Senior Lecturer's Office	-	15.50
Other Teaching Staff Space	-	13.50
Tutorial Teaching Staff's Office	-	7.00
Technical Staff Space	-	7.00
Secretarial Space	-	7.00
Science Staff Research Laboratory	-	16.50
Education Staff Research Laboratory	-	14.50
Seminar Space per student	-	1.85
Laboratory Space per student	-	7.50

Resource Requirement for Teaching and Learning

Facilities

A Demonstration Laboratory in the Chemistry Education Department
An Educational Technology Laboratory
A Micro-teaching Unit
Other Laboratories in the cognate Department of Chemistry in the Faculty of Sciences

Equipment

The Periodic Table of Elements
Mettler analytical balance

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Centrifuge
Laptop and desktop computers
Fume hood/fume cupboard
Microwave oven
Paper chromatography ink
Electronic microscope
Pipette bulb
Spectrophotometer
Bomb calorimeter
Goethe barometer/storm glass
Weights or masses
Spring weighing scale
Steel ruler
Thermometer with Celsius and Fahrenheit scales
Desiccator and Vacuum Desiccator Glassware
Microscope
Gas equipment and bunsen burner
Water supply
Bunsen Burners
Test Tubes
Test Tube Racks (Plastic)
Fire Extinguisher Big
Sand Buckets
Water Bath
Ph Meter
Hand Lens
Table Sinks
White Board
Gas Fitting (Big)
First Aid Kit (Big)
Retort Stands Complete
Beakers
Petri Dishes
Flat/Round Bottom Flask 500ml
Spatula Stainless 150mm
Chromatography Apparatus
Wet And Dry Bulb Thermometer
Measuring Cylinder, Funnels
Bench Centrifuge
Shelves For Reagents
Laboratory Tables
Hot Plate
Micrometer Screw Guage
Vernier 0-18cm
Hacksaw Blades
Plain Goggles

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Engraver
Gas Cylinder
Muffler Furnace (Model 5xl)
Heating Mantle (5lflask)
Heating Mantle (2l Flask)
Heating Mantle (1l Flask)
Water Bath (Dk-8a)
Dessicator
Refrigerator
Stabilizer (2000va)
Manesty (Distillatory)
Chromatography Tank With Accessories
Column Chromatography
Centrifuge
First Aid Box
`Meter Rule
Adaptor (15amp)
Petri Dishes
Washing Brush
Microscope (Binocular)
Incubator/Sterilizer
Water Filter
Drying Oven (30^0 -120^0)
Sechi Disc
Test tubes
Watch glasses
Crucibles (with lids)
Volumetric glasses
Beakers
Bunsen burner
Spatulas and Scopulas
Magnifying glasses
Spring balance
Droppers
Latex gloves
Safety goggles
Brushes for test tubes
Funnels
Tongs and Forceps
Wash bottles
Burettes
Thermometer
Measuring Cylinders
Pipettes
Conical flasks
Boiling flasks

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Ring stands,rings and clamps
Litmus and filter papers
Mass spectrometers
Nuclear Magnetic Resonance
Batch reaktor
Rheometer
Polymer Extrusion
Injection Moulding
Infrared spectrometer
Personal Protective Equipments
Water heater
Water hardness tester
Light box
PH meter
Distilled Water maker
Washing machine
Sample dyeing machine
Data Colour (Spectrophotometer)
Water bath
BIO-XPS photoelectron spectrometer
X-ray diffraction/X-ray reflection
JSPM-5400 Scanning Probe Microscope MFP-3D Atomic Force Microscope
Microcal VP-ITC Microcalorimeter
Chromatographic systems HPLC and GC-MS
The Bruker FT-IR Spectrometer
Fluorescence Spectrometer FLS 900
Laser Flash Photolysis Spectrometer LP920
The Finnigan LXQ Mass Spectrometer
DESI-MS
The Thermo Scientific Exactive high resolution MS
The JEOL JSM-5600LV SEM
Ion Chromatography equipment with three detection units(Conductivity, Amperometry and Spectrometry)
Atomic Absorption Spectrophotometer
Total Organic C and N analysers
Flow Injection Analyzer
UV Spectrophotometer
Automated Titration System
Physical Properties Measurement Systems, Electrical furnaces, Polarimeters and Magnetometers
Digital Refractometers
Flash point tester
Fuel Analyzer
Vapour Pressure Analyzer
Oxidation Stability Analyzer
Oil in water Analyzer

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Rheometer/Viscometer
Titration Equipments
Laboratory information management systems
Elemental Analyzers; Combustion Analyzer, Atomic Spectrometer and Mass Spectrometer.

Lab. Chemicals

S/N Item

Mineral acids
Bases
Simple salts
Phenylhydrazine Hydrochloride
Iodine solution
Fehling’s Reagent A and B
Barfoed's Reagent
Seliwanoff's Reagent
Bial's Reagent
Sodium acetate
Glacial acetic acid
Glucose and Fructose