Programme Title**: BSc. Chemistry**

Programme Code: 5212

1. **Philosophy, Aims and Objectives of the Degree Programme**

PHILOSOPHY

The Programme shall support and inform instruction and research in allied areas of physical, biological and environmental science. An important part of the philosophy of our approach is that the chemistry students have broad background in mathematics and physics, while still undergraduates. The Programme is dedicated to teaching chemistry in a mode in which physical distance from the University is an insignificant constraint in the access of instructional materials (ODL); the advent of the internet gives credence to this mode of instruction delivery. The Unit is also committed to contributing to the advancement of scientific discovery in the areas of energy, sustainability and the preservation of the natural environment.

AIMS AND OBJECTIVES

- *To stimulate in the students sustained interest and enthusiasm in chemistry and applications*
- *To build in students a culture of continuing enquiry*
- *To provide students with a broad and balanced base of chemical knowledge and practical skills*
- *To develop in students a range of skills applied in chemical and non-chemical areas, that can provide confidence for employment*
- *To develop the students' capacity to readily adapt to and make use of emerging technologies in an open-distance learning environment.*
- ***To provide easily accessible, flexible and lifelong learning in Chemistry for a Nigerians***
- ***To promote appreciation of professional responsibility***
- ***To promote a basic knowledge of the concepts of mathematics and science, particularly***

chemistry and the ability to apply this knowledge in the design, implementation, and analysis of experiments

- *To produce self-reliant graduates for self-employment in applied chemistry.*
- *To prepare the students for jobs in the growing chemical and allied manufacturing industries in the country.*
- *To provide students with a solid base of chemical knowledge and skills that are required for postgraduate studies and research*

- *To Inculcate in students an appreciation of chemistry in all human endeavours*

1. **Admission and Graduation Requirements**

Admission Requirements

Admission requirements

1. *4 –year B.Sc(Hons) Chemistry*

- *The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, Chemistry, Physics to form the core course, and any other relevant science subjects at the Senior Secondary School Certificate or its equivalent. In addition, an acceptable pass in the University.*
- *O'level credit passes in five subjects, which must include **Mathematics**, **English language**, **Chemistry** and **Physics**; and obtained in not more than 2 sittings.*

**'O' level results are the ones conducted by: West African Examination Council (WAEC), GCE London-moderated 'O' level, and University of Cambridge-moderated 'O' level.*

1. *3 –year B.Sc(Hons) Chemistry (Direct entry)*

1. *O'level credit passes in five subjects, which must include **Mathematics**, **English language**, **Chemistry** and **Physics**; and obtained in not more than 2 sittings.*
2. *In addition, candidates must possess at least an upper credit in OND or NCE in Chemistry or a closely related course.*
3. *Candidates with two A level passes (graded A-E) at the Advanced Level in one or more relevant subjects (Biology, Botany, Chemistry, Geography, Mathematics and Physics)*

Graduation requirements

To graduate, a student shall have undergone at least 6-8 semesters of study depending on entry point, including field practical training. Students are to pass a minimum of 128 credit units for a 4-year B.Sc (Chemistry) programme; and 98 units for a 3-year B.Sc (Chemistry) programme, excluding the GST courses. The submission of an undergraduate project thesis based on a supervised research is a graduation requirement which cannot be compromised.

OUTLINE PROGRAMME PROPOSAL (OPP)

B.Sc. Chemistry

Year I

First Semester

Code	Course Title	Status	Units
GST101	Use of English and Communication Skills I	C	2
GST107	The Good Study Guide	C	2
BIO 101	General Biology I	C	2
BIO 191	General Biology Practical 1	C	1
CHM 101	Introductory Inorganic Chemistry	C	2
CHM 103	Introductory Physical Chemistry	C	2
CHM 191	Introductory Practical Chemistry I	C	1
MTH 101	Elementary Mathematics I	C	3
PHY101	Elementary Mechanics, Heat and Properties of Matter	C	2
PHY191	Introductory Practical Physics I	C	1
	TOTAL		**20**

Second Semester

Code	Course Title	Status	Units
GST104	Use of Library	C	2
BIO 102	General Biology II	C	2
BIO 192	General Biology Laboratory II	C	1
CHM102	Introductory Organic Chemistry	C	2
CHM192	Introductory Practical Chem. II	C	1
CIT 104	Introduction to Computer	C	2
MTH102	Elementary Mathematics II	C	2
PHY 102	Electricity, Magnetism and Modern Physics	C	3
PHY 192	Introductory Practical Physics II	C	1
STT102	Introductory Statistics	C	2
	TOTAL		**18**

Year II

First Semester

Code	Course Title	Status	Units
GST201	Nigerian Peoples and Cultures	C	2
GST203	Introduction to Philosophy and logic	C	2
CHM201	Physical Chemistry II	C	2
CHM203	Organic Chemistry II	C	2
CHM205	Inorganic Chemistry II	C	2
CHM291	Practical Chemistry III-Inorganic	C	1
MTH281	Mathematical Methods I	C	2

Students are to choose at least ONE of the elective courses below			
BIO 213	Chemistry of Amino Acids and Proteins	E	2
BIO 203	General Physiology 1	E	2
	TOTAL		**15**

Second Semester

Code	Course Title	Status	Units
GST202	Fundamentals of Peace Studies & Conflict Resolutions	C	2
CHM202	Analytical Chemistry I	C	2
CHM204	Structure and Bonding	C	2
CHM292	Practical Chemistry IV – Physical and Organic	C	1
MTH212	Linear Algebra II	C	2
PHY202	Modern Physics I	C	2
PHY204	Electromagnetism	C	2
Students are to choose at least ONE of the elective courses below			
BIO 216	Chemistry of Carbohydrates and , Lipids & Nucleic acids	E	2
ESM112	Introductory Ecology	E	2
	TOTAL		**15**

Year III

First Semester

Code	Course Title	Status	Units
GST302	Business Creation and Growth	C	2

CHM301	Physical Chemistry III	C	3
CHM303	Inorganic Chemistry III	C	3
CHM305	Organic Chemistry III	C	3
CHM307	Atomic & Molecular Structure & Symmetry	C	3
CHM309	Organic Spectroscopy	C	2
CHM391	Practical Chemistry V Inorganic & Analytical	C	1
Students are to choose at least ONE of the courses below			
CHM311	Petroleum Chemistry	E	2
CHM315	Carbohydrate Chemistry	E	2
	TOTAL		**19**

Second Semester

Code	Course Title	Status	Units
CHM302	Polymer Chemistry I	C	2
CHM306	Instrumental Methods of Analysis	C	2
CHM312	Industrial Chemical Processes I	C	2
CHM314	Environmental Chemistry	C	2
CHM318	Natural Product Chemistry I	C	2
CHM394	Industrial Training (SIWES)	C	6
Students are to choose at least One of the courses below			
CHM304	Colour Chemistry and Technology	E	2
CHM316	Industrial Chemical Technology I	E	2
	TOTAL		**18**

Year IV

First Semester

Code	Course Title	Status	Units
CHM 407	Reaction Kinetics	C	3
CHM 409	Electrochemistry	C	2
CHM 411	Project	C	6
CHM 413	Analytical Chemistry II	C	2
CHM 421	Heterocyclic Chemistry	C	2
CHM 423	Coordination Chemistry	C	3
	Students are to choose at least one of the courses below		
CHM 405	Chemical Thermodynamics	E	2
CHM417	Industrial chemical processes II	E	2
CHM415	Industrial Chemical Technology II	E	2
	TOTAL		**20**

Second Semester

Code	Course Title	Status	Units
CHM 400	Seminar	C	1
CHM406	Nuclear and Radiochemistry	C	2
CHM408	Polymer Chemistry II	C	2
CHM414	Photochemistry and Pericyclic Reactions	C	2
CHM416	Organic Synthesis	C	2
	Students are to choose at least TWO of the courses below		

CHM422	Natural Products Chemistry II	E	2
CHM426	Chemistry of Lanthanides & Actinides	E	2
CHM402	Theory of molecular spectroscopy	E	2
CHM424	Non Aqueous Solvents	E	2
	TOTAL		**13**

SUMMARY OF COURSE STATUS

S/N	LEVEL	**STATUS** **COMPULSORY COURSES (CREDIT UNIT**	**STATUS** **ELECTIVE COURSES** **(CREDIT UNIT)**	**TOTAL CREDIT UNIT**
1	100	38	0	38
2	200	26	4	30
3	300	33	4	37
4	400	27	6	33
TOTAL		**124**	**14**	**138**

Detailed Programme Proposal (DPP)

BSc. Chemistry

100 LEVEL

GST101: Use of English and Communication Skills 1 (2 Units)

Listening enabling skills; Listening and comprehending; comprehension; note-taking and information retrieval, including data, figures, diagrams and charts; listening for main idea, interpretation and critical evaluation. Effective reading: skimming and scanning; Reading and comprehension at various speed levels; Vocabulary development in various academic contexts; Reading diverse texts in

narratives and expository; Reading and comprehending passages with tables; Scientific texts; Reading for interpretation and critical evaluation.

GST107: The Good Study Guide (2 Units)

Getting started: How to use the book, why read about skills, getting yourself organised ; what is studying all about, reading and note taking; Introduction, reactions to reading, your reading strategy, memory, taking notes, conclusion. Other ways of studying: Introduction, learning in groups, talks and lectures, learning from TV and radio broadcasts, other study media. Working with numbers; Getting to know numbers, describing the world, describing with the tables, describing with diagrams and graphs; What is good writing? The Importance of writing, what does an essay look like, what is a good essay? Conclusion. How to write essays: Introduction, the craft of writing, the advantages of treating essay writing as a craft, making your essay flow, making a convincing case, the experience of writing. Preparing for examination.

CHM 101: Introductory Inorganic Chemistry (2 units)

Hypothesis, theory and law with appropriate illustrations, Nature of matter – 3 states of matter, Atomic structure, electronic energy levels and orbital. Periodic classification of elements and its relationship to their electronic configurations, Chemical bonding, Survey of properties and trends in groups I, II, IV, VI and transition metal,

CHM 102: introductory organic chemistry (2 units)

Simple reactions of hydrocarbons, alcohols, and acids. Petroleum chemistry, Oils and fats, hydrogenation of oils, polymer and biologically important molecule.

CHM 103: Introductory Physical Chemistry (2 units)

Mole concepts and calculations based on it, methods of expressing concentrations, Chemical Kinetics and equilibrium, and related calculations, Important application of equilibrium – pH, solubility products and solubility of ionic solids, Thermochemistry and simple calculations based on Hess's law, Electrochemistry and working of various cells, Brief mentions of corrosion; chemical thermodynamics; DG = DH – TDS

CHM 191: Introductory practical chemistry I (1 unit)

Practical based of CHM 101 and CHM 103: Cations and anions – identification, Acid- base titrations, Redox reactions and determinations

CHM 192: Introductory practical chemistry II (1 unit)

Practical based on general chemistry CHM 101 and introductory organic chemistry I CHM 102- Determination of melting and boiling points and reaction of functional groups.

BIO 101: GENERAL BIOLOGY I (2 UNITS)

Characteristics of living things; cell as the basic unit of living things, cell structure, organization, cellular organelles, tissues, organs and systems.

Classification of living things, general reproduction and concept of inter-relationships of organism. Heredity and evolution. Elements of ecology (introduction) and habitats.

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BIO 102 GENERAL BIOLOGY II (2 UNITS)

Systematic studies of diversity of life including monera, protista, plants (Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and angiosperms) and animals (Protozoa, Platyhelminthes, Annelids, Arthropods, Fishes, Amphibians, Reptiles, Birds and Mammals) based on similarities and differences in external morphology. Taxonomic divisions of plant and animal kingdoms. Ecological adaptations of these forms.

BIO 191 GENERAL BIOLOGY PRACTICAL I (1 UNIT)

What practical work in biology involves. Laboratory organization. Handling common laboratory equipment. Microscopic handling and maintenance. Making microscopic measurements. Procuring animal materials for practicals. Killing, preserving and maintaining animal materials. Procuring plant materials. External features of plants (differences and similarities). Preparation of temporary slides. Preparation of stains and reagents. Techniques for microbial culture and grain staining. Setting up demonstration for physiological processes in plants. Setting up apparatus for demonstrating physiological processes in animals. Preparation required for dissection.

BIO 192 GENERAL BIOLOGY LABORATORY II (1 UNIT)

Observation and description of the morphological and diagnostic features as well as the differences among the different phyla of the plant, animal, archebacteria, eubacteria, fungi and protista kingdoms. Identification of the taxonomic hierarchy of the members of the above groups. Study of the structure and functions of their parts and habitats specifications.

CIT 101: Computers IN Society (2 UNITS)

What is Computer, Types of Computer, History of Digital Computer, Element of a Computer : Hardware and Software. How to work with a computer. Operating System Windows Files word processing, copying a text, saving, Changes to a document and Formatting, spelling checker and

introduction to Printing a document. Spread sheet, Entering and correcting data. Using Formula, Numeric Formats Creating Charts. Types of Charts Power Points and presentation. Networking, Internet and E-mail. Reading and responding to an E-mail message.

MTH 101 ELEMENTARY MATHEMATIC I: (3 UNITS)

(ALGEBRA AND TRIGONOMETRY)

Elementary set theory, subsets, union, intersection, complements, venn diagrams. Real numbers; integers, rational and irrational numbers, mathematic I, induction real sequences and series, theory of quadratic equations, binomial theorem. Complex numbers; algebra of complex numbers; the Argand Diagram. Re Moivre's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formalae.

MTH 102: ELEMENTARY MATHEMATICS II: (2 UNITS)

Calculus: 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

STT 102: Introductory Statistics (2 UNITS)

Measures of Central Tendency and dispersion, (grouped and ungrouped); mean: – arithmetic and geometric, harmonic, median, mode quartiles, deciles, modes, relative and absolute dispersion, sample space and events as sets. Finite probability space properties of probability. Statistical independence and conditional probability. Tree diagram. Bayes theorem. Discrete and continuous random variables. Expectation, independent Bernoulli trials. Binomial Poisson and Normal distributions. Normal approximation to binomial and Poisson distribution, Hyper geometric.

PHY 101: ELEMENTARY MECHANICS, HEAT AND PROPERTIES OF MATTER (2 UNITS)

Space and Time: Physical quantities: Units and dimensions of physical quantities; Kinematics: Uniform velocity motion, uniformly accelerated motion; Dynamics: Newton's laws of motion; Impulse and Linear Momentum, Linear Collision, Newton's universal law of gravitation; Work, energy and power; Conservation laws; Concept of mechanical equilibrium; Centre of mass and centre of gravity; Moment of a force; Rotational kinematics and dynamics: Torque; Moment of Inertia; angular momentum; Total mechanical energy. Simple harmonic motion

Heat and temperature, work and heat, Quantity of heat: heat capacities, latent heat; Thermal expansion of solids, liquids and gases; Gas laws, heat transfer; Laws of thermodynamics: Isothermal and Adiabatic changes, Carnot cycle; Application kinetic theory of gases; van der Waals gas.

Classification of matter into (solids, liquids and gases, forces between atoms and molecules,

molecular theory of matter, Elasticity, plasticity, Hook's Law, Young's Shear and bulk Moduli) Crystalline and non-crystalline materials, Hydrostatics: pressure, buoyancy, Archimedes' principle; Hydro-dynamics-streamlines, Bernouli and Continuity equations, turbulence, Reynold's number, Viscosity, laminar flow, Poiseuille's equation; Surface tension, adhesion, cohesion, capillary, drops and bubbles.

PHY 102: ELECTRICITY, MAGNETISM AND MODERN PHYSICS (3 UNITS)

Electrostatics: Coulomb's law, Gauss's law, potential and capacitance, dielectrics, production and measurement of static electricity. Current: Ohm's law, resistance and resistivity, heating. Galvanometers, Voltmeters and Ammeters; D.C. circuits: sources of emf and currents, Kirchhoff's laws; Electrochemistry; The Earth's magnetic field; Magnetic fields and induction, Faraday's and Lenz's laws; Force on a current-carrying conductor. Biot-Savart law. Flemming's right and left-hand rules, motors and generators. A.C. Theory. Atomic structure; Production and properties of X-rays; Radioactivity; Photoelectric emission.

PHY 191: Introductory Practical Physics I (1 unit)

Graphs, Measurement, Error Analysis, Determination of Acceleration due to Gravity by Means of Simple Pendulum, Determination of force constant of a spiral spring, Determination of effective mass of a spiral spring and the constant, Determination of surface tension of water, Determination of specific latent heat of fusion of ice, Determination of the co-efficient of limiting static friction between two surfaces, Determination of the co-efficient of static friction on two surfaces using an inclined plane, Determination of Relative Density of kerosene using the specific Gravity Bottle, Determination of the Relative Density of a Granular substance not soluble in water using the specific gravity bottle.

PHY 192: Introductory Practical Physics II (1 unit)

Refraction through the glass block; Image formed by a concave mirror; Determination of the focal length of the convex mirror; Refraction through the triangular prism; Determination of the focal length of a converging lens and the refractive index of groundnut; Determination of resistance of resistors in series and in parallel in simple circuits; Determination of internal resistance of a dry cell using a potentiometer; To compare the E.M.F. of cells using potentiometer; Determine the unknown resistance of a resistor using Wheatstone Bridge; To determine the relationship between current through a Tungsten and a potential applied across it.

200 LEVEL

GST 201 Nigerian Peoples and Culture (2 Units)

Nigerian history, culture and arts in pre-colonial times; Nigerians' perception of their world; culture areas of Nigeria and their characteristics; evolution of Nigeria as a political unit; indigene/settler phenomenon; concepts of trade; economic self- reliance; social justice; individual and national development; norms and values; negative attitudes and conducts (cultism and related vices); re-

orientation of moral and national values; moral obligations of citizens; environmental problems.

GST 202 FUNDAMENTALS OF PEACE STUDIES AND CONFLICT RESOLUTION (2 UNITS)
Meaning and nature of conflict; causes and types of conflicts; conflict analysis, management, resolution and transformation; processes of conflict resolution peace education: the role of communication and language in conflicts; importance of the rules of conflict intervention latent stage of conflict and possible responses global issues and peace-building.

GST 203 INTRODUCTION TO PHILOSOPHY AND LOGIC (2 UNITS)

Nature and scope of philosophy, the traditional and special fields of philosophy; conceptions of the term ‘philosophy; epistemology, metaphysics, ethics and logic

BIO 213 CHEMISTRY OF AMINO ACIDS AND PROTEINS (2 UNITS)

Structure, properties and classification of amino acids, pH, pka and buffer, peptide. Reactions of specific amino acids, separation of sequence of peptides, chemistry of proteins including their structural level and types of bonds stabilizing them, properties, functions and classifications of proteins, enzymes, vitamins and co-enzymes

BIO 216 CHEMISTRY OF CARBOHYDRATES, LIPIDS AND NUCLEIC ACIDS (2 UNITS)

Classification of physical properties of carbohydrates, structure of glucose, projection and perspective formular, structure of properties of other monossacharides, brief treatment of dissacharides and polyssacharides. Chemistry, classification and properties of lipids. Methods of analysis of lipids, lipoprotein, membrane and membrane structure. Chemistry of nucleic acids (Bases, Sugar and Phosphate acid). Structure and roles of RNA and DNA

CHM 201: Physical chemistry II (2 units)

Kinetic theory of gases, behaviour of real gases; The laws of thermodynamic Entropy and free energy, reactions and phrase equilibrium; reaction rate laws for gases where the concentration of the reactions are the same. Mechanism and theories of unimolecular reactions.

CHM 202: Analytical chemistry I (2 units)

Theory of errors, statistical treatment of data; Theory of sampling, chemical methods of analysis including volumetric (acid base, oxidation – reduction, precipitation and complexiметry); Physicochemical methods (Optical methods of analysis – UV/V), separation methods. pH notation and buffer solutions. Gravimetry solubility product and its application to separation methods of metals.

CHM 203: Organic chemistry ii (2 units)

Factors affecting structure and physical properties of organic compounds; Factors affecting availability of electrons, Stereo-chemistry; Energy of activation and free radical substitution reactions in alkenes. Functional group chemistry. Electrophillic and nucleophillic substitution reactions. Aromaticity. Various type of organic reactions; e.g. addition, free radical, elimination and substitution

reactions.

CHM 204: Structure and BONDING (2 units)

Idea of quantum states. Orbitals, shape and energy, simple valence theory. Electron repulsion theory; atomic spectra. The structure and chemistry of some representative main group element compounds.

CHM 205: Inorganic chemistry II (2 units)

Chemistry of first row transition metals. Introduction to co-ordination Chemistry including elementary treatment of crystal field theory. Comparative Chemistry of the following elements: Ga, In, Tl, (b) Ge, Sn, Pb, (c) As, Sb, Bi (d) Se, Te, Po. Elementary introduction to Organometallic Chemistry. Role of metals in biochemical Systems

CHM 291: Practical chemistry III – INORGANIC chemistry (1 units)

Inorganic chemistry practical based on CHM 205

CHM 292: Practical chemistry IV – organic and physical chemistry (1 units)

Organic and physical chemistry practical based on CHM 201 and CHM 203.

MTH 212: Linear Algebra II (2 UNITS)

Vector spaces. Liner independence. Basis, change of basis and dimension. Linear equations and matrices. Linear maps. The diagonal, permutation, triangular matrices. Elementary matrix. The inverse of a matrix. Rank and nullity. Determinants. Adjoint, cofactors, inverse matric. Determinantial rank. Crammer's rule. Canonical forms, similar matrics, Eigen values and vectors, quadratic forms.

MTH 281: MATHEMATICAL METHODS 1: (2 Units)

Real-valued functions of a real variable. Review of differentiation and integration and their applications. Mean value theorem. Taylor series. Real-valued functions of two or three variables. Partial derivatives chain rule, extrema, languages multipliers. Increments, differentials and linear approximations. Evaluation of line, integrals. Multiple integrals.

PHY 202: Modern Physics I (2 Units)

Atomic structure, Charge quantisation, Mass spectra, the plum pudding model, Rutherford model and Bohr models of the atom, Hydrogen spectra, Magnetic moment and Angular momentum of an atom, Electron spin, Pauli exclusion principle and electronic configuration, X-ray spectra, Wave-particle duality, Nuclear structure: nomenclature, binding energy and stability, Radioactivity, The radioactive series, Accelerators, Detectors.

PHY 204: Electromagnetism (2 UNITS)

Macroscopic properties of dielectrics: polarisation, Gauss's law in a dielectric, the displacement

vector, boundary conditions on **D** and **E**, dielectric strength and breakdown; Capacitor: capacitance, the parallel plate capacitor, effect of a dielectric, energy stored in a dielectric medium, capacitors in series and parallel, practical capacitors; Microscopic properties of dielectrics: microscopic picture of a dielectric in a uniform electric field, determination of local field, Clausius-Mossotti equation, behaviour of dielectric in alternating fields; Magnetism of materials: response of various substances to a magnetic field, magnetic moment and angular momentum of an atom, diamagnetism and paramagnetism, Lamor precession, magnetisation of paramagnets, ferromagnetism, magnetic field due to a magnetised material, magnetic intensity, relationship between **E** and **H** for magnetic material, magnetic circuits.

300 LEVEL

GST302: Business Creation and Growth (2cr)

Concept of Business and New Value Creation: Business Planning Process; Start-up Decision – What Motivate people to begin new businesses; Opportunity Search and Identification; Legal Issues at Start-up; & Feasibility Analysis of New Ventures and New Venture Financing. ***Theories of Growth: An Overview***: Concepts and Reasons of Growth; Challenges of Growth; Strategies for Growth (External Growth Strategies Franchising, Buy-In and Buy-Out); Mergers and Acquisition; ***Sources of Funds***: Internal Sources and External Sources; Formal and Informal Sources; Efficiency in the use of Resources. ***Marketing***: Concept of Marketing: Small and Big Business Marketing; Marketing Mix; Modern Marketing Tools. ***Ethics and Social Responsibility***: The Importance of Ethics in Business; Ethical Behaviour and Practices in Nigeria; Community Development Projects/Walfare. ***New Opportunities for Expansion***: E-Commerce; E-Business; E-Trade. ***Managing Transition: From Start up to Growth***: Personal Disciplines; Learning; Decision Making; Control.

CHM 301: Physical chemistry III (3 units)

Introduction to key thermodynamic functions and applications. First, second and third laws of thermodynamics, internal energy of a system: the carnot heat engine; The concept of entropy and the criteria for spontaneity and equilibrium for physical and social processes including single and multiple comparism system. The concept of reversibility and irreversibility, free energy derivations, Maxwell relations, Gibbs functions. Equilibrium thermodynamic as (ideal solutions and vapour, fugacity concepts). Properties of electrolytes (colligate properties and phrase rule. Introduction to statistical thermodynamics

CHM 302: Polymer chemistry I (2 units)

The nature of Polymer nomenclature. Outline of sources of raw materials for polymers; Polymerization process, condensation polymerization in details. Solubility and solution properties of polymers. Structures and properties of polymers. Fibre forming polymers.

CHM 303: Inorganic chemistry III (3 units)

The noble gases. Hydrogen, electronic structure and general properties and comparative study of

Group IA Group IIA elements. Chemistry of Boron: Carbon and Silicon, nitrogen and phosphorous, oxygen and sulphur. The halogens, and transition element, separation of metals. Coordination chemistry, Ligand and crystal field theories, Introduction to radio chemistry , radio activity and the periodic table.

CHM 304: Colour chemistry and TECHNOLOGY (2 units)

Colour and constitution. Chemistry, properties of dyes and pigments. Classification of dyes and fibres. Dyeing mechanisms. Preparation and dyeing of natural and synthetic fibres.

CHM 305: Organic chemistry III (3 units)

Alcohols and their reactions. Ethers and Epoxides. Carboxylic acids and their derivatives. Aldehydes and ketones. Carbanion, α and β – unsaturated compounds. Polyfunctional compounds. Heterocyclic chemistry. Stereochemistry**;** Chirality, enantomers, E and Z. cis and trans, conformations

CHM 306: Instrumental methods of ANALYSIS (2 units)

Spectroscopic techniques, physicochemical optical; flame and X-ray methods. Fluorence method, magnetic resourance and electron spin resonance. Referchemistry and interferometry. florerimentry, polarography , calorimetry.

CHM 307: Atomic and molecular structure & symmetry (3 units)

Schrödinger equation. Helium atom, ground and excited states, spin and Pauli principles, hydrogen molecule, comparison of molecutar orbital and Valence bond theories; concepts of resonance and configuration of orbital for historic molecular, walsh rules. Rotational and vibrational bond length and angles. Brief mention of other methods, atomic spectra, Russell Sounder's coupling, orbital and spin angular momentum. Use of symmetry in chemistry. Heat capacities of solids. Theory of bonding in H_2^+ and H_2. Rotation and vibration of molecules. Heat capacities of crystals

CHM 309: Organic SPECTROSCOPY (2 units)

Principles and applications of UV, IR, NMR and Mass spectroscopy the determination and elucidation of structure of organic compounds.

CHM 311: Petroleum CHEMISTRY (2 units)

Petroleum in the contemporary energy scene: Nature, classification and composition of crude petroleum and natural gases. Distribution of petroleum and natural gas resources (the global and Nigerian situations). Petroleum technology, survey of refinery products and process. Petrochemicals as industrials raw materials. Prospects for the petrochemical industry in Nigeria and LNG

CHM 312: Industrial chemical processes I (2 units)

Production of primary intermediates and synthesis of industrial organic chemicals; Polymers, adhesives, dyes, explosives, insecticides, pesticides, herbicides, flavouring agents and

pharmaceutical. Fermentation process.

CHM 313: OrganOmetallic chemistry I (2 units)

Classification of organometalic compounds. Preparation, structure and reactions including abnormal behaviour of organmetalics. Generation and detection of free radicals from organometalic compounds.

CHM 314: Environmental CHEMISTRY (2 units)

Concepts of elementary cycles. Characteristics of the atmosphere. Sources, types and effects of environmental pollution. Waste water treatment. Composition of domestic wastes. Water chemistry and analysis. Chemical and Physical instrumentation in environmental sciences.

CHM 315: Carbohydrate CHEMISTRY (2 units)

Classification, structure and nomenclature of carbohydrates. Sugars, general reaction; preparations and reaction mechanisms. Configurations. Epimerisation.

CHM 316: Industrial chemical technology I (2 units)

Heat transfer and Mass transfer processes. Unit operations. Chemical technology equipment.

CHM 318: Natural PRODUCTS CHEMISTRY I (2 units)

Terpenoids, carotenoids, steroids, alkaloids and lipids

CHM 391: Practical chemistry V -Inorg and Analytical (1 units)

Inorganic and analytical chemistry practical, based on CHM 303 and CHM 202

400 LEVEL

CHM 402: Theory of molecular SPECTROSCOPY (2 units)

Quantum theory of rotation and vibration. Theory of microwave, IR, Raman, UV, Visible and NMR spectroscopy. General introduction to electron spin resonance, Mossbauer effect, nuclear quadruple resonance and other modern techniques.

CHM 405: Chemical THERMODYNAMICS (2 units)

Equations of state for gases, intermolecular forces, The laws of thermodynamics, internal energy and entropy; criteria for equilibrium, free energy; partial molar quantities, the chemical potential; Chemical equilibrium in ideal and non-ideal systems; The thermodynamics of mixtures; Statistical mechanics: microstates and randomness, probability and distribution functions; The Boltzmann distribution; Statistical thermodynamics of gases.

CHM 406: Nuclear and RADIOCHEMISTRY (2 units)

Natural radioactivity, fusion, fission, decay process, nature of radiation. Nuclear models, energetic of nuclear reaction. Principles and measurement of radioactivity. Applications of radioactivity. Radiation Hazards.

CHM 407: Reaction KINETICS (3 units)

Review of first, second and third order rate equations. Rate constants, and equilibrium constant collision theory, transition state theory, reaction coordinates. Unimolecular reaction theory, Bimolecular reaction mechanism: Chain reaction mechanisms; catalysis and heterogeneous reactions. Photochemical reactions mechanism.

CHM 408: Polymer chemistry II (2 units)

Polymerization mechanisms; detailed treatment of addition polymerization. Stereospecific polymerization. Copolymensation. Phase systems for polymerization. Industrially important thermoplastic and thermosetting polymers: Polyurethanes. Rubber elasticity. Mechanical properties of polymers. Analysis and testing of polymers. Degradation of polymers.

CHM 409: ELECTROCHEMISTRY (2 units)

Electrical double layer, potential at zero charge, polarizable and non-polarizable interface, mass transport, concentration polarization, Fick's Laws, Levic equation. Electrodics. Polargraphy. Corrosion – types and prevention.

CHM 411: PROJECT (6 UNITS)

A laboratory research project in any area of chemistry

CHM 413: Analytical chemistry II (2 units)

Theory of error-significance round correlation tests. Potentiometer and pH titrations. Conductometric methods, electrolytic methods, radiochemical methods. Chromatography Calorimetry.

CHM 414: Photochemistry and pericyclic REACTIONS (2 units)

Interaction of radiation with matter, electronic excitation, selection rules, deactivation routes, sensitization, quenching, photo fragmentation, oxidation, reduction, rearrangement, pericyclic reactions and molecular orbital symmetry

CHM 415: Industrial chemical technology II (2 units)

Hydrogen and carbon monoxide -synthesis gas, oxoprocess, water gas, source of hydrogen and its application. Industrial organic materials, Raw materials, Technical and economic principles of processes and product routes. Flow diagrams. Selected oils and fats, soaps and detergents, sugar, varnishes, plastics, wood pulp and paper. Environmental pollution.

CHM 416: Organic synthesis (2 units)

Critical view of important reactions, reagents and methods including the mechanisms. Application of synthesis of important and complex organic compounds.

CHM 421: Heterocyclic chemistry (2 units). The Synthetic and mechanistic aspects of fused heterocyclic system-particularly Quinolines, Iso- quinolines, Benzofurans, Benzothiophenes, Indoles, Genzopyrylium salts, Coumarius and Chromones. Application of heterocyclic systems in drug synthesis.

CHM 422: Natural products chemistry II (2 units)

Chemistry of terpenoids, steroids, and alkaloids, antibiotics, flavonoids. Prostaglandins and chlorophylls. Other natural products of pharmaceutical Importance. General methods of Isolation, separation, purification and structural determination of the natural products. Classifications. Discussion of chemistry of important members; Biogenesis.

CHM 423: Coordination CHEMISTRY (3 units)

Definition, Recognition and Applications of Coordination compounds. Nomenclature, Coordination formula and Isomerism in complexes. Stereochemistry of complex molecules; Theories of structures and bonding. Physical methods of structural investigation. Magnetic properties. Absorption and Vibrational spectra. The spectrochemical series. The Nephelauxetic series and the Jahn-Teller distortions. Stabilization of unusual oxidation states by complex formation. Thermodynamic stability of complex compounds, the stability constant, the chelate effect. Preparation and reactions complexes. Kinetics and Mechanisms.

CHM 424 NON-AQUEOUS SOLVENTS: (2 UNITS)

Classification and General Characteristics, solute-solvent interaction. Protonic solvents. Oxyhalide solvents. Liquid halides. Divitrogen tetroxide, sulphur dioxide. Leveling effects, non-aqueous titrations.

CHM 426: CHEMISTRY OF LANTHANIDES AND ACTINIDES (2 UNITS)

The elements and the position of the two series in the periodic table. Comparison of the two series. Lanthanides contractions. The electronic configuration and their sequences on oxidation states, size relationship, magnetic properties and colour. Chemical properties and structure of the elements and their compounds. Recovery and separation of the elements. Uses of Lanthanides and Actinides.