

**BAYERO UNIVERSITY, KANO**  
**COLLEGE OF NATURAL AND PHARMACEUTICAL SCIENCES**  
**FACULTY OF PHYSICAL SCIENCES**  
**DEPARTMENT OF PURE AND INDUSTRIAL CHEMISTRY**

**STUDENT HANDBOOK**



**2024**

## THE UNIVERSITY CREST

The University Crest is in the shape of a traditional slate: rectangular in shape with the four corners slightly slanted. Within the slate are the crest and the star.



The University Crest

The university crest encloses a crescent and a star rendered in beautiful Arabic calligraphy, an art form prevalent in the larger host community at the present time. The shape has a multi-symbol representation of the industry and learning for which Kano has been renowned for centuries. The shape is that of tanned animal skin (*buzu*), alluding to the centuries-old hides and skin industry and there sitting by learned scholars; at the same time, the shape is that of a slate/tablet used for writing throughout the sub-region in schools from ancient times to date. The calligraphy in the crescent unfurls into the phrases “*Jami’atu Bayero Kano*” which in English translates as “Bayero University, Kano”, a pointer to the centuries-long bilingual local scholarship. The star-shaped calligraphy is the motto of the university, a graphic pun, excerpted from the Holy Qur’an: “*Wa Fawqa Kulli Dhi Ilmin’ Alim*” it echoes an eternal truth that also underlines the humility and sense of service the community has come from its stars in the learning firmament: “**...And above every possessor of knowledge, there is One more learned**”.



The Vice-Chancellor  
Professor Sagir Adamu Abbas, FMAN  
B.Sc., (BUK), M.Ed., (BUK), PhD. (ABU)



The Registrar,  
Haruna Aliyu  
B.Sc., MSc., MBF (BUK)



The Provost, College of Natural and Pharmaceutical Sciences  
Prof. Tijjani Hassan Darma  
B.Sc., M. Sc. (BUK), PhD. (UWS, Scotland)





The Dean, Faculty of Physical Sciences  
Prof. Bashir Ali  
B.Sc., M. Sc. (BUK), PhD. (UNN)



The Head, Department of Pure and Industrial Chemistry  
Prof. Umar Sani  
B.Sc., M. Sc., PhD. (BUK)

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## **PHILOSOPHY OF THE UNIVERSITY**

Abdullahi Bayero College, Kano was reconstituted into a University College with effect from 1<sup>st</sup> October 1975 and into a university in October 1977. The philosophy and cardinal principles of Bayero University, Kano is to pay due respect to human values. Briefly, it is to:

Be rooted in its community and act as a symbol of the spirit of its community, the guardian of its morals, the formulator of its hopes and aspirations. Therefore, it shall cultivate a distinct tradition and character that reflect those essential values and nuances that give the host community its identity. The university shall ensure respect for human values as accepted by the host community, safeguard the objectives of a united, fair and just nation, promote the universality of knowledge and pursuit of academic excellence.

### **VISION**

*To lead in research and education in Africa.*

### **MISSION**

*Committed to addressing African developmental challenges through cutting-edge research, knowledge transfer and training high-quality graduates.*

### **MOTTO**

*“...And above every possessor of knowledge, there is One more learned”.*

### **CORE VALUES**

The University has the following values to guide its work performance: Humanity and Sacrifice; Discipline and Commitment; Integration and Active Learning; professionalism and Good Governance; Innovation and Creativity.

### **A Brief history of the Department**

The Department of Chemistry (initial name) was created in 1976 when the Faculty of Science was established in line with the Federal Government policy of creating seven (7) new second generation universities – Bayero University, Kano inclusive. The Department started under the Headship of Prof. B. J. Sulter-Duke in February 1977 and graduated first set of fifteen (15) students in 1980/81. Two (2) of the students made First Class Honours Degree. Three (3) students had Second Class Upper Honours, Eight (8) students had Second Class Lower Division while two (2) students had Third Class Honours Degree. The Department continued to grow in terms of Staff strength and development, student enrolment and facilities. By 1984/85, the Department was viewed as one of the best in the country in terms of teacher – student ratio owing to the fact that twenty-one (21) Lecturers out of a total of twenty-two (22) had PhD degrees. The Department in 2004/05 started B.Sc. Industrial Chemistry programme and was later renamed as Department of Pure and Industrial Chemistry in 2008 as it runs both B.Sc. Chemistry and B.Sc. Industrial chemistry. The department commenced B.Sc. Forensic Science programme during 2021/22 session, and presently the students admitted into the programme are at their third year.

Consequently, laboratory facilities were expanded to the major areas of Analytical, Colour/Polymer, Inorganic, Organic, Physical and Industrial Chemistry and at the same time

incorporating respective research laboratories, Instrumentation laboratory and a Glass Blowing Workshop. At present, out of the Staff strength of 43, 95% are products of the Department's Staff development programme.

The Department was ran under the headship of the following Staff during the sessions indicated against their names:

➤ Prof. B. J. Sulter-Duke	1977/78 – 1980/81
➤ Prof. T. A. Olagbemi	1981/82 – 1983/84
➤ Prof. A. M. Qureshi	1984/85 – 1989/90
➤ Prof. A. I. Onuchukwu	1990/91 – 1991/92
➤ Prof. B. B. Dambatta (Former Vice Chancellor)	1992/93 – 1993/94
➤ Dr. M. M. Idris	1994/95 – 1995/96
➤ Dr. W. L. O. Jimoh	1996/97 – 2002/03
➤ Prof. A. A. Audu	2003/04 – 2006/07
➤ Dr. S. M. Gumel	2006/07 – 2010/11
➤ Dr. M. A. Kurawa	2010/11 – 2014/15
➤ Dr. H. Musa	2014/15 – 2018/19
➤ Dr. I. T. Siraj	2018/19 – 2021/22
➤ Prof. U. Sani	2021/22 – Date

## PART A

### CURRICULUM FOR THE FOUR-YEAR B.Sc. DEGREE PROGRAMME IN CHEMISTRY

#### Philosophy:

The training in Chemistry is focused towards producing skilled manpower through excellent knowledge in teaching and research for the overall national growth, development and sustenance.

#### Objectives:

- i. Chemical education emphasizes the importance of a thorough grounding in theoretical and experimental chemistry by exposing students to modern analytical tools.
- ii. The graduates are equipped not only for teaching and higher studies in chemistry but also for careers in public and private enterprises.
- iii. It exposes chemists to the need for up-to-date knowledge in various fields of chemical sciences, makes them creative and innovative and aligns them with state-of-art tool of research and development.
- iv. It closes the gap between the low standard of chemical literacy in relation to the exploding national population.

#### (c) Admission Requirements:

- i. For entry into 100 Level:  
Five SSCE/GCE/NECO O/Level credits in English, Mathematics, Physics, Chemistry and Biology, obtained in not more than two (2) sittings.

ii. For Direct entry into 200 Level:

Minimum of five subjects passed at credit level in not more than two (2) sittings with at least TWO 'A' level and THREE others which must be credit at 'O' level. (No subject should be counted at both ordinary and advanced level).

OR

A Diploma (at least Lower Credit) in Industrial Chemistry of Bayero University or any other recognized institution (at least Upper Credit) and 'O' Level credits or equivalent in five (5) related subjects including Mathematics and English.

OR

IJMB credits in Chemistry, Physics and Mathematics and 'O' Level credits or equivalent in five (5) related subjects including Mathematics and English.

OR

Pass in two (2) major subjects in the NCE with 'O' Level credits or equivalent in five (5) related subjects including Mathematics and English.

OR

Any other equivalent certificate deemed fit by the Departmental/Faculty admission committee.

### **COURSE NOMENCLATURE**

Course Numbering:

The four numbering is used as follows;

First digit	-	Level
Second digit	-	Credit value
Third digit	-	Subject area
0	-	Project, Seminar and Industrial attachment
1	-	Analytical
2	-	Color and Polymer
3	-	Inorganic
4	-	Organic
5	-	physical
6	-	practical
7	-	SIWES
8	-	Industrial Chemistry
Fourth digit	-	Course serial number

### **COURSE DISTRIBUTION PER LEVEL PER SEMESTER**

A candidate in order to satisfy the requirements for the award of degree in B.Sc chemistry must offer the following courses

**LEVEL 100**

- Chemistry Courses      08 Credits (Core)
- Mathematics              06 Credits (Core)
- Physics                      08 Credits (Core)
- GSP                          04 Credits (Core)
- Additional 08 credits from either Biology or Mathematics

Total      =    34 Credits

The details of the courses are as follows

<b>First Semester</b>		
<b>Course</b>	<b>Title</b>	<b>Credits</b>
CHM 1231	Inorganic Chemistry	2
CHM 1241	Organic Chemistry	2
MTH 1301	Elementary Math I	3
STA 1311	Probability	3
CSC 1201	Introduction To Computer	2
GSP 1201	Use Of English	4
PHY 1170	Physics Practical	1
PHY 1210	Mechanics	2
PHY 1220	Electricity And Magnetism	2
BIO 1201	General Biology I	2
BIO 1203	General Biology III	2
<b>Total</b>		<b>25</b>

<b>Second Semester</b>		
<b>Course</b>	<b>Title</b>	<b>Credits</b>
CHM 1251	Physical Chemistry	2
CHM 1261	Practical Chemistry	2
MTH 1302	Elementary Math II	3
MTH 1303	Elementary Maths III	3
PHY 1180	Physics Practical	1
PHY 1230	Behaviour Of Matter	2
BIO 1202	General Biology II	2
BIO 1204	General Biology IV	2
GSP 1202	Use of Library and ICT	22
<b>Total</b>		<b>22</b>

**LEVEL 200**

- Chemistry Courses      16 Credits (Core)
- Mathematics              05 Credits (Core)
- Physics                      06 Credits (Core)
- GSP                          06 Credits (Core)
- Additional 04 core credits from GSP 2201 and GSP 2202 for Direct entry students only
- All level 200 students must register additional 05 credits from Physics and/or Mathematics

Total      =    38 Credits



The details of the courses are as follows

<b>First Semester</b>		
<b>Course</b>	<b>Title</b>	<b>Credits</b>
CHM 2241	Organic Chemistry 1	2
MTH 2203	Linear Algebra 1	2
PHY 2310	Elementary Modern Physics	3
PHY 2320	Electric Circuits And Electronics	3
GSP 2204	Foundation Of Nigerian Culture, Govt and Economy	2
GSP 2206	Peace & Conflict Resolution	2
CHM 2251	Physical Chemistry	2
CHM 2232	Structure & Bonding	2
<b>Total</b>		<b>18</b>

<b>Second Semester</b>		
<b>Course</b>	<b>Title</b>	<b>Credits</b>
CHM 2261	Practical Chemistry	2
CHM 2212	Computing In Basic For Chemist	2
CHM 2211	Analytical Chemistry	2
CHM 2242	Organic Chemistry II	2
CHM 2231	Inorganic Chemistry	2
GSP 2205	Logic and Philosophy	2
MTH 2302	Differential Equations	3
<b>Total</b>		<b>15</b>

<b>Electives (First Semester)</b>			<b>Electives (Second Semester)</b>		
<b>Course</b>	<b>Title</b>	<b>Credits</b>	<b>Course</b>	<b>Title</b>	<b>Credits</b>
MTH 2301	Mathematical Methods 3	3	MTH 2204	Linear Algebra II	2
PHY 2160	Renewable Energy	1	PHY 2180	Practical Physics	1
PHY 2170	Practical Physics	1	PHY 2340	Waves And Optics	3
			PHY 2350	Thermal Physics	3

### **LEVEL 300**

- Core Courses                    20 Credits
- Electives                            At least 06
- EEP 3201                            02 Credits
- Students must register a minimum of 26 credits and a maximum of 32 credits

The details of the courses are as follows

<b>First Semester</b>		
<b>Course</b>	<b>Title</b>	<b>Credits</b>
CHM 3213	Instrumental Methods Of Analysis	2
CHM 3231	Inorganic Chemistry I	2
CHM 3232	Inorganic Chemistry II	2
CHM 3241	Applied Spectroscopy	2
CHM 3242	Organic Chemistry	2
CHM 3251	Physical Chemistry	2
CHM 3252	Atomic And Molecular Structure And Symmetry	2
EEP 3201	Entrepreneurship and Innovation	2
<b>Total</b>		<b>16</b>
<b>Electives (First Semester)</b>		<b>Credits</b>
CHM 3211	Computing In Basic For Chemist	2
CHM 3212	Environmental Chemistry	2
CHM 3222	Polymer Chemistry I	2
CHM 3223	Colour Chemistry And Technology I1	2
CHM 3235	Organometallic Chemistry I	2
CHM 3245	Natural Products I	2
Chm 3255	Chemical Physics And Photochemistry	2
Chm 3281	Industrial Chemical Tech. I	2
Chm 3282	Industrial Chemical Process I	2

<b>Second Semester</b>		
<b>Course</b>	<b>Title</b>	<b>Credits</b>
CHM 3671	SIWES	6
<b>Total</b>		<b>6</b>

#### **LEVEL 400**

- Core Courses      26 Credits
- EEP                      02 credits
- Elective Courses    At least 06 credits
- Students must register a minimum of 36 credits and a maximum of 46 credits

The details of the courses are as follows

<b>Core First Semester</b>		
<b>Course</b>	<b>Title</b>	<b>Credits</b>
CHM 4200	Seminar	2
CHM 4212	Analytical Chemistry	2
CHM 4242	Physical Organic Chemistry	2
CHM 4252	Theory Of Molecular Spectroscopy	2
CHM 4251	Applied Electrochemistry	2
CHM 4284	Industrial Chemical Process II	2
CHM 4243	Heterocyclic Chemistry	2
CHM 4344	Organic Synthesis	3
<b>Total</b>		<b>17</b>

<b>Electives (First Semester)</b>		
CHM 4253	Material Science And Corrosion	2
CHM 4284	Industrial Chemical Process II	2
CHM 4222	Polymer Chemistry II	2
CHM 4225	Colour Chemistry And Technology II	2
CHM 4257	Group Theory And Symmetry	2
CHM 4234	Inorganic Chemistry In Non Aqueous Media	2
CHM 4235	Nuclear Chemistry And Radio Chemistry	2
CHM 4233	Inorganic Reaction Mechanism	2

<b>Core Second Semester</b>		
<b>Course</b>	<b>Title</b>	<b>Credits</b>
CHM 4600	Project	6
CHM 4331	Coordination Chemistry	3
EEP 4201	Business Creation and Growth	2
<b>Total</b>		<b>9</b>

<b>Electives (Second Semester)</b>		
CHM 4224	Polymer Technology & Rheology	2
CHM 4226	Textile Chemistry	2
CHM 4232	Chemistry Of Lanthanides & Heavy Metals	2
CHM 4245	Carbohydrate Chemistry	2
CHM4254	Quantum Chemistry	
CHM 4255	Statistical Mechanics	2
CHM 4256	Thermodynamics And Surface Phenomena	2
CHM 4259	Applied Surface & Colloids Chemistry	2
CHM 4244	Petrochemistry	2
CHM 4236	Organometallic Chemistry	2
CHM 4246	Photochemistry And Pericyclic Reaction	2
CHM 4258	Chemical Kinetics	2

## BSc CHEMISTRY COURSE CONTENT

### LEVEL 100 COURSES

#### CHM 1231: INORGANIC CHEMISTRY

Atoms, molecules and chemical reactions; chemical equation and Stoichiometry. Atomic structure; discovery and properties of fundamental particles of atom (Thomson's discharge tube experiment, Rutherford's  $\alpha$  - scattering experiment, Millikan's oil drop experiment and Chadwick experiment). Models of the Atom (Thomson's plum pudding model, Rutherford's model, Bohr model). Concept of isotopy, Atomic and molecular mass, Empirical and molecular formula. Electronic structure; Energy levels, Quantum Numbers and Electronic configuration. Periodic Table and periodicity; General properties of periodic Table; atomic radii, ionic radii, ionization energy density, electron affinity, electronegativity, melting point, boiling point and oxidation states. Introduction to transition metals; electron configuration and general properties. Types of bonding and inter molecular forces. Extraction of metals. Introduction to nuclear Chemistry.

#### CHM 1241: ORGANIC CHEMISTRY

Historical survey of the development and importance of Organic Chemistry, IUPAC Nomenclature and classification of Organic compounds, Homologous series, hybridization of carbon atom to reflect tetravalency. Electronic theory in organic chemistry. Qualitative and quantitative organic chemistry, Empirical and Molecular Formula, Simple techniques of writing structural formulas. Saturated hydrocarbons, structural isomerism. Preparation, properties and reactions of alkenes and cycloalkanes, their basic chemistry and uses in petroleum; unsaturated hydrocarbons, alkenes, cycloalkenes, alkynes, *cis*, *trans* isomerism, simple electrophilic addition reaction, polymerization.

#### CHM 1251: PHYSICAL CHEMISTRY

Interconversion of some physical units. Properties of Ideal and real gases; Equation of state,  $PV = nRT$  and its application, Deviation from ideality and Van der Waal's equation. Elementary kinetics molecular Theory of gases. Thermodynamics and enthalpy of reaction, Bond energies, Hess's Law and Born - Haber cycle. Chemical equilibrium; Dynamic equilibrium,  $K_{eq}$ ,  $K_c$  and  $K_p$ .  $K_c$ - $K_p$  relationship and Le Chatelier's principle. General concept of acids and bases. Ionic equilibrium.  $K_w$ , pH, pOH, Buffer solutions, indicators, Solubility product and its application, common ion effect. Electrochemistry; Oxidation - reduction reaction, Electrode potential and Gibb's free energy change ( $\Delta G$ ) relationship. Solids; General properties of solids, unit cells and lattice points.

#### CHM 1261: CHEMISTRY PRACTICALS

Laboratory instruction and Experimental products shall be conducted for the candidates from the following subject areas:

**Physical:** Determination of heats of reaction, effects of solute on boiling point of solvents, partition coefficient. Other experiments based on the scope of the Lectures and as approved by the Department.

**Organic:** Safety precautions, classification of organic compounds by their solubilities in common solvents. The Lessinger's tests for

qualitative analysis of common elements in organic compounds. Identification and classification of acids and bases functional groups. Identification and differentiation of the following neutral functional groups; alcohols, aldehydes, ketones, esters, anhydrides and ethers. Acetylation of aniline as an example of the preparation of solid aniline derivatives. An electrophilic addition reaction.

**Inorganic:** Qualitative and quantitative analysis: molarity, concentration and percentage purity.

## LEVEL 200 COURSES

### CHM 2211: INTRODUCTION TO ANALYTICAL CHEMISTRY

25 Lectures/5 Tutorials Assessment Scheme B

2 – Hours Examination

Brief introduction of analytical chemistry fundamental concepts such as moles, concentration etc., theory of errors in Analysis, steps in Analysis, pretreatment techniques and methods of Analysis.

### CHM 2231: INORGANIC CHEMISTRY

25 Lectures/5 Tutorials Assessment Scheme B

2 – Hours Examination

Stereochemistry and molecular orbital theory of simple molecules containing homo and heteroatoms.

Hydrogen; Structure of ice and water, the hydron ion, protonic acids, oxoacids, hydrides.

Group IA; Electronic structure and general properties. Anomalous behaviour of lithium, alkali metals in liquid ammonia, binary and complex compounds of alkali metals.

Group IIA; Electronic structure and general properties, composition of beryllium with other elements in this group. Binary and complex compounds of group IIA elements.

The Noble gases; Occurrence, isolation, application, group trend compounds of inert gases and their structure.

Concept of hard and soft acids and bases. Oxidation-reduction reactions, chemistry in aqueous and non-aqueous media.

### CHM 2232: STRUCTURE AND BONDING

25 Lectures/5 Tutorials Assessment Scheme B

2 – Hours Examination

Ideas of bonding and degenerate state. Atomic orbitals, shape and energy. Electronic structure of atoms and experimental basis survey (Millikan, Rutherford, Bohr etc.). Simple valence bond theory, electron pair repulsion theory, atomic spectra, method of determining molecular shapes, bond lengths and angles. Structure and bonding in ionic crystals, Isomorphism and polymorphism, crystal lattice, lattice energy and polarization of ions.

### CHM 2241: ORGANIC CHEMISTRY I

25 Lectures/5 Tutorials Assessment Scheme B

2 – Hours Examination

Factors affecting structure and properties of organic compounds; atomic orbitals, bonding and hybridization. Factors affecting availability of electrons; Inductive, mesomeric and steric effects. Introductory stereochemistry; optical



activity, conformational isomers, Chirality etc. E – Z system of naming geometrical isomers. Methane, energy of activation and free radical substitution reaction in alkanes. Conformational analysis of open chain and ring systems. Alkyl halides; preparation, properties, nucleophilic and electrophilic substitution reactions, Elimination reactions. Aromaticity and electrophilic reactions.

**CHM 2242: ORGANIC CHEMISTRY II**  
20 Lectures/10 Labs. Sessions  
2 – Hours Examination Assessment Scheme A  
Preparation, properties and reaction mechanisms of Alcohols, Ethers, Epoxides, Aldehydes, Ketones, Carboxylic acids and their derivatives and  $\alpha$ ,  $\beta$  - unsaturated carbonyl compounds.

**CHM 2251: PHYSICAL CHEMISTRY**  
25 Lectures/5 Tutorials Assessment Scheme B  
2 – Hours Examination  
Thermodynamics; Laws of thermodynamics, Entropy, Gibb's and Helmholtz's free energies. Feasibility of chemical systems. Equipartition principle;  $C_v$  and  $C_p$  for perfect gas. Phase rule and its application. Kinetics and rate of reactions; rate equation; rate Law, order and factors affecting rate of reaction. Introduction to collision rate.

**CHM 2261: PRACTICAL CHEMISTRY**  
30 laboratory sessions/Assessment Scheme C  
Candidates shall conduct at least 10 laboratory practicals chosen from each of the following subject areas: Inorganic, Organic and Physical. A laboratory manual shall be provided as guide to the student.

**Organic:**  
Determination of melting points of organic solids, mixtures, boiling points of organic liquids. Simple and fractional distillation of two or more components at normal and reduced pressures. Separation of azeotropic mixtures. Crystallization and re-crystallization of organic solids. The refluxing techniques. Use of separatory funnel. Thin layer and column chromatography. Aromatic electrophilic substitution reactions. Determination of partition coefficients of organic compounds.

**Inorganic:**  
Studies of some typical reactions of transition metals, redox titration. Ion exchange technique.

**Physical:**  
Measurements of boiling points, enthalpy, Gibb's free energy and other related parameters for ideal and real solutions. Determination of rates, order and activation energy of reactions. The effect of catalyst on kinetics parameters.

**Analytical:**  
Statistical treatment of analytical data. Experiments to be designed based on gravimetric, titrimetric and Spectrophotometric methods of analysis.

### LEVEL 300 COURSES

**CHM 3231: INORGANIC CHEMISTRY I**  
20 Lectures/10 Laboratory sessions  
2 – Hours Examination Assessment Scheme A  
Pre-requisites CHM 2250 and CHM 2231  
Group III A: Chemistry of Boron and its compounds. Group IV; Group trend, diamond, graphite, carbides and compounds with C – N and C – S bonds.

Chemistry of silicon and its compounds such as halides, oxyhalides silicones and silicate. Group VA; group trend, anomalous behaviour of nitrogen. Important compounds of nitrogen and phosphorous including hydrazine, hydrazoic acid and hydroxyl amine. Group VI A; Group trend, chemistry of halides, oxohalides, peroxides and peracids of oxygen and sulphur, sulphur – Nitrogen compound. Group VII A; the halogens. General trend within group. Binary ionic halides, molecular halides, oxohalides, oxoacids of halogen and their salts. Interhalogen compounds, polyhalides. Charge transfer compounds of halogens.

- CHM 3232: INORGANIC CHEMISTRY II**  
20 Lectures/10 Laboratory sessions  
2 – Hours Examination Assessment Scheme A  
Introduction to transition Elements: General Comparison of the elements of second row and third row transition series with the elements of first series. Study of the following elements and their important compounds: [Zr, Hf], [Nb, Ta], [Mo, W], [Te, Re], [the platinum metals] and [Ag, Au]. Separation of metals; solvent extraction, ion exchange techniques.
- CHM 3241: APPLIED SPECTROSCOPY**  
20 Lectures/10 Tutorials  
2 – Hours Examination Assessment Scheme B  
Principles and application UV, IR, NMR and Mass Spectroscopy to the determination and elucidation of structures of organic compounds. Practical Instrumentation.
- CHM 3242: ORGANIC CHEMISTRY I**  
20 Lectures/10 Labs. Sessions  
2 – Hours Examination Assessment Scheme A  
Preparation, properties and reaction mechanisms of Alcohols, Ethers, Epoxides, Aldehydes, Ketones, Carboxylic acids and their derivatives and  $\alpha$ ,  $\beta$  - unsaturated carbonyl compounds.
- CHM 3243: ORGANIC CHEMISTRY**  
20 Lectures/10 Labs. Sessions  
2 – Hours Examination Assessment Scheme A  
Carbonion I: Acidity of  $\alpha$  – hydrogen, Claisen and crossed Claisen condensation, tautomerism and Reformatsky reactions, Carbonion II: Malonic ester and Aceto-acetic ester synthesis, Decarboxylation of  $\beta$  – keto acids, Chemistry of Amines and Introduction to four, Five and Six membered heterocyclics with one or two heteroatoms.
- Pre-requisite CHM 3242
- CHM 3251: PHYSICAL CHEMISTRY**  
20 Lectures/10 Laboratory sessions  
2 – Hours Examination Assessment Scheme A  
Gibb's and Helmholtz's functions, thermodynamics of gases and solutions, and properties of electrolytes.
- CHM 3252: ATOMIC AND MOLECULAR STRUCTURE AND SYMMETRY**  
20 Lectures/ 5 Tutorials  
2 – Hours Examination Assessment Scheme B  
Introduction to quantum mechanics, Schrödinger equation, Electron spin and Pauli exclusion principle, Simple application of Born –

Oppenheimer approximations, molecular orbitals for diatomic molecules, Hückel theory for simple  $\pi$  electron systems, discussion of Hückel ( $4n + 2$ ) rule, Walsh rule, Comparison between molecular and valence bond theories, simple application of rotational, vibrational and electronic spectra in determining bond lengths and angles, Atomic spectra, Russell Saunders Coupling for orbitals, spin and total angular momentum, Term symbols and selection rules and molecular symmetry.

- CHM 3211: COMPUTING IN BASIC FOR CHEMISTRY**  
25 Lectures/ 5 Tutorials  
2 – Hours Examination Assessment Scheme B  
Introductory Concept, BASIC LANGUAGE, BASIC COMMANDS, branching and loop, Basic in chemistry.
- CHM 3212: ENVIRONMENTAL CHEMISTRY**  
25 Lectures/ 5 Tutorials  
2 – Hours Examination Assessment Scheme B  
Atmosphere Assessment, hydrosphere, lithosphere, Biosphere and Food.
- CHM 3213: INSTRUMENTAL METHODS OF ANALYSIS**  
25 Lectures/ 5 Tutorials  
2 – Hours Examination Assessment Scheme B  
Theory and working of selected Instruments and their applications to problems of organic and inorganic chemistry. UV Visible Spectrometry, Infrared, IR spectrometry, Flame Emission and Atomic Absorption Spectrometry. Fluorescence and Phosphorescence spectrometry. Introduction to Electro Analytical Techniques. X- ray and radiochemical methods of analysis.
- CHM 3222: POLYMER CHEMISTRY**  
20 Lectures/ 5 Labs. Sessions  
2 – Hours Examination Assessment Scheme A  
Pre-requisite CHM 2261, 2241  
Polymerization process, preparation of polymer intermediates, structure and properties of polymers, Fiber forming polymers.
- CHM 3223: COLOUR CHEMISTRY AND TECHNOLOGY I**  
20 Lectures/ 5 Labs. Sessions  
2 – Hours Examination Assessment Scheme A  
Pre-requisite CHM 2261, 2240  
Properties of dyes and pigments. Dyeing mechanisms. The preparation and dyeing of natural fibres' Vat, Azoic and Sulphur dyes on cellulose and acid dyes on protein fibres. Colour fastness properties and assessment techniques.
- CHM 3235: ORGANOMETALLIC CHEMISTRY I**  
25 Lectures/ 5 Tutorials / 5 Labs. Sessions  
2 – Hours Examination Assessment Scheme B  
Pre-requisite CHM 2231, 2241  
Classification of Organometallic compounds. Preparation, structure and reactions including abnormal behaviours and synthetic utility of organometallics of alkali metals and alkali earth metals.

- CHM 3244: PETROCHEMISTRY**  
 25 Lectures/5 Tutorials 2 – Hours Examination Assessment Scheme B  
 Pre-requisite CHM 2241  
 Petroleum in contemporary energy scene. Nature, Classification and composition of crude petroleum and natural gases. Distribution of petroleum technology (cracking, catalytic reforming, dewaxing etc), survey of refinery products and processes. Petrochemicals in Industrial raw materials (coal, wood, water, gas, fats, oil etc)
- CHM 3245: NATURAL PRODUCT CHEMISTRY**  
 20 Lectures/ 5 Labs. Sessions  
 2 – Hours Examination Assessment Scheme A  
 Pre-requisite CHM 2241  
 Biosynthesis and chemistry of Terpenoids, Carotenoids, Steroids, Alkaloids, Lipids, Flavonoids, Prostaglandins and Chlorophylls. Modes of isolation and identification.
- CHM 3255: CHEMICAL PHYSICS AND PHOTOCHEMISTRY**  
 25 Lectures/5 Tutorials  
 2 – Hours Examination Assessment Scheme B  
 Pre-requisite CHM 2251  
 i. Chemical physics: theory of bonding in  $H_2^{+1}$  and  $H_2$ , Rotation and Vibration molecules, Heat capacities of crystals.  
 ii. Photochemistry: photochemical equivalence, light absorption by atoms and molecules, photochemical kinetics and experimental studies, photosynthesized gas reaction, flash photolysis, photochemical equilibrium, chemiluminescence and radiation chemistry.
- CHM 3285: INDUSTRIAL CHEMICAL TECHNOLOGY**  
 25 Lectures/5 Tutorials  
 2 – Hours Examination Assessment Scheme B  
 Pre-requisites CHM 2251, Co-Req. CHM 3251  
 Applied chemical thermodynamics, Heat transfer, Bernoulli equation, Continuity equation, thermodynamics of fluid flow, mechanism of fluid flow, Heat transfer coefficients, Economic of material balance, flow diagram. Recycle and by-pass streams. Unit operations. Chemical technology equipments. Pressure drops and calculation, Fourier law, Heat exchangers, Simple reactor principle, Economic and technical feasibility of chemical processes.
- CHM 3283: INDUSTRIAL CHEMICAL PROCESS I**  
 25 Lectures/5 Tutorials  
 2 – Hours Examination Assessment Scheme B  
 1. Characterization and importance of chemical Industries  
 Conversion efficiency, yield and rationalization. Economic and Technical feasibilities as applied to production of primary intermediates and finished products.  
 2. Synthesis of Industrial Organic Chemicals, Polymers, adhesives, dyes, explosives, insecticides, pesticides, herbicides and pharmaceuticals.  
 3. Flow characteristics: Back mixing, residence time, distribution and dispersion models, catalytic reactions, designed operation of gas/liquid and liquid /liquid phases.

**CHM 3671: INDUSTRIAL ATTACHMENT**

A total of 6 months Industrial Attachments.  
Assessment Scheme C.

This course is compulsory to all B. Sc. Chemistry students. It is designed to train students on the industrial application of chemistry. The candidates shall undertake Industrial Attachment as follows:

At the end of first semester Level 300 for 6 (six) months

The assessment here is sub divided as follows:

(a) Industrial written report by the candidate:	40%
(b) Management's assessment for candidate:	30%
(c) Supervisor's Assessment:	<u>30%</u>
Total	<u>100%</u>

**LEVEL 400 COURSES**

All courses in Level 400 consist of compulsory and electives. Candidates shall be guided by the department in choosing the electives.

**CHM 4600: RESEARCH PROJECT**

A supervised project involving research in the laboratory and library. The student is expected to spend at least 270 hrs. the results are to be presented in a typed bound dissertation, which will be orally examined by the supervisor, one other member of staff from related area of the subject and the external examiner. The final grade will be determined as follows:

External Examiner	30%
Internal Examiner	10%
Supervisor	40%
Oral presentation	10%

In case where a fail grade [ $<40\%$ ] has been recorded, the examiners may require the candidate to carry out further specified tasks and to resubmit the dissertation by a specified date.

Pre-requisites: pass in at least 8 – credits in compulsory CHM 3000 (Level III) courses.

**CHM 4200: LIBRARY TECHNIQUES AND SEMINAR**

- Use of Chemical literature such as text books, chemical Abstracts, Journals etc.
- A topic involving a literature search.  
Assessment; course work 40%  
Supervisor's Assessment 60%

**CHM 4212: ANALYTICAL CHEMISTRY**

25 Lectures/ one Industrial visit /3 Tutorials  
2 – Hours Examination Assessment Scheme B  
Potentiometric and pH methods, conductometric methods.  
Chromatography and Electrolytic methods. Industrial safety

**CHM 4222: POLYMER CHEMISTRY II**

20 Lectures/ 10 Labs. Sessions  
2 – Hours Examination Assessment Scheme A  
Pre-requisite CHM 3222

Detail treatment of addition polymerization, mechanisms and kinetics of ionic and free-radical polymerization. Stereo-specific polymerization, co-polymerization (introduction). Phase systems for polymerization-bulk,



solution and suspension polymerization. Industrially important thermoplastics thermosetting polymers:- preparation, properties and uses. Polyurethanes-fibers, elastomers and coatings and adhesives. polymer solutions:- thermodynamic properties, phase separation and fractionation. Mechanical properties of polymers. Analysis and testing of polymers. Degradation of polymers.

**CHM 4224: POLYMER TECHNOLOGY AND RHEOLOGY**

25 Lectures/ one Industrial visit /3 Tutorials

2 – Hours Examination Assessment Scheme B

Pre-requisite CHM 3222, Co-requisite CHM 4222

The crystalline state of polymers. amorphous state of polymers. Mechanical properties of polymers. Visco elastic properties of polymers. Rubbers (Elastomer): Natural and synthetic rubbers, Elasticity, mastication, vulcanization and compounding of rubbers, uses of latex and rubber materials. Flow properties of molten polymers.

Polymer additives: anti-oxidants and anti-degradation additives, flame retardants, fillers, plasticizers; blowing agents; cross-linking agents; pigments and dye stuffs.

Polymer processing techniques: mixing, extrusion, injection moulding, compression moulding, calendaring, vacuum forming, casting and surface coatings, paints and adhesives.

**CHM 4225: COLOUR CHEMISTRY AND TECHNOLOGY II**

25 Lectures/ 2 Tutorials/3 Laboratory Sessions

2 – Hours Examination Assessment Scheme B

Pre-requisite CHM 3223

Application of unit processes such as nitration, sulphonation, oxidation etc. in the preparation of intermediates from dyestuff industry. The preparation and chemistry of azo compounds and their application in the manufacture of commercial azo dyes. The chemistry of azo dyes. Outline chemistry of fluorescent brightening agents. The chemistry of ionic and non-ionic surface-active agents and their uses. Classification and properties of pigments. Industrial uses of pigments such as paints, plastics, printing inks.

**CHM 4226: TEXTILE CHEMISTRY**

25 Lectures/ 3 Laboratory /2 Tutorials

2 – Hours Examination Assessment Scheme A

Pre-requisite CHM 3222, CHM 3223

Chemistry of textile fibres, chemistry of wet processing of textiles, Environmental control and energy conservation in textile industry, methods of treatment and disposal of effluents, principle and experimental techniques of various chemical processes and industrial Visits.

**CHM 4331: CO-ORDINATION CHEMISTRY**

20 Lectures/ 5 Laboratory Sessions

2 – Hours Examination Assessment Scheme A

Pre-requisite CHM 2230, 3230, 3221

Nomenclature, isomerism, stability constant and their determination, stability of complex ions in solution chelate effect. Valance-bond theory, Crystal field theories, Molecular orbital theory and ligand field theories

to explain bonding in coordination compounds. (In octahedral, tetrahedral and square planar geometry). High spin and low spin complexes. The spectrochemical series: crystal field stabilization energies, solubility of hexaaqua-ions, John-Teller effect. Electronic spectra of transition metal complex. Magnetic and spectral properties of transition metal complexes. Method of characterization of transition metal complexes. Electron deficient compounds: Boranes, Borene anion, carboranes, metal alkyls and aryls. Preparation, reactions and structure of complexes with  $\pi$ -bonding ligands as CN, CO, NO.

**CHM 4232: CHEMISTRY OF LANTHANIDES, ACTINIDES AND SOME HEAVY METALS**

25 Lectures/ 5 Laboratory Sessions

2 – Hours Examination      Assessment Scheme B

Pre-requisite CHM 3231, 3232

The elements and the position of the two series in the periodic table, General characteristics of the f-block elements, The electronic configuration and their consequences on the following:

- i)      oxidation states
- ii)     size relationship
- iii)    magnetic properties
- iv)    colour.

Chemistry of Lanthanides ( $_{58}\text{Ce} - _{71}\text{Lu}$  and  $_{57}\text{La}$ ), Chemistry of Actinides ( $_{90}\text{Th} - _{103}\text{Lw}$  and  $_{89}\text{Ac}$ ), Similarities and differences between lanthanides and Actinides., Chemistry of trans-actinides, Chemistry of some selected heavy transition metals (e.g. Platinum metals), Separation of metals by solvent extraction and ion exchange techniques.

**CHM 4233: INORGANIC REACTION MECHANISMS**

25 Lectures/ 2 Tutorials

2 – Hours Examination      Assessment Scheme B

Pre-requisite CHM 2231, 3231, 3232.

Complex definition, properties and structure, inert and labile complex, Substitution reaction of octahedral complexes and their kinetics, Substitution reaction square planar complexes, Outer sphere and inner sphere reactions. Complimentary reactions, Experimental methods for fast and slow reactions. Reaction mechanisms in some bioinorganic systems.

**CHM 4234: INORGANIC CHEMISTRY IN NON-AQUEOUS MEDIA**

25 Lectures/ 2- Tutorials

2 – Hours Examination      Assessment Scheme B

Pre-requisite CHM 2231.

Classification and general characteristics of non-aqueous solvents, Solute-solvent interaction, Protonic solvent, Oxyhalides solvents, Liquid halides solvents, Dinitrogen tetra oxide, Sulphur dioxide and flourosulphuric acid solvents, Cyclic carbonates, Preparation of the interhalogens.

**CHM 4235: NUCLEAR & RADIOCHEMISTRY**

25 Lectures/ 2- Tutorials

2 – Hours Examination      Assessment Scheme B

Pre-requisite CHM 2231, 3231, 3232.

The development of nuclear chemistry, Fundamental particles and nuclear structure, Nuclear reactions and radioactivity, proportion of

nuclear reactions. The detection and measurement of nuclear radiation, production of isotopes. Radiochemical methods: rate of radioactive decay, half-life, instruments for measuring radioactivity, application of radionuclides.

**CHM 4236: ORGANOMETALLIC CHEMISTRY**

25 Lectures/ 2- Tutorials

2 – Hours Examination Assessment Scheme B

Introduction to organometallic compounds of the transition metals. Classification of ligands and electron rule. Bonding, preparation, reactivity and structures of organotransition metal compounds. The organic chemistry of ferrocene and related compounds. The role of organometallic compounds in some catalytic reaction. Reaction intermediates from organotransition compounds of industrial and synthetic uses. Stability and Thermochemistry of organometals. Electron transfer and charge transfer processes in the cleavage of alkylmetals. Charge transfer interaction in the reaction of organometals with acceptors. Reactions of organometals electrophiles.

**CHM 4242: PHYSICAL ORGANIC CHEMISTRY**

25 Lectures/ 5- Tutorials

2 – Hours Examination Assessment Scheme B

Pre-requisite CHM 3242, 3243, 3251.

Methods for the study of organic reaction mechanisms. Nucleophilic substitution reactions, elimination and addition reactions, re-arrangement reactions, preparation and reaction of stereoisomers; stereoselectivity; neighbouring group effects. Hammett equation.

**CHM 4243: HETEROCYCLIC CHEMISTRY**

25 Lectures/ 5- Tutorials

2 – Hours Examination Assessment Scheme B

The synthesis and mechanism of fused heterocyclic system particularly Quinolines, Isoquinolines, Benzofurans, Benzothienopyrenes, Indoles, Benzopyrylium salts, Coumarins and chromones. Applications of heterocyclic systems in drug synthesis.

**CHM 4244: PETROCHEMISTRY**

25 Lectures/5 Tutorials

2 – Hours Examination Assessment Scheme B

Pre-requisite CHM 2241

Petroleum in contemporary energy scene. Nature, Classification and composition of crude petroleum and natural gases. Distribution of petroleum technology (cracking, catalytic reforming, dewaxing etc), survey of refinery products and processes. Petrochemicals in Industrial raw materials (coal, wood, water, gas, fats, oil etc.)

**CHM 4344: ORGANIC SYNTHESIS**

25 Lectures/ 5- Tutorials

2 – Hours Examination Assessment Scheme B

Application of basic concepts of functional group chemistry through alkylation, acylation, acetylation, halogenation, oxidation, reduction through rearrangement and miscellaneous other reactions used in synthetic routes. A number literature reactions will be examined and their synthesis scheme mastered.

- CHM 4245: CARBOHYDRATE CHEMISTRY**  
 25 Lectures/ 5- Tutorials  
 2 – Hours Examination      Assessment Scheme B  
 Pre-requisite CHM 3242, 3243.  
 Nomenclature, classification and structures of sugars. Monosaccharides, disaccharides, and polysaccharides. General reactions, preparation and reaction mechanisms. Configurations. Epimerization. Starch, cellulose etc.; synthetic significance of sugars in the biosynthesis of nucleotides.
- CHM 4246: PHOTOCHEMISTRY & PERICYCLIC REACTIONS.**  
 25 Lectures/ 5- Tutorials  
 2 – Hours Examination      Assessment Scheme B  
 Interaction of radiation with matter, Electronic excitation, selection rules, reactivation rules, sensitization, Quenching, photofragmentation; oxidation, reduction, rearrangement; pericyclic reactions and orbital symmetry. Orbital –symmetry correlations in organic reactions.
- CHM 4251: ELECTROCHEMISTRY**  
 25 Lectures/ 5- Tutorials  
 2 – Hours Examination      Assessment Scheme B  
 Pre-requisite CHM 3251.  
 Electrical double layer, potential at zero charge, polarizable and non-polarizable interfaces, mass transport, concentration polarization, Fick's Law, Levic equation. Electrode kinetics: kinetics of electronic charge transfer, standard electrode potential, over potential, ohmic polarization, limiting and exchange current densities, redox reactions, Nernst equation, Tafel equation and i-v polarization principles.  
 Polarography:  $E_{1/2}$  wave potential, cyclic voltammetry, Electro-Analytical principles. Battery technology and gas production by electrolysis. Electro-organic equation.
- CHM 4252: THEORY OF MOLECULAR SPECTROSCOPY**  
 25 Lectures/ 5- Tutorials  
 2 – Hours Examination      Assessment Scheme B  
 Pre-requisite CHM 3250.  
 Quantum theory of rotation and vibration. Theory of microwave spectroscopy, infra-red spectroscopy, Raman spectroscopy, ultraviolet/visible spectroscopy, nuclear magnetic resonance spectroscopy. General introduction to electron spin resonance, Mossbauer effect, nuclear quadrupole resonance and other modern techniques.
- CHM 4253: MATERIAL SCIENCE AND CORROSION**  
 25 Lectures/ 5- Tutorials  
 2 – Hours Examination      Assessment Scheme B  
 Pre-requisite CHM 3251.  
 Material science: classification of industrial material, BCC, FCC and HCP structure with emphasis of industrial material. Atomic packing factor (APF). Identification of industrial materials, material defects and dislocation. Alloy: manufacture, mineral chemistry. A survey of Nigeria's industry and raw material requirement. Corrosion: principles and mechanism of corrosion, Types, factors and kinetics of corrosion monitoring, prevention, control of corrosion in petroleum, chemical

industries and water works departments. Stress corrosion and hydrogen embrittlement concept. Electroplating Technology: Electroplating principles, dendritic electroplating effect, Throwing power of solution, Alloy electroplating.

**CHM 4254: QUANTUM CHEMISTRY**

25 Lectures/ 5- Tutorials

2 – Hours Examination Assessment Scheme B

Pre-requisite CHM 3251.

Postulate of quantum mechanics: operator; angular momentum; solution of hydrogen atom problem. Theory of atomic spectra; Hartress-Fock theory applied to atoms. Self-consistent theory; choice of basis functions; use of *ab-initio* methods. Approximate molecular theory; Parisier-Parr-Pople method and other extensions of Hückel theory; C.N.D.O; I.N.D.O.; M.I.N.D.O.; methods. Applications of large systems of biochemical interest.

**CHM 4255: STATISTICAL MECHANICS**

25 Lectures/ 5- Tutorials

2 – Hours Examination Assessment Scheme B

Pre-requisite CHM 3251.

Maxwell-Boltzmann statistics, calculation of thermodynamic properties, partition functions, heat capacities, entropy, equilibrium constant, use of spectroscopic data, transition state theory, Quantum effects.

**CHM 4256: THERMODYNAMICS AND SURFACE PHENOMENA**

Review of Gibbs phase rules, the concept of variables and application. Solid-liquid equilibria. Simple eutectic diagrams proportion of azeotrophes. Zero component systems, triangular phase diagram and calculations.

**CHM 4257: GROUP THEORY AND SYMMETRY**

25 Lectures/ 5- Tutorials

2 – Hours Examination Assessment Scheme B

Pre-requisite CHM 3251.

Review of molecular symmetry operation: definition of groups, molecular symmetry groups, revision of linear algebra. Group representation, character tables, irreducible representations, group presentations and quantum mechanics. Detailed study of groups  $C_n$ ,  $D_n$ ,  $C_{\infty v}$ ,  $D_{\infty h}$  and full rotation group. Applications: hybrid orbitals, symmetry orbitals, ligand field theory, normal modes of vibrations, selection rules in vibrations and electronic spectra. General symmetry applications, dipole moments, optical activity, Woodward-Hoffman rules. Symmetry of crystal lattice, block orbitals for infinite systems.

**CHM 4258: CHEMICAL KINETICS**

25 Lectures/5 Tutorials

2 – Hours Examination

Assessment Scheme B

Pre-requisites CHM 2251, Co-Req. CHM 3251

Second and third order reactions. Accounting for the rate laws, concept of rate limiting step and steady state approximation.

Collision theory, transition state theory, reaction coordinates. Complex reactions, Unimolecular reaction theory, bimolecular reaction

mechanisms, chain reactions mechanisms; heterogeneous reaction (BET and Langmuir isomers); photochemical reaction mechanism; introduction to activation and catalysis.

**CHM 4259:**

**APPLIED SURFACE CHEMISTRY AND COLLOID**

25 Lectures/5 Tutorials

2 – Hours Examination

Assessment Scheme B

Pre-requisite CHM 2251

Surface Chemistry; surface and interfacial tension. Surface thermodynamics, spreading and wetting and application to agriculture and animal husbandry. Detergents and soaps. Criteria for effective washing and dirt removal.

Colloids: the colloidal state, classification of colloidal systems, structure, preparation and purification. Lyophilic, lyophobic and hydrophilic systems, light scattering for particle size measurements.

Adsorption isotherm, particle size measurement, BET application, Electrical potential of surface solid-gas interface and liquid-solid interface.

**CHM 4284:**

**INDUSTRIAL CHEMICAL PROCESS II**

20 Lectures/ 5- Tutorials

2 – Hours Examination

Assessment Scheme B

Pre-requisite CHM 3283.

Industrial electrochemistry, electroplating, food canning and preservation. Chemical processing of minerals. Metallurgical and hydrometallurgical processes, manufacture of some heavy inorganic chemicals: cement, binding materials, inorganic fertilizers.

## PART B

### CURRICULUM FOR THE FOUR-YEAR B.Sc. DEGREE PROGRAMME IN INDUSTRIAL CHEMISTRY.

#### 1. PHILOSOPHY AND OBJECTIVES

**Philosophy** The training of students in the general industrial chemical processes field and management capabilities that would help sustain the manufacturing sector of the national economy with a strong commitment to maintaining a sustainable environment.

#### Objectives:

The programme is intended to:

- i. Emphasize on a thorough grounding in theoretical and experimental chemistry with their proper uses in chemical processing activities.
- ii. Produce graduates with creative, innovative and research oriented minds that would employ local resource in product development and their subsequent use in manufacturing activities.
- iii. Expose the students to the various accounting and management tools that would ensure their useful contribution in the day-to-day management of any manufacturing industry.

#### 2. Admission Requirements

- a For entry into 100 Level:

Five SSCE/GCE/NECO O/Level credits in English, Mathematics, Physics, Chemistry and Biology, obtained in not more than two (2) sittings.

- b For Direct entry into 200 Level:

Minimum of five subjects passed at credit level in not more than two (2) sittings with at least TWO 'A' level and THREE others which must be credit at 'O' level. (No subject should be counted at both ordinary and advanced level).

OR

A Diploma (at least Lower Credit) in Industrial Chemistry of Bayero University or any other recognized institution (at least Upper Credit) and 'O' Level credits or equivalent in five (5) related subjects including Mathematics and English.

OR

IJMB credits in Chemistry, Physics and Mathematics and 'O' Level credits or equivalent in five (5) related subjects including Mathematics and English.

OR

Pass in two (2) major subjects in the NCE with 'O' Level credits or equivalent in five (5) related subjects including Mathematics and English.

OR

Any other equivalent certificate deemed fit by the Departmental/Faculty admission committee.

### 3. Graduation Requirements

A candidate in order to satisfy the requirement for the award of degree in industrial chemistry must offer the following course,

#### LEVEL 100

- (i) 8 credits of core courses in chemistry
- (ii) 6 credits of mathematics
- (iii) Additional 8 credits each from mathematics and physics
- (iv) 4 credits of general studies

#### LEVEL 200

A student at level 200 shall register courses as follows:

- (i) 14 credits of core courses in Chemistry
- (ii) 5 credits from mathematics, 6 credits from physics and 5 credits from either Maths and/or physics.
- (iii) 3 credits from Biochemistry (BCH 2301)
- (iv) 6 credits from General studies for returning students and in addition GSP 2401 for DE students. so that a minimum of 39 or a maximum of 43 credits are obtained
- (v) At the end of level 200 candidates shall undertake an industrial visit.

#### LEVEL 300

A student at level 300 shall register for courses as follows:

- (i) 20 credits of core courses
- (ii) Choose courses from the electives listed in order to obtain 26 minimum or 32 maximum credits as required at this level.
- (iii) 3 credits from Mathematics (MTH 3304).
- (iv) CHM 3671, Industrial Attachment for 6 months is compulsory for all students at the end of level 300.

#### LEVEL 400

A student at level 400 shall register for courses as follows:

- (i) 31 credits of core courses.
- (ii) The electives are chosen provided the pre-requisites are satisfied and in order to obtain minimum of 32 and maximum of 42 credits.
- (iii) The Project (CHM 4600) and Seminar (CHM 4200) shall be assessed as approved for chemistry programme.

### 4. COURSE NOMENCLATURE

Course Numbering:

The four numbering is used to as follows;

- First digit - Level
- Second digit - Credit value
- Third digit - Subject area
  - 0 - Project, Seminar and Industrial attachment
  - 1 - Analytical
  - 2 - Color and Polymer
  - 3 - Inorganic
  - 4 - Organic
  - 5 - physical
  - 6 - practical
  - 7 - SIWES
  - 8 - Industrial Chemistry
- Fourth digit - Course serial number



### Level 100 Courses

First Semester		
Course	Title	Credits
CHM 1231	Inorganic Chemistry	2
CHM 1241	Organic Chemistry	2
MTH 1301	Elementary Math I	3
STA 1311	Probability	3
CSC 1201	Introduction To Computer	2
GSP 1201	Use Of English	4
PHY 1170	Physics Practical	1
PHY 1210	Mechanics	2
PHY 1220	Electricity And Magnetism	2
BIO 1201	General Biology I	2
BIO 1203	General Biology III	2
<b>TOTAL</b>		<b>23</b>

Second Semester		
Course	Title	Credits
CHM 1251	Physical Chemistry	2
CHM 1261	Practical Chemistry	2
MTH 1302	Elementary Math II	3
MTH 1303	Elementary Maths III	3
PHY 1180	Physics Practical	1
PHY 1230	Behaviour Of Matter	2
BIO 1202	General Biology II	2
BIO 1204	General Biology IV	2
GSP1202	Library Skills and ICT	2
<b>Total</b>		<b>24</b>

### Level 200 Courses

First Semester		
Course	Title	Credits
CHM 2241	Organic Chemistry 1	2
MTH 2203	Linear Algebra 1	2
PHY 2310	Elementary Modern Physics	3
PHY 2320	Electric Circuits And Electronics	3
GSP 2204	Foundation Of Nigerian Culture Government & Economy	2
GSP 2206	Peace & Conflict Resolution	2
GSP 2401	Use Of English	4
CHM 2251	Physical Chemistry	2
CHM 2232	Structure & Bonding	2

Second Semester		
Course	Title	Credits
CHM 2261	Practical Chemistry	2
CHM 2211	Analytical Chemistry	2
CHM 2242	Organic Chemistry II	2
CHM 2231	Inorganic Chemistry	2
GSP 2205	Logic and Philosophy	2
MTH 2302	Differential Equations	3
<b>Total</b>		<b>15</b>

CHM2281	Industrial Raw Material Resource Inventory	2
<b>TOTAL</b>		<b>22</b>

Electives (First Semester)			Electives (Second Semester)		
Course	Title	Credits	Course	Title	Credits
MTH 2301	Mathematical Methods 3	3	MTH 2204	Linear Algebra II	2
PHY 2160	Renewable Energy	1	PHY 2180	Practical Physics	1
PHY 2170	Practical Physics	1	PHY 2340	Waves And Optics	3
			PHY 2350	Thermal Physics	3

### Level 300 Courses

First Semester		
Course	Title	Credits
CHM 3212	Environmental Chemistry	2
CHM 3231	Inorganic Chemistry I	2
CHM 3213	Instrumental Methods of Analysis	2
CHM 3241	Applied Spectroscopy	2
CHM 3251	Physical Chemistry	2
CHM 3281	Industrial Chemical Tech. I	2
CHM 3282	Industrial Chemical Process I	2
EEP3201	Entrepreneurship and Innovation	2
MTH 3302	Complex Analysis	3
<b>TOTAL</b>		<b>19</b>

Second Semester		
Course	Title	Credits
CHM 3671	SIWES	6
<b>Total</b>		<b>6</b>

Electives (First Semester)		Credits
CHM 3232	Inorganic Chemistry II	2
CHM 3222	Polymer Chemistry I	2
CHM 3223	Colour Chemistry	2
CHM 3285	Industrial Process Control	2

### Level 400 Courses

Core First Semester		
Course	Title	Credits
CHM 4200	Seminar	2
CHM 4212	Analytical Chemistry	2
CHM 4242	Physical Organic Chemistry	2
CHM 4251	Applied Electrochemistry	2
CHM 4258	Chemical Kinetics	2
CHM 4284	Industrial Chemical Process II	2
CHM 4286	Technical Economics	2
CHM 4287	Industrial Management	2
EEP4201	Business Creation and Growth	2
<b>Total</b>		<b>19</b>

Electives (First Semester)		
CHM 4222	Polymer Chemistry II	2
CHM 4225	Colour Chemistry And Technology Ii	2
CHM 4243	Heterocyclic Chemistry	2
CHM 4344	Organic Synthesis	3
CHM 4264	Reaction Process Kinetics	2
CHM 4283	Leather Chemistry and Technology	2

Core Second Semester		
Course	Title	Credits
CHM 4600	Project	6
CHM 4331	Coordination Chemistry	3
CHM 4282	Industrial Chemical Technology II	2
CHM4285	Laboratory and Industrial Organisation	2
CHM4286	Large Scale Industrial Process	2
BCH 4312	Industrial Biochemistry	2

### Electives (Second Semester)

CHM 4224	Polymer Technology & Rheology	2
CHM 4226	Textile Chemistry	2
CHM 4256	Thermodynamics And Surface Phenomena	2
CHM 4253	Material Science and Corrosion	2
CHM 4244	Petrochemistry	2
CHM 4281	Industrial polymer Chemistry	2

**NOTE:** All candidates must register and pass CHM 4600 & CHM 4200 (Project and Seminar).

## Course Content for BSc Degree in Industrial Chemistry

### LEVEL 100 COURSES.

#### CHM 1231: INORGANIC CHEMISTRY

Atoms, molecules and chemical reactions; chemical equation and Stoichiometry. Atomic structure; discovery and properties of fundamental particles of atom (Thomson's discharge tube experiment, Rutherford's  $\alpha$  - scattering experiment, Millikan's oil drop experiment and Chadwick experiment). Models of the Atom (Thomson's plum pudding model, Rutherford's model, Bohr model). Concept of isotopy, Atomic and molecular mass, Empirical and molecular formula. Electronic structure; Energy levels, Quantum Numbers and Electronic configuration. Periodic Table and periodicity; General properties of periodic Table; atomic radii, ionic radii, ionization energy density, electron affinity, electronegativity, melting point, boiling point and oxidation states. Introduction to transition metals; electron configuration and general properties. Types of bonding and inter molecular forces. Extraction of metals. Introduction to nuclear Chemistry.

#### CHM 1241: ORGANIC CHEMISTRY

Historical survey of the development and importance of Organic Chemistry, IUPAC Nomenclature and classification of Organic compounds, Homologous series, hybridization of carbon atom to reflect tetravalency. Electronic theory in organic chemistry. Qualitative and quantitative organic chemistry, Empirical and Molecular Formula, Simple techniques of writing structural formulas. Saturated hydrocarbons, structural isomerism. Preparation, properties and reactions of alkenes and cycloalkanes, their basic chemistry and uses in petroleum; unsaturated hydrocarbons, alkenes, cycloalkenes, alkynes, *cis*, *trans* isomerism, simple electrophilic addition reaction, polymerization.

#### CHM 1251: PHYSICAL CHEMISTRY

Interconversion of some physical units. Properties of Ideal and real gases; Equation of state,  $PV = nRT$  and its application, Deviation from ideality and Van der Waal's equation. Elementary kinetics molecular Theory of gases. Thermodynamics and enthalpy of reaction, Bond energies, Hess's Law and Born - Haber cycle. Chemical equilibrium; Dynamic equilibrium,  $K_{eq}$ ,  $K_c$  and  $K_p$ .  $K_c$ - $K_p$  relationship and Le Chatelier's principle. General concept of acids and bases. Ionic equilibrium.  $K_w$ , pH, pOH, Buffer solutions, indicators, Solubility product and its application, common ion effect. Electrochemistry; Oxidation - reduction reaction, Electrode potential and Gibb's free energy change ( $\Delta G$ ) relationship. Solids; General properties of solids, unit cells and lattice points.

#### CHM 1261: CHEMISTRY PRACTICALS

Laboratory instruction and Experimental products shall be conducted for the candidates from the following subject areas:

**Physical:** Determination of heats of reaction, effects of solute on boiling point of solvents, partition coefficient. Other experiments based on the scope of the Lectures and as approved by the Department.

**Organic:** Safety precautions, classification of organic compounds by their solubilities in common solvents. The Lessinger's tests for

qualitative analysis of common elements in organic compounds. Identification and classification of acids and bases functional groups. Identification and differentiation of the following neutral functional groups; alcohols, aldehydes, ketones, esters, anhydrides and ethers. Acetylation of aniline as an example of the preparation of solid aniline derivatives. An electrophilic addition reaction.

**Inorganic:** Qualitative and quantitative analysis: molarity, concentration and percentage purity.

## LEVEL 200 COURSES

### CHM 2211: INTRODUCTION TO ANALYTICAL CHEMISTRY

25 Lectures/5 Tutorials      Assessment Scheme B

2 – Hours Examination

Brief introduction of analytical chemistry fundamental concepts such as moles, concentration etc., theory of errors in Analysis, steps in Analysis, pretreatment techniques and methods of Analysis.

### CHM 2231: INORGANIC CHEMISTRY

25 Lectures/5 Tutorials      Assessment Scheme B

2 – Hours Examination

Stereochemistry and molecular orbital theory of simple molecules containing homo and heteroatoms.

Hydrogen; Structure of ice and water, the hydron ion, protonic acids, oxoacids, hydrides.

Group IA; Electronic structure and general properties. Anomalous behaviour of lithium, alkali metals in liquid ammonia, binary and complex compounds of alkali metals.

Group IIA Electronic structure and general properties, composition of beryllium with other elements in this group. Binary and complex compounds of group IIA elements.

The Noble gases; Occurrence, isolation, application, group trend compounds of inert gases and their structure.

Concept of hard and soft acids and bases. Oxidation-reduction reactions, chemistry in aqueous and non-aqueous media.

### CHM 2232: STRUCTURE AND BONDING

25 Lectures/5 Tutorials      Assessment Scheme B

2 – Hours Examination

Ideas of bonding and degenerate state. Atomic orbitals, shape and energy. Electronic structure of atoms and experimental basis survey (Millikan, Rutherford, Bohr etc.). Simple valence bond theory, electron pair repulsion theory, atomic spectra, method of determining molecular shapes, bond lengths and angles. Structure and bonding in ionic crystals, Isomorphism and polymorphism, crystal lattice, lattice energy and polarization of ions.

### CHM 2241: ORGANIC CHEMISTRY

25 Lectures/5 Tutorials      Assessment Scheme B

2 – Hours Examination

Factors affecting structure and properties of organic compounds; atomic orbitals, bonding and hybridization. Factors affecting availability of electrons; Inductive, mesomeric and steric effects. Introductory stereochemistry; optical activity, conformational isomers, Chirality etc.

E – Z system of naming geometrical isomers. Methane, energy of activation and free radical substitution reaction in alkanes. Conformational analysis of open chain and ring systems. Alkyl halides; preparation, properties, nucleophilic and electrophilic substitution reactions, Elimination reactions. Aromaticity and electrophilic reactions.

**CHM 2251:**

**PHYSICAL CHEMISTRY**

25 Lectures/5 Tutorials      Assessment Scheme B

2 – Hours Examination

Thermodynamics; Laws of thermodynamics, Entropy, Gibb's and Helmholtz's free energies. Feasibility of chemical systems. Equipartition principle;  $C_v$  and  $C_p$  for perfect gas. Phase rule and its application. Kinetics and rate of reactions; rate equation; rate Law, order and factors affecting rate of reaction. Introduction to collision rate.

**CHM 2281:**

**INDUSTRIAL RAW MATERIAL RESOURCE INVENTORY**

25 Lectures/5 Tutorials      Assessment Scheme B      2 – Hours Examination

Survey of Nigeria's industries and their raw material requirements. Mineral Chemistry, Fossiles and their uses. Plants and animal products. Nuclear, solar and hydrodynamic sources of energy. Potentials and applications of locally available raw materials as industrial feedstocks.

**CHM 2261:**

**PRACTICAL CHEMISTRY**

30 laboratory sessions/Assessment Scheme C

Candidates shall conduct at least 10 laboratory practicals chosen from each of the following subject areas: Inorganic, Organic and Physical. A laboratory manual shall be provided as guide to the student.

**Organic:**

Determination of melting points of organic solids, mixtures, boiling points of organic liquids. Simple and fractional distillation of two or more components at normal and reduced pressures. Separation of azeotropic mixtures. Crystallization and re-crystallization of organic solids. The refluxing techniques. Use of separatory funnel. Thin layer and column chromatography. Aromatic electrophilic substitution reactions. Determination of partition coefficients of organic compounds.

**Inorganic:**

Studies of some typical reactions of transition metals, redox titration. Ion exchange technique.

**Physical:**

Measurements of boiling points, enthalpy, Gibb's free energy and other related parameters for ideal and real solutions. Determination of rates, order and activation energy of reactions. The effect of catalyst on kinetics parameters.

**Analytical:**

Statistical treatment of analytical data. Experiments to be designed based on gravimetric, titrimetric and Spectrophotometric methods of analysis.

**LEVEL 300 COURSES.**

**CHM 3231:**

**INORGANIC CHEMISTRY I**

20 Lectures/10 Laboratory sessions

2 – Hours Examination

Assessment Scheme A

Pre-requisites CHM 2250 and CHM 2231

Chemistry of groups IIIA, IVA, VA, VIA and VIIA.

- CHM 3241: APPLIED SPECTRIOSCOPY**  
 20 Lectures/10 Tutorials  
 2 – Hours Examination Assessment Scheme B  
 Principles and application of UV, IR, NMR and Mass spectroscopy to the determination and elucidation of structures of organic compounds. Practical Instrumentation.
- CHM 3242: ORGANIC CHEMISTRY I**  
 20 Lectures/10 Labs. Sessions  
 2 – Hours Examination Assessment Scheme A  
 Preparation, properties and reaction mechanisms of Alcohols, Ethers, Epoxides, Aldehydes, Ketones, Carboxylic acids and their derivatives and  $\alpha$ ,  $\beta$  - unsaturated carbonyl compounds.
- CHM 3251: PHYSICAL CHEMISTRY**  
 20 Lectures/10 Laboratory sessions  
 2 – Hours Examination Assessment Scheme A  
 Gibb's and Helmholtz's functions, thermodynamics of gases and solutions, and properties of electrolytes
- CHM 3213: INSTRUMENTAL METHODS OF ANALYSIS**  
 25 Lectures/ 5 Tutorials  
 2 – Hours Examination Assessment Scheme B  
 Theory and working of selected Instruments and their applications to problems of organic and inorganic chemistry. UV Visible Spectrometry, Infrared, IR spectrometry, Flame Emission and Atomic Absorption Spectrometry. Fluorescence and Phosphorescence spectrometry. Introduction to Electro Analytical Techniques. X- ray and radiochemical methods of analysis.
- CHM 3212: ENVIRONMENTAL CHEMISTRY**  
 25 Lectures/ 5 Tutorials  
 2 – Hours Examination Assessment Scheme B  
 Atmosphere Assessment, hydrosphere, lithosphere, Biosphere and Food.
- CHM 3222: POLYMER CHEMISTRY**  
 20 Lectures/ 5 Labs. Sessions  
 2 – Hours Examination Assessment Scheme A  
 Pre-requisite CHM 2261, 2241  
 Polymerization process, preparation of polymer intermediates, structure and properties of polymers, Fiber forming polymers.
- CHM 3223: COLOUR CHEMISTRY AND TECHNOLOGY I**  
 20 Lectures/ 5 Labs. Sessions  
 2 – Hours Examination Assessment Scheme A  
 Pre-requisite CHM 2261, 2241  
 Properties of dyes and pigments. Dyeing mechanisms. The preparation and dyeing of natural fibres' Vat, Azoic and Sulphur dyes on cellulose and acid dyes on protein fibres. Colour fastness properties and assessment techniques.

- CHM 3244: PETROCHEMISTRY**  
 25 Lectures/5 Tutorials  
 2 – Hours Examination  
 Assessment Scheme B  
 Pre-requisite CHM 2241  
 Petroleum in contemporary energy scene. Nature, Classification and composition of crude petroleum and natural gases. Distribution of petroleum technology (cracking, catalytic reforming, dewaxing etc.), survey of refinery products and processes. Petrochemicals in Industrial raw materials (coal, wood, water, gas, fats, oil etc.)
- CHM 3255: CHEMICAL PHYSICS AND PHOTOCHEMISTRY**  
 25 Lectures/5 Tutorials  
 2 – Hours Examination  
 Assessment Scheme B  
 Pre-requisite CHM 2251  
 iii. Chemical physics: theory of bonding in  $H_2^{+1}$  and  $H_2$ , Rotation and Vibration molecules, Heat capacities of crystals.  
 iv. Photochemistry: photochemical equivalence, light absorption by atoms and molecules, photochemical kinetics and experimental studies, photosynthesized gas reaction, flash photolysis, photochemical equilibrium, chemiluminescence and radiation chemistry.
- CHM 3284: INDUSTRIAL CHEMICAL PROCESS I**  
 25 Lectures/5 Tutorials  
 2 – Hours Examination  
 Assessment Scheme B  
 1. Characterization and importance of chemical Industries  
 Conversion efficiency, yield and rationalization. Economic and Technical feasibilities as applied to production of primary intermediates and finished products.  
 2. Synthesis of Industrial Organic Chemicals, Polymers, adhesives, dyes, explosives, insecticides, pesticides, herbicides and pharmaceuticals.  
 3. Flow characteristics: Back mixing, residence time, distribution and dispersion models, catalytic reactions, designed operation of gas/liquid and liquid /liquid phases.
- CHM 3283: INDUSTRIAL CHEMICAL TECHNOLOGY I**  
 30 Lectures  
 2 – Hours Examination  
 Assessment Scheme B  
**Chemical Engineering Thermodynamics**  
 Applied chemical thermodynamics, heat transfer, Bernoulli, continuity equation of fluid flow, Mechanism of heat flow, heat transfer coefficients, counter and co – currents heat exchangers.  
**Mass Transfer**  
 Economics of mass balance, flow diagrams, Recycle and bye-pass streams. Unit operations. Chemical Technology equipment.  
**Heat Transfer**  
 Drying and humidification: Mechanism, rates, equipment. Evaporation: single and multiple effects, efficiency and crystallization.





from related area of the subject and the external examiner. The final grade will be determined as follows:

External Examiner	30%
Internal Examiner	10%
Supervisor	40%
Oral presentation	10%

In case where a fail grade [ $<40\%$ ] has been recorded, the examiners may require the candidate to carry out further specified tasks and to resubmit the dissertation by a specified date.

Pre-requisites: pass in at least 8 – credits in compulsory CHM 3000 (Level III) courses.

**CHM 4200: LIBRARY TECHNIQUES AND SEMINAR**

c. Use of Chemical literature such as text books, chemical Abstracts, Journals etc.

d. A topic involving a literature search.

Assessment: course work 30%

Supervisor's assessment 70%

**CHM 4212: ANALYTICAL CHEMISTRY**

25 Lectures/ one Industrial visit /3 Tutorials

2 – Hours Examination Assessment Scheme B

Potentiometric and pH methods, conductometric methods. Chromatography and Electrolytic methods. Industrial safety.\_

**CHM 4222: POLYMER CHEMISTRY II**

20 Lectures/ 10 Labs. Sessions

2 – Hours Examination Assessment Scheme A

Pre-requisite CHM 3222

Detail treatment of addition polymerization, mechanisms and kinetics of ionic and free-radical polymerization. Stereo-specific polymerization, co-polymerization (introduction). Phase systems for polymerization-bulk, solution and suspension polymerization. Industrially important thermoplastics thermosetting polymers:- preparation, properties and uses. Polyurethanes-fibers, elastomers and coatings and adhesives. polymer solutions:- thermodynamic properties, phase separation and fractionation. Mechanical properties of polymers. Analysis and testing of polymers. Degradation of polymers.

**CHM 4224: POLYMER TECHNOLOGY AND RHEOLOGY**

25 Lectures/ one Industrial visit /3 Tutorials

2 – Hours Examination Assessment Scheme B

Pre-requisite CHM 3222, Co-requisite CHM 4222

The crystalline state of polymers. amorphous state of polymers. Mechanical properties of polymers. Visco elastic properties of polymers. Rubbers (Elastomer): Natural and synthetic rubbers, Elasticity, mastication, vulcanization and compounding of rubbers, uses of latex and rubber materials. Flow properties of molten polymers.

Polymer additives: anti-oxidants and anti-degradation additives, flame retardants, fillers, plasticizers; blowing agents; cross-linking agents; pigments and dye stuffs.

Polymer processing techniques: mixing, extrusion, injection moulding, compression moulding, calendaring, vacuum forming, casting and surface coatings, paints and adhesives.



- CHM 4283: LEATHER CHEMISTRY AND TECHNOLOGY**  
 25 Lectures/3 Laboratory sessions/ 2 Industrial visits  
 2 – Hours Examination      Assessment Scheme A  
 Sources, nature and characteristics of hides and skins.  
 flaying, methods of drying and preservation of hides and skins  
 Hides and skins improvement.  
 Processes of converting hides and skins into leather, i.e. soaking, liming,  
 deliming, dehairing, enzymatic treatment (bating), mineral and vegetable  
 tannings, pickling, washing and drying.  
 Leather dyeing and finishing  
 Scientific control and analysis in Leather Manufacture.  
 Leather Utilization and Marketing.
- CHM 4281: INDUSTRIAL POLYMER CHEMISTRY**  
 25 Lectures/ 2 Tutorials / 1 industrial visit  
 2 – Hours Examination      Assessment Scheme B  
 Pre-requisite CHM 3222  
 Polymer Additives: importance, oxidative degradation antioxidants, UV  
 stabilizers, stabilization of PVC, PVC plasticizers, fillers and reinforcing  
 agents, carbon black.  
 Polymeric surface coatings and adhesives: the constituents of surface  
 coatings, classification of surface coatings, alkyls, emulsion (polyvinyl  
 acetate), polyurethanes, unsaturated polyester and epoxy coatings,  
 rheology and coatings and adhesives, adhesives and adhesion.  
 Introduction to electrically conducting polymers: properties, synthesis  
 and their application. Introduction to liquid crystals (chemistry of liquid  
 crystal technology), properties and uses. Introduction to inorganic  
 polymers.
- CHM 4331: CO-ORDINATION CHEMISTRY**  
 20 Lectures/ 5 Laboratory Sessions  
 2 – Hours Examination      Assessment Scheme A  
 Pre-requisite CHM 2231, 3231, 3221  
 Nomenclature, isomerism, stability constant and their determination,  
 stability of complex ions in solution chelate effect. Valance-bond theory,  
 Crystal field theories, Molecular orbital theory and ligand field theories  
 to explain bonding in coordination compounds. (In octahedral,  
 tetrahedral and square planar geometry). High spin and low spin  
 complexes. The spectrochemical series: crystal field stabilization  
 energies, solubility of hexaaqua-ions, John-Teller effect. Electronic  
 spectra of transition metal complex. Magnetic and spectral properties of  
 transition metal complexes. Method of characterization of transition  
 metal complexes. Electron deficient compounds: Boranes, Borene anion,  
 carboranes, metal alkyls and aryls. Preparation, reactions and structure  
 of complexes with  $\pi$ -bonding ligands as CN, CO, NO.
- BCH 4312 INDUSTRIAL BIOCHEMISTRY**  
 30 Lectures  
 2 – Hours Examination      Assessment Scheme B  
 A short review of microbial physiology and genetics; A review of  
 general metabolic pathways, control and application in industrial  
 processes: Continuous culture methods; principles and applications; The  
 chemostat and its application in industrial fermentations;

Fermentations – alcoholic, amino acids, antibiotics, and other secondary metabolites, Primary and Secondary metabolism; process evaluation and development; Over production of metabolites – amino acids, taste enhancers, vitamins, toxins, etc.; methods for screening and selecting micro-organisms and plants for the purpose of overproduction; Strain selection/ development and enhancement; gene dosage and its applications in industrial processes.

**CHM 4264: REACTION PROCESS KINETICS**

25 Lectures/ 5Tutorials

2 – Hours Examination Assessment Scheme B

Pre-requisite CHM 3252

Kinetics of homogenous reactions, kinetic view of equilibrium for elemental reaction. Temperature dependency from Arrhenius Law. Collision and Transition state theories

**CHM 4284: INDUSTRIAL CHEMICAL PROCESSES II**

25 Lectures/ 5 Tutorials

2 – Hours Examination Assessment Scheme B

Pre-requisite CHM 3262

Industrial electrochemistry, electroplating, food canning and preservation. Chemical processing of minerals, metallurgical processes. Manufacture of some heavy inorganic chemicals, cement, binding materials, inorganic fertilizers

**CHM 4285: LABORATORY AND INDUSTRIAL ORGANISATION**

25 Lectures/ 5 Laboratory Projects

2 – Hours Examination Assessment Scheme A

Pre-requisite CHM 3282 and CHM 3283.Co – requisite CHM 4265.

Industrial location and site principles. A simple treatment of laboratory set up; Safety criteria, feature and laboratory utilities. The various principles of Industrial practice. Industrial set up in the manufacture of primary and finished products.

Laboratory Project: Candidate shall undertake the setting up of a pilot plant.

**CHM 4286: LARGE SCALE INDUSTRIAL PROCESS**

25 Lectures/5 Tutorials Assessment Scheme B

2 – Hours Examination

The laboratory assessment of chemical conversions, pilot plants from simple laboratory scale up and calculation principles of flow chart for manufacture of: Cement, Fertilizer, Paints, Matches, Bitumen.

Batch and steady state flow processes. Simple optimization principles, energy consumption and recycle.

**CHM 4287: TECHNICAL ECONOMICS**

25 Lectures/5 Tutorials

2 – Hours Examination Assessment Scheme B

Technical Economics: Influence of economic factors on chemical processes and production, Product Development. Industrial site location, the criteria for site location, optimal design and operation of plant. Demand and supply analysis.

**CHM 4288:****INDUSTRIAL MANAGEMENT:**

25 Lectures/5 Tutorials

2 – Hours Examination

Assessment Scheme B

Fundamentals of investment evaluation: Fixed investment, Working Capital, Cost estimate through feasibility studies, Unit and instrumental costs. Fixed capital control. Manufacturing, cost estimation and control profitability control and calculation of returns on investment.

**CHM 4258:****CHEMICAL KINETICS**

25 Lectures/5 Tutorials

2 – Hours Examination

Assessment Scheme B

Pre-requisites CHM 2251, Co-Req. CHM 3251

Second and third order reactions. Accounting for the rate laws, concept of rate limiting step and steady state approximation.

Collision theory, transition state theory, reaction coordinates. Complex reactions, Unimolecular reaction theory, bimolecular reaction mechanisms, chain reactions mechanisms; heterogeneous reaction (BET and Langmuir isomers); photochemical reaction mechanism; introduction to activation and catalysis.

**PART C**  
**CURRICULUM FOR THE FOUR-YEAR B.Sc. FORENSIC SCIENCE PROGRAMME**

**Philosophy and Objectives**

The B. Sc. Forensic Science Programme has been designed to provide a sound understanding of the concepts and methodologies of modern Forensic Science in key areas that meet the needs of its host community, Nigeria and the world at large. Graduates of Forensic Science are expected to apply knowledge and skills in solving theoretical and practical problems majorly related, but not limited, to criminal investigations, wildlife conservation, identification of mass disaster victims and resolution of civil disputes such as paternity, maternity, genetic genealogy, negligence, product liability and insurance investigations.

**OBJECTIVES**

The principal objectives of the Bachelor of Science Honours Degree Programme in Forensic Science should be:

- (i) To instill a sense of enthusiasm for Forensic Science and appreciation of its application in different contexts
- (ii) To produce manpower with a broad, optimal and balanced competencies and practical skills in Forensic Science that will enable them to perform effectively in the academics, research as well as the private sector
- (iii) To involve students in an intellectually stimulating and satisfying experience of learning, studying and research in the broad spectrum of Forensic Science
- (iv) To provide graduates with a skills-based knowledge from which they can proceed to pursue postgraduate studies in specialized areas of Forensic Science
- (v) To produce graduates who will be adequately equipped for relevance in the global knowledge-based economy

**Admission Requirements:**

The entry requirements shall be at least credit level passes in five subjects, including English Language, Mathematics, Biology, Chemistry and Physics at the Senior Secondary School Certificate (SSCE) or its equivalent. In addition, an acceptable pass in the Unified Tertiary Matriculation Examination (UTME) into 100-Level will be required.

Candidates with three A-Level passes (graded A-E) in Biology, Chemistry and Physics may be admitted into 200-Level to undertake a three-year degree programme.

B. Sc. Forensic Science will be a full-time academic programme and shall run for a minimum of eight (8) semesters (6 for DE candidates) and a maximum of twelve (12) semesters (10 for DE candidates).

## Course Contents

Presented below are the units of each course, the number of lecture hours (LH) and the number of practical hours (PH), for those with practical component and Tutorials (T), have been indicated.

### 100 LEVEL

Students take most of these courses from the Faculties of Life and Physical Sciences and also the General Studies and Entrepreneurial Unit.

#### **BIO 1201 General Biology I: (2 Units) (L 30: P 0: T 30)**

Cell structure and organization, functions of cellular organelles, diversity, characteristics and classification of living things, general reproduction, interrelationship of organisms; heredity and evolution, elements of ecology and types of habitats.

#### **BIO 1202 General Biology II: (2 Units) L 30: P 0: T 30)**

A generalized survey of the plant and animal kingdoms based mainly on study of similarities and differences in the external features, ecological adaptation of these forms.

#### **BIO 1203: General Biology III (2 Units; LH 30)**

Same as BIO 1201 but with emphasis of plants.

#### **BIO 1204: General Biology IV (2 Units; LH 30)**

Same as BIO 1202 but with emphasis the Plant King, Bacteria, Viruses, Algae, Fungi, Bryophyte, Pteridophytes, Gymnosperms and Angiosperms.

#### **CHM 1231: Introduction to Inorganic Chemistry (2 Units: LH 30)**

Gross features of atomic structure; Isotopes and isobars; Electronic configuration, periodic table and periodicity; Comparative chemistries of groups IA, IIA and IVA; Preparation, properties, structure and applications of some of the selected compounds; Extraction of metals; Introduction to transition metal chemistry and nuclear chemistry; Empirical and molecular formulae.

#### **CHM 1241: Introduction to Organic Chemistry (2 Units: LH 30)**

Historical survey of the development of organic chemistry; Functional groups and classification of organic compounds; Homologous, isologous and genetic series; Isolation and purification of organic compounds (purification methods: distillation – simple, fractional, steam and vacuum-, re-crystallization, sublimation, solvent extraction and chromatography – thin layer, paper and column); Qualitative and Quantitative analysis; Molecular mass, empirical formula and molecular formula; Hydrocarbons: Alkanes, Alkenes and Alkynes; Hybridization and the hybrid orbitals ( $sp$ ,  $sp^2$ , and  $sp^3$ ); Isomerism: structural, geometrical, positional and functional.



**CHM 1251: Physical Chemistry****(2 Units: PH 45)**

Interconversion of some physical units. Properties of Ideal and real gases; Equation of state,  $PV = nRT$  and its application, Deviation from ideality and Van der Waal's equation. Elementary kinetics molecular Theory of gases. Thermodynamics and enthalpy of reaction, Bond energies, Hess's Law and Born-Haber cycle. Chemical equilibrium; Dynamic equilibrium,  $K_{eq}$ ,  $K_c$  and  $K_p$ .  $K_c$ - $K_p$  relationship Le Chatelier's principle. General concept of acids and bases. Ionic equilibrium.  $K_w$ , pH, pOH, Buffer solutions, indicators, Solubility product and its application, common ion effect. Electrochemistry; Oxidation – reduction reaction, Electrode potential and Gibb's free energy change ( $\Delta G$ ) relationship. Solids; General properties of solids, unit cells and lattice points.

**CHM1261: Practical Chemistry I****(2 Units: PH 90)**

Laboratory instruction and Experimental products shall be conducted for the candidates from the following subject areas:

**Physical:** Determination of heats of reaction, effects of solute on boiling point of solvents, partition coefficient. Other experiments based on the scope of the Lectures and as approved by the Department.

**Organic:** Safety precautions, classification of organic compounds by their solubilities in common solvents. The Lessinger's tests for qualitative analysis of common elements in organic compound. Identification and classification of acids and bases functional groups. Identification and differentiation of the following neutral groups; alcohols aldehydes, ketones, esters, anhydrides and ethers. Acetylation of aniline as an example of the preparation of solid aniline derivatives. An electrophilic addition reaction.

**Inorganic:** Qualitative and quantitative analysis: molarity, concentration and percentage purity.

**CSC1301: Introduction to Computer Science I****(3 Units: LH 45)**

History of computing: Definition Generation of computers, Components of a computer systems; Von Neumann model of computation: The fetch/decode/execute cycle; basic machine organization Computer Hardware: Input/output devices. Computer Software: System Software, Application Software, Utility programs. Introduction to operating: basic functions of operating, types of operating system, Operating system and resource management. Language Translators: compiler, interpreter and assembler. Introduction to computer Networks; types, network devices and their uses. The Internet; browser, url, search engine. Computer security; risks and safeguards, how viruses work and how to prevent them, Information privacy.

**CSC 1202: Fundamentals of Cyber Security I****(2 Units: LH 15)**

Provides an overview of the introductory topics in cyber security, which will be the basis for the other security-related in the MSIS. Topics include basic concepts on CIA (Confidentiality, Integrity, and Availability), methodologies for implementing security policies, best current practices, testing security, and incident response, risk management, disaster recovery, access control, basic cryptography and software application vulnerabilities.

**FRS 1201/2210: Introductory Forensic Science****(2 Units: LH 30)**

Historical development of forensic Science; Scopes/ Areas in Forensic Science; Medical and legal aspects of forensic science; Analytical techniques in forensic science; Documentation and court presentation; Fingerprint: Detecting and preservation of developed finger prints from crime scene, patterns/classification of finger prints and analysis of finger prints

**GSP 1201/2201 Use of English:****(2 Units: LH 30)**

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

**GSP 1202/2202: Use of Library, Study Skills and ICT****(2 Units: LH 30)**

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

**MTH 1301 Elementary Mathematics I****(3 Units: LH 45)****(Algebra and Trigonometry)**

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

**MTH 1303 Elementary Mathematics III****(3 Units: LH 45)****(Calculus)**

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

**PHY 1210 Mechanics****(2 Units: LH 30)**

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

**PHY 1220 Electricity, Magnetism and Modern Physics****(2 Units: LH 30)**

Electrostatics; conductors and currents; dielectrics; magnetic fields and electro- magnetic induction; Maxwell's equations; electromagnetic oscillations and waves; Coulomb's law; methods of charging; Ohm's law and analysis of DC circuits; AC voltages applied to Inductors, capacitors and resistance; Applications.

**PHY 1170 Physics Practical I (1 Unit: PH 45)**

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

**PHY 1180 Physics Practical II (1 Unit: PH 45)**

This is a continuation of the experiments designed for PHY 1170 and PHY 1180 some of which have been covered under PHY 1220.

**100 LEVEL ELECTIVES:**

**FRS 1202: French For Beginners (2 Units: LH 30)**

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

**FRS 1203: Arabic For Beginners (2 Units: LH 30)**

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

**200 LEVEL**

**BCH 2301: General Biochemistry I (3 Units: LH 45)**

Historical Perspective of Biochemistry, Introduction to meaning of biochemistry, branches of Biochemistry and Fields of Application; Cell biology- prokaryotic versus Eukaryotic organism, the living cells of plants and animals- biochemical structures, size and functions of organelles; Carbohydrate chemistry- classification, structure, isomerism, reactions and importance; Chemistry of Amino Acid, protein and their derivatives, The three dimensional structures of simple biomolecules – configuration and conformation, Methods of isolation and purification; Lipid Chemistry – classification, structure, isomerism, reaction and importance; Nucleic Acid Chemistry – nucleoside and nucleotides – classification, structures and reaction.

**BCH 2302: General Biochemistry II (3 Units: LH 45)**

Integration of cellular functions; Cell division and differentiation; Digestion and transport of biomolecules; Introduction to enzymes, types, properties, classification and nomenclature; Coenzymes; Factors affecting the rate of enzyme catalyzed reaction; Biological oxidation and bioenergetics. Gibb's equation, chemical coupling; Phosphorylation, ATP and NADPH cycles

**PCL 2201: Introductory Pharmacology (2 Units: LH 30)**

Drugs – source and composition; Drug identity and Nomenclatures; General pharmacologic response to drug – nature and mechanism; Routes of drug administration, placebo effect, drug allergy, drug idiosyncrasy; Drug development/ assays – concept of agonist, antagonists and receptors; Quantitative pharmacology- Dose – response, therapeutic index ( T I ), Lethal Dose, etc.; Drug Interactions – cumulations, synergism, tolerance, antagonism; Cellular Metabolism in infected cells ; Host – Parasite relationships; Biochemical basis of chemotherapy ; Enzyme inhibitors as drugs, the physical basis of drug selectivity; Drug tolerance and resistance

**B10 2201 Genetics I: [2 Units] [L 30: P0: T0]**

Hereditary and non-hereditary characteristics. probability and tests of goodness of fit. quantitative inheritance; variation in genome structure, introduction to population genetics.

**BIO 2206: Biostatistics (2 Units: LH 30)**

Biostatistics is essential to ensuring that findings and practices in science and biomedicine are supported by reliable evidence. Basic tools for the collection, analysis, and presentation of data; Assessing the impact of chance and variability on the interpretation of research findings; General principles of study design; hypothesis testing; review of methods for comparison of discrete and continuous data including ANOVA, t-test, correlation, and regression.

**CHM 2241: Organic Chemistry I (2 Units: LH 30)**

Factors affecting structures and properties of organic compounds (inductive, electromeric, mesomeric, and steric effects and hyperconjugation); Electrophilic and nucleophilic reagents, nucleophilicity and basicity; Alkyl halides (preparation and chemical properties); Types of organic reactions: Addition reactions (Electrophilic and nucleophilic); Substitution reactions [Electrophilic and nucleophilic ( $S_N1$  and  $S_N2$ )]; 1,2-Elimination reactions (E1 and E2); Free radical substitution reactions of alkanes; Stereochemistry (introduction).

**CHM 2231: Inorganic Chemistry I (2 Units: LH30)**

Chemistry of first row transition metals; Introduction to coordination chemistry: Elementary treatment of crystal field theory; Comparative chemistry of the following element: (a) 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 system.

**CHM 2211: Introduction to Analytical Chemistry (2 Units: LH 30)**

Theory of errors; Statistical treatment of data; Theory of sampling; Chemical method of analysis including volumetric, gravimetric and physicochemical methods; Optical methods of analysis; Separation methods

**CHM 2261: Practical Chemistry II****(2 Units: PH45)**

Some important Terms; Drying and dehydrating agents; Volumetric analysis: Acid and Base - Titrations of monobasic acids and monobasic bases using indicators and pH meters; Redox titrations – permanganate titrations; Buffers; Qualitative organic analysis: Confirmatory tests for functional groups; Dehydrochlorination of 2-Chloro-2-methylbutane; Reaction rates of SN<sub>1</sub> and SN<sub>2</sub> reactions as functions of substrate structures; Effects of leaving group on an SN<sub>1</sub> and SN<sub>2</sub> reaction; Concentration effect on an SN<sub>1</sub> and SN<sub>2</sub> reactions; Secondary steric effects on SN<sub>2</sub> reactions

**CBS 2202: Fundamental of Cyber Security II****(2 Units: LH 30)**

Operating system protection mechanisms, intrusion detection systems, formal models of security, cryptography, Steganography, network and distributed system security, denial of service (and other) attack strategies, worms, viruses, transfer of funds/value across networks, electronic voting, secure applications, homeland cybersecurity policy, and government regulation of information technology.

**CSC 2201: Introduction to Computer Science II****(3 Units: LH 45)**

Problem solving using computer; Algorithm, Flowchart, Pseudocode. Programming: Program Control/Logic structure, Programming paradigms (Structured and OO programming). Machine level representation of data: Bits, bytes, and words; numeric data representation and number bases; fixed and floating-point systems; signed and twos complement representations. Basic concept of files: data, information, records, fields, types of files, Databases. Basic data Structures: Meaning of data structure. Brief discussion on: Array, linked lists, stacks and queues, tree; tree traversal, uses of binary trees. VISUAL BASIC Programming Language.

**FRS 2203: Crime Scene Investigation****(3 Units: LH 45)**

Crime Scene: Definition and types of crime scene (primary and secondary crime scenes); General Crime Scene Procedures: Crime scene Management; Role of forensic scientists, forensic doctors, fire brigade and judiciary, maintaining the chain of custody; Securing, Protecting and Recording the Crime Scene: Forensic Photography, sketching and field notes; Definition, importance and types of physical evidences; Collection and preservation of physical evidences, and forwarding to the Forensic Laboratory in crimes like murder, theft, extortion, explosion etc.; Investigation and sketching of indoor and outdoor scenes of crime using triangulation method and baseline method; Collection and packaging of different types of evidences; Collection and Handling of toxicological, hit and run crime scene and fire crime scene samples; Analysis of different types fibres; Examination of soil and paints samples.

**GSP 2204: Nigerian Government, Culture and Economy****(2 Units: LH 30)****GSP: 2206: Logic & Philosophy****(2 Units: LH 30)**

A brief survey of the main branches of Philosophy; Symbolic logic; Special symbols in symbolic logic-conjunction, negation, affirmation, disjunction, equivalent and conditional statements, law of tort. The method of deduction using rules of inference and

bi-conditionals, qualification theory. Types of discourse, nature or arguments, validity and soundness, techniques for evaluating arguments, distinction between inductive and deductive inferences; etc. (Illustrations will be taken from familiar texts, including literature materials, novels, law reports and newspaper publications).

**FRS 2204: Trace Evidence**

**(2 Units: LH45)**

Physical Properties of evidences (temperature, weight, density and refractive index); physical evidences like soil, glass, fibre, hair and liquids; Forensic Examination of Glass: Composition of glass, Measuring and comparing Physical Properties of glass; classification of glass samples; Comparison of glass fragments and fractures; Collection and preservation of glass evidence; Forensic analysis and examination of soil– colour, density, size distribution of particles, mineral and chemical analysis of soil; variations in soil, collection and preservation of soil evidence; Types of paints and their composition, macroscopic and microscopic studies, pigment distribution, micro-chemical analysis-solubility test and other necessary analytical techniques helping in the interpretation of paint evidence; Fibers: Classification of fibres and preliminary examination; Identification and comparison of manufactured fibres, Significance of match; Collection and preservation of fibre evidence; Antigen-Antibody reaction (Blood Groupings); Studying the morphology of different plant parts; Study of conducting tissue- Xylem and phloem elements in Angiosperms and Gymnosperms as seen in L.S. and R.L.S.; Study of fungal colonies by using PDA culture; Separation of dyes by TLC and Paper Chromatographic techniques

**FRS 2205: Introduction to Human Rights law**

**(2 Units: LH 30)**

Definition Meaning and Classes of Human Rights; Introduction to Human Rights and Civil Liberties; Historical Antecedents of Human Rights in Nigeria; Human Rights as a Universal Concern; Fundamental Objectives and Directive Principles of State Policy; Fundamental Rights and Fundamental Right Cases; Fundamental Human Rights Cases; Violation – Consequences of Disobedience; Right to Life and the Scope and Limit of Exercise of Police Powers; Judicial Attitude to Individual or Fundamental Human Rights in Nigeria; Right to Life and Abortion in Nigeria; Euthanasia and the Right to Life; Fundamental Human Rights section 37, 38, 42 and 43 of the 1999 Nigerian Constitution; Right to Freedom of Association, Accommodation, Food, Education and Equal Opportunities; Comparative Analysis of Human and Civil Liberties under Nigerian Law and International Instruments; The International Human Rights movement: historical origins and key international declarations, agreements and instruments; Selected human rights issues under international and national law: The topical and burning for the Bulgarian society and the European Union; The standards developed in international human rights law and the European standards; Relating the universal rights concept, guaranteed by international institutions, to individual rights, established by the Nigerian Constitution

**GST 2205 Peace and Conflict Resolutions**

**(2 Units: LH 30)**

Basic Concepts in peace studies and conflict resolution; Peace as vehicle of unity and development; Conflict issues; Types of conflict, e. g. Ethnic/religious/political/economic conflicts; Root causes of conflicts and violence in Africa; Indigene/settler phenomenon; Peace – building; Management of conflict and security. Elements of peace studies and conflict resolution; Developing a culture of peace; Peace mediation and peace-keeping; Alternative Dispute Resolution (ADR). Dialogue/arbitration in conflict resolution; Role of international organizations in conflict resolution, e.g. ECOWAS, African Union, United Nations, etc.

**LAW 2202: Criminal Law for Forensic Scientists (2 Units: LH30)**

Elements of evidence law; Expert Witness Testimony; Ingredients of establishing offences; Specific offenses relating to homicide and non-fatal offenses; Police: history and structure; Police administration; Juvenile delinquency; Drug abuse; Relevant Provisions of Motor Vehicle Act, 1 (Offenses and Penalties); Relevant Provisions of Nigerian Penal Code.

**FRS 2206: Introduction to Criminal Justice Administration (2 Units: LH 30)**

Definition of criminal justice; Aspects of the procedure and practice of the criminal process; Concepts and principles underlying criminal law; The crime picture; Causes of crime; Criminal law; The legal environment; The court: The courtroom workgroup; Sentencing; Probation and parole; Prisons; The future of criminal justice

**FRS 2207: Forensic Psychology (2 Units: LH 30)**

The concept and scope of forensic psychology, techniques and processes of forensic investigations, art of identification of incidence, psychological approaches to interrogations and confessions using psychological skills; crime and delinquency, psychopathic behaviours and society, juvenile offender, social and psychological implications of legal judgements; crime culture and prevention, the reliability of eye witness testimony, construction of the personality profile of criminals; role of psychologists in the criminal justice system (court room), the mental health of the offender and mental health legislation.

**300 LEVEL**

**ZOO 3305 Basic Entomology (2 Units: LH 30)**

Evolution and systematics of insects. Insects structure and function with particular emphasis on the insect integument, antennae, mouth parts and legs including functional modifications of these parts. Life history – moulting Methods of locomotion in insects. Feeding, digestive, excretory and reproductive systems in insects. Insects of economic importance. The success of insects. Insects, pests and control methods. Insects' collection methods. Identification and preservation techniques.

**FRS 3201 Molecular Biology: (3 Units) (L 30: PO: T 15)**

Biogenesis of microtubules, microfilaments, Golgi and mitochondria. Membrane-membrane interactions. Introduction to bioenergetics and thermo-dynamics.

Pre-requisite -BIO 205.

**FRS 3202: Principles of Immunology (2 Units: LH 30)**

Blood chemistry and composition. Preparation of serum and plasma. Protein components of plasma. Innate and acquired immunity. Antigens, antibodies, cellular immunity. Antigen-antibody interactions. Immunological tolerance and suppression. Immunological anomalies, diagnostic immunology, vaccines. Structure of immunoglobulins. Combining sites of antibodies. Myeloma and hybridoma immunoglobulins. The antigen binding site. Domains of antibody molecules-gene duplication and diversification. Generation of diverse antibody specificities, clonal selection theory of antibody formation. Biological significance of clonal selection.

**FRS 3203: Organic Chemistry II****(2 Units: LH 30)**

Alcohols and their reactions; Ethers and epoxides; Carboxylic acids and their derivatives; Carbonyl compounds – aldehydes and ketones; Carbanion and C-C bond formation: E1cB elimination reaction, alkyl lithium and Grignard reagent; Aldol reaction, Claisen condensation, Dieckman cyclization and alkylation of enolates compounds;  $\alpha,\beta$ -unsaturated carbonyl compounds; Michael addition.

**CHM 3242: Organic Chemistry III****(2 Units: LH 30)**

Basicity of aliphatic and aromatic amines; Preparation and Chemical reactions of amines; Hoffmann degradation and elimination; Nitrosation of amines (diazonium salts); Tests for amines; Alicyclic Chemistry: Conformation of alicyclic rings; bicyclic compounds – classification; non-benzenoid aromatic compounds (e.g., azulenes); their synthesis, properties and reactions. Alicyclic compounds in nature; Aromatic chemistry: Aromaticity; Electrophilic substitution reactions; Activating, deactivating and directive influences of substituents; Sandmeyer and coupling reactions; Regioselectivity in second and third aromatic Electrophilic substitution reactions; Reactions of fused benzene rings.

**FRS 3213: Network Management and Security****(2 Units: LH 30)**

Analog and Digital Data Transmission; Networking and Introduction to Internet; Basics of Networking; Types of topologies, Networking Devices (Switches, hub, bridge); LAN and WAN; World Wide Web (WWW), E-mails, Search Engines, Network Security – Threats, Vulnerabilities, Access Control, Malicious Code (Virus, Worms, Trojans, etc.);

**CHM 3304: Applied Spectroscopy****(2 Units: LH 30)**

Principles and applications of UV, IR, NMR and mass spectroscopy; Determination and elucidation of structures of organic compounds

**CHM 3213: Instrumental Methods of Analysis****(2 Units: LH 30)**

Spectroscopic techniques; Quantitative analysis; X-ray methods; Fluorescence methods; Nuclear magnetic resonance and electron spin resonance; Refractometry and interferometry; Polarimetry, polarography and calorimetry.

**FRS 3210: Introduction to Forensic Serology****(2 Units: LH 30)**

Origin, development, structure and function of blood cells, ABO, Rhesus and MNS blood groups — biochemistry, biosynthesis, distribution and genetic theory. Blood grouping techniques principles, advantages, and disadvantages. Antisera, Lectins and enzymes including preparation and standardization. Blood group serology in paternity and maternity disputes, Forensic applications of BGS. Identification of bloodstains by Kastle-Meyer colour test, Hema test tablet test, Luminol test. Determination of species of origin: Microscopic methods, Ring test, single diffusion, double diffusion, Crossed-Over electrophoresis. Grouping of blood stains: Techniques for the determination of blood groups from bloodstains; Composition and examination of Biological Fluids such as Saliva, semen, Vaginal Fluid, Urine and sweat. Tests used in Blood Analysis: Catalytic and crystal tests; Use of spectrophotometric, chromatographic and immunological methods in blood analysis. Protection of Biological Evidences, Packaging and transportation of Biological Evidences; Bloodstain Pattern interpretation: Properties of human blood, target



surface considerations. Size, Shape and Directionality of bloodstains, Spattered blood, other Bloodstain Patterns, interpretation of Bloodstain on clothing and footwear; Documentation and Photography for Bloodstain Pattern Analysis; Preservation of blood evidence; procedures and precautions

**FRS 3207: Fingerprint**

**(2 Unit: LH 30)**

Fingerprinting: History and Development of fingerprints; classification of fingerprints by the Henry System; Extension of Henry system, Single digit Classification, Fingerprint Bureau; Principles of Fingerprints, Importance, nature and location; Fingerprints as evidence: Its recognition, Collection and Preservation; Biological significance of skin pattern, Ridge formation, counting and tracing; important figures in the field of fingerprints, Fingerprint patterns, general and individual characteristics of fingerprints; Fingerprints and other Impressions: Taking fingerprints from living and dead persons; Other Impressions: Tyre marks, tool marks (compression marks, striated marks, combination of compression and striated marks, repeated marks), lip prints and foot print examinations; Latent fingerprint and Chance Fingerprints in criminal investigation, investigating latent fingerprints, Various methods of development of fingerprints and other impression marks: conventional, physical and chemical, fluorescent, Magnetic Powder, fuming, laser methods; lifting of latent fingerprints; Restoration of Erased/Obliterated Marks: Method of making cast, punch, engrave, obliteration, restoration, etching (etchings for different metals), magnetic, electrolytic etc.; recording of restored marks – restoration of marks on wood, leather and polymer; presentation of fingerprints and other impressions as evidences in court.

**FRS 3206: Forensic Practical I & II**

**(2 Units: PH 45)**

Blood Group analysis from fresh and old blood stains; Catalytic and Crystal tests for Blood; Determination of species of origin; Blood stain pattern analysis; Analysis of Biological Fluids (Semen, Saliva, Sweat, Urine); Photography of bite marks and skid marks; Preparation of permanent slides by using maceration technique of various forensic materials of Plant origin; Study of pollen grains and spores of forensic significance; Identification of pollen grains and diatoms; Study of life cycle of blowflies; Study of structure of hair; Finding results of different logic gates and their combinations; Working with Windows – File (creation, modification, deletion, attributes), Folder (creation, nesting, attributes); Working with Linux – File (creation, modification, deletion, attributes), Various commands on Linux (basic utility commands e.g. Date Viva-Voce, Cal etc.); Obtaining the system and process information (Windows)

**FRS 3208: Forensic Anthropology and Odontology**

**(2 Units: LH 30)**

Forensic Anthropology: Introduction, definition & History of Anthropology; Physical Anthropology & Human Variability, scope and application of Forensic Anthropology; Understanding Archeology, Osteology and related sciences; Study of Skeletal Material: Human and animal remains; burned bones and bone fragments; Assessing and determining the time and cause of Death using the skeletal remains; Attribution of Sex, Estimation of Age and reconstruction of stature from long bones, skull and their medico-legal implication; Facial reconstruction using photography, clay modeling etc. and its importance; Forensic Odontology: Introduction of Odontology, Body Identification by Dental Records, Post Mortem Examination and Records, Ante-mortem examination and records, Record Analysis and Processing, Forensic Dentistry in Mass

Disasters, Bite Mark Analysis – Time of Death, Collection of Bite mark evidence & comparison.

**FRS 3209: Forensic Toxicology**

**(2 Units: LH 30)**

Metallic Poisons:- Arsenic, mercury, bismuth, lead(nature, administration, symptoms, post-mortem findings, detection and medico-legal aspects);Insecticides:- Organo-phosphorus compounds, organo-chlorine compounds and carbamates (nature, administration, symptoms, post-mortem findings, isolation, detection, estimation and medico-legal aspects);Volatile Poisons:- Methyl alcohol, ethyl alcohol, chloroform, and acetone(nature, administration, symptoms, post-mortem findings, isolation, detection, and estimation, medico-legal aspects); Toxicology of alcohol:- Introduction, definition of alcohol and illicit liquor; Proof spirit, absorption, detoxication and excretions of alcohol; problems in alcohol cases and difficulties in diagnosis; Breath test instruments, field sobriety testing, analysis of blood for alcohol; Cases of drunken driving; Analytical techniques in the analysis of alcohol; Miscellaneous Poisons:- *Animal poisons*: snake, scorpions and other insects; *Vegetable Poisons*: opium, Dhatura, oleander, madar, Abrus precarious, Castor, cannabis, Nux vomica, cyanide, etc.(Nature, administration, symptoms, post-mortem findings, isolation, detection and medico-legal aspects)

**FRS 3671: Industrial Training II**

**(6 Units)**

Student's Industrial work experience of 6 months' duration. Students' reports will be presented in a seminar.

**EPP 3201 Entrepreneurship**

**(2 Units: LH 30)**

Profiles of business ventures in the various business sectors such as:

Soap/Detergent, Tooth brush and Tooth paste making; Photography; Brick making; Rope making; Brewing; Glassware production/ Ceramic production, Paper production; Water treatment/conditioning/packaging; Food processing/preservation/packaging; Metal fabrication; Tanning industry; Vegetable oil extraction; Farming; Fisheries/aquaculture; Plastic making; Refrigeration/Air-conditioning; Carving, Weaving; Bakery; Tailoring; Printing; Carpentry; Interior Decoration; Animal husbandry etc. Case Study Methodology applied to the development and administration of Cases that bring out key issues of business environment, start-up, pains and gains of growth of businesses, etc. with particular reference to Nigerian businesses. Experience sharing by business actors in the economy with students during Case presentations.

**300 LEVEL ELECTIVES:**

**BIO 3301 Genetics II:**

**(3 Units) (L 45: P15: T0)**

Aspects of human genetics; pedigree analysis. Further consideration of various deviations from basic principles. Gene interaction. Pre- requisite -BIO 201.

**FRS 3311: General Cytology**

**(3 Units: LH 30: PH 15)**

Light, phase contrast, dark-field and electron microscopy, auto-radiography, florescence, cell cycle; introduction to cytogenetics.

**CHM 3231: Inorganic Chemistry II****(2 Units: LH 30)**

The noble gases and hydrogen: Electronic structure and properties; Comparative study of group Ia and IIa elements; Chemistry of: boron, carbon and silicon; nitrogen and phosphorus; oxygen and sulphur; halogens; transition elements; Separation of metals; Coordination chemistry: Ligands and crystal field theory; Introduction to radiochemistry; Radioactivity and the periodic table

**FRS 3213: Defense Chemistry I****(2 Units: LH 30)**

Police, Riot, Civil Commotion and Demonstration; Chemical Weapons: Classification of chemical weapons agents according to physiological effects: Non-lethal or incapacitating agents (riot control agents, RCAs); Introduction to the Lethal agents (sub-classified into:- Choking agents, Blister agents, Blood agents and nerve agents); Classification according to persistent or non-persistent effects; Pulmonary agents (oxides of nitrogen, perfluoroiso-butylene); Calmative Agents; Malodorants; chemical weapon designation.

**CHM 3222: Polymer Chemistry I****(2 Units: LH 30)**

The nature of polymer, nomenclature; Outline of sources of raw materials for polymers; Polymerization processes: Condensation polymerization in details; Solubility and solution properties of polymer; Structure and properties of polymer; Fibre forming polymers.

**FRS 3214: Defense Chemistry II****(2 Units: LH 30)**

Lethal agents (sub-classified into: - Choking agents, Blister agents, Blood agents and nerve agents); Methods of protection against chemical agents (both individual and collective protective measures); detection and decontamination methods and available chemical agents antidotes; chemical weapons disposal; current world picture regarding the potential use of chemical weapons; Haber's law; Median lethal dose ( $LD_{50}$ ), effective dose ( $ED_{50}$ ) and therapeutic index;

**CHM 3223: Colour Chemistry and Technology I****(2 Units: LH 30)**

Colour and constitution chemistry; Properties of dyes and pigments; Classification of dyes and fibres; Dyeing mechanisms; Preparation and dyeing of natural and synthetic fibres; Colour fastness properties; Quality control procedures and the colouration industry.

**FRS 3215: Object Oriented Programming and Java****(2 Units: LH 30)**

Brief survey of programming paradigms: procedural, object-oriented and functional; Introduction to object-oriented programming; Introduction to a typical object-oriented language C++/JAVA; Fundamental design (concept and principles); introduction to design patterns; object oriented analysis and design; design for re-use; Data declaration: Variables, types, and expressions; assignment, classes and objects; syntax of class definitions; methods, members; Message passing: Simple methods; parameter passing; Sub-classing and inheritance; Control Structures: iteration, conditionals; Simple Data structure: Arrays and strings; Programming assignments involving hands-on practice in the design and implementation of simple algorithms such as finding the average, standard deviation, searching and sorting.

**FRS 3214: Cryptographic Techniques (2 Units: LH 30)**

Explores symmetric and asymmetric cryptography, key management, and encryption algorithms such as DES, AES, RSA, and PGP, Discusses PKI, SSL, and VPN including how to use protocols, hashing, digital signatures, and certificates and certificate authorities. Covers policies, procedures, and methods for the proper use of cryptography in secure systems.

**MCB 3302 Pathogenic Bacteriology (3 Units: LH 30: PH 45)**

Concepts and historical perspectives of Bacteriology; Gross morphology of bacteria cells; structure of bacteria, Relationship between size and metabolism of bacteria. Nutrition in bacteria, bacterial growth, bacterial and classification, pathogenic bacteria and diseases; Virulence, spectrum and symptoms of infection, treatment and control. Koch's postulate; Methods of isolation of bacterial pathogens.

**MCB 3308 Pathogenic Mycology (3 Units: LH 15: PH 45)**

Structure, life cycle, physiology and classification of fungi; fungi of economic importance; laboratory methods of mycology, pathology and immunology of superficial systems importance; laboratory methods of mycology, pathology and immunology of superficial systems mycoses and actinomycoses.

**400 LEVEL**

**CHM 4252: Theory of Molecular Spectroscopy (2 Units: LH 30)**

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 4212: Analytical Chemistry II (2 Units: LH 30)**

Theory of error; potentiometer and pH scale; conductor-metric method; electrolytic method; radiochemical methods and chromatographic techniques

**CHM 4214: Explosive Chemistry (2 Units: LH 30)**

Chemical and physical explosion; Detonation kinetics of explosions; the explosion nucleus; thermal theory and branching chain theory; explosion limits; Limitation of explosions in liquids and solids by friction and impact; growth of explosions to detonation; The composition of modern explosives (explosive trains); The chemistry of active materials for the manufacture of explosives preparation (formulations) of some well-known explosives: stability tests

**FRS 4215: Introduction to Questioned Documents (2 Units LH: 30: PH 15)**

Questioned Documents: Definition, types, importance, nature and problems; Location, collection, handling and presentation of documents; adequacy of examples and standards; Examination of alterations, erasures, overwriting, additions and obliterations; Methods of Detection: Detection and deciphering of indented writing, charred documents, invisible/secret writing; Ink Examination: Composition of major types (carbon ink, fountain pen ink, ballpoint pen ink, rolling ball marker inks, fiber or porous tips pen ink);

analysis of writing inks and ink dating; Analysis of documents: Pencil lead examination and age of the documents; Identification and comparison of typescripts; Paper analysis: Physical characteristic, water mark examination, fiber analysis, chemical and trace elemental analysis; Equipment required: Camera, Microscope, Reference standards, TLC and HPLC; Handwriting and Signature: Identification, Principle of handwriting, individual and class handwriting characteristics; External, internal and physical characteristics affecting the handwriting; Signatures: Authentic, forged, disguised and traced signatures and their characteristics; Factors affecting the signature of individuals

### **FRS 4216: Forensic Pathology**

**(2 Units: LH30)**

Introduction: Global Medical Jurisprudence, Legal Procedure in Nigeria:-Police, Magistrate's and Coroner's inquests; Oath and affirmation; Documentary evidence:-Medical certificates, medical reports, death declaration; Understanding laws and ethics of medical practice; Death:- Medico-legal aspects of death; Diagnosis of death-somatic and molecular; early and intermediate changes following death; late changes after death-putrefaction, autolysis, bacterial action, factors affecting these changes; Determination of time since death, including histopathological methods; Post-mortem Examination:- Ante- and Post – mortem examinations; external and internal examination; collection, preservation and packaging of viscera; Role of a Forensic Pathologist; Wounds: definition, types and identification; Medico-legal aspects of wounds; determining the age of the injury, ante – mortem, post – mortem injuries; Abrasions, grazes, lacerations, Bruises and contusion; Punctured wounds and incised wounds – causes, dimensions, ante – mortem, post – mortem analysis and its medico-legal aspects; difference between suicidal, homicidal and accidental wounds; Wound / Terminal Ballistics:- Introduction, Injuries and the quantity of energy of projectiles; Shock wave and cavitation effect; Wounding mechanism, Elements of wound Ballistics; Nature of target, Velocity of projectile, Constructional features of projectile; Contact, Point blank, near, chips and distant ranges; Penetration of shots in different regions of the body; Personal Identification: Importance and need for personal identification, cases that will require personal identification; Documents proof: scars, professional marks, personal articles, Finger printings, dentures, sketches and photographs, skeletal remains; identification in mass disasters, mutilated remains and decomposed bodies.

### **FRS 4217: Forensic Ballistics**

**(3 Units: LH 45)**

Fire Arms: Introduction, brief history of fire arms, weapon types and their operations, proof marks; Ammunition: A brief history, components, nontoxic shots, propellants, priming compounds and primers, head stamp marking on ammunition; Bullet comparisons, cartridge case examination, class and individual characteristics of identification; Firearms: Nature, parts and classification; Uses of standard firearms data bases and automated search systems (DRUGFIRE and IBIS); Ballistics: Definition and Forensic Importance; Types of ballistics: internal, external and terminal ballistics; velocity and theory of recoil, barrel pressure measurement, ballistic coefficient, angle of elevation of the barrel; Range of Fire; Muzzle pattern, scorching, blackening, tattooing, wad distribution, pellet patterns, GSR analysis, and primer residues; Reconstruction of the sequence of events in a shooting case; Presentation of evidence in the court; Ricochet: Critical angle for ricochet for the bullet and the surface, Relationship between the angle of incidence and ricochet, Stability in flight after ricochet, and Lethal effects of ricochet bullet.

**FRS 4218: DNA Fingerprinting****(2 Units: LH 30)**

DNA Fingerprinting: Definition, importance in Forensic Science; collection and types of evidences for DNA fingerprinting; Genetic basis of DNA Fingerprinting; Chromosomes, DNA, Nuclear DNA and Mitochondrial DNA; Techniques of DNA Fingerprinting; Isolation, performing southern blots, making radioactive probe, Hybridization reaction, visualization, VNTR, HLA-DQ $\alpha$ , STRs, RFLP; Types of DNA Fingerprinting: Single locus DNA and multi – locus DNA Fingerprinting; Mini satellite, micro-satellite, FTA cards for isolation of DNA; Polymerase Chain Reaction: Instrumentation, principle, significance in forensic case samples; Denaturation, annealing and extension; Detection of PCR products; Practical application of DNA Fingerprinting: Paternity and maternity testing, personal identification, criminal identification etc.; DNA databank; limitations of DNA Fingerprinting; legality of DNA Fingerprinting in Nigeria

**FRS 4219: Forensic Practical III****(2 Units PH: 45:)**

Examination and detection of fraudulent documents; Scientific report writing; Identification of Indented writing, Invisible writing, class and individual characteristics in handwriting; TLC of different ink samples; Photography of documents; Quantitative analysis using Colorimeter and Spectrophotometer; Immuno-diffusion technique; Electrophoretic separation of proteins

**FRS 4220: Forensic Practical IV****(2 Units PH: 45)**

Spot test for explosives; Comparison of bullets; Chemical analysis of explosive materials (e.g. Gun powder)-Colour test and microscopic examination; Study of various parts of the firearms: - barrel, stock, caliber, choke etc.; Electrophoresis of blood, blood proteins and enzymes; Isolation of DNA; Examination of personal Identification marks; Visit for autopsy; Identification of Bite marks.

**FRS 4221: Research Methodology****(2 Units LH: 45)**

Introduction to Research Methodology: Definition, concept and research in science and forensic science; Scientific, social science and behaviour science methods; Experimental research and non– experimental research design; Tools of Data Collection; Observation, questionnaires, interview schedules and case study methods; Introduction to statistics: parametric and non-parametric statistics; Descriptive Statistics: Measures of central tendency and dispersion; graphical representation of the data and simple correlation methods.

**FRS 4222: Microscopy****(2 Units: LH 30)**

Microscopy: Definition, different types of microscopes: Simple microscope, Compound microscope, Comparison microscope, Stereomicroscope, Polarizing Microscope, SEM and TEM microscopes, and Fluorescence microscope (Components, performance criteria and uses); Scope of microscopy in Forensic Science and elementary theory of microscope; light and lenses; Fiber Optics: Optical fibres, Propagation of light through optical fibre, Angle of acceptance and numerical aperture, losses and Solar cells;

**FRS 4223: Applied Forensic Physics****(2 Units: LH 30)**

Physics of Speech: Generation of sound, amplitude vibration, simple harmonic motion, sine waves, physical properties of vibrating systems; propagation of sound and standing waves, modes of vibration and its significance in voice identification; Causes and Investigation of Vehicular Accidents: Automobile accidents-Introduction, sources of information, eye witnesses, Tire and other marks, Pedestrian impacts and vehicle condition, speed and damage; curved scuffmarks, Time and distance, reaction time, Photography and plans; Forensic Photography: Introduction, Types of cameras and films, Digital photo imaging, ISO number, Exposure Index, Photo imaging evidence; angle, scale, depth of field, light, ambient light, color, temperature, flash/ strobe; Surveillance photography and Aerial photography and accessories; Methods for developing photographs; High-speed photography, legal aspects of visual evidence; Image magnification, Photography of finger prints, impressions, tool marks and restored latent prints and impressions.

**MCB 4301: Pathogenic Microbiology****(3 Units: LH 30: PH 45)**

Study of some microbial pathogens of plants and animals with emphasis on those prevalent in Nigeria. The geographical distribution, isolation, identification, morphology, life cycle, source of infection, transmission and the host. Ecology, clinical manifestations of specific bacterial, viral and fungal pathogens of man.

**FRS 4600: Final Year Student's Project****(6 Unit)**

Carryout independent research on selected areas of interest and present findings before internal and external examiners.

**400 LEVEL ELECTIVES****MCB 4203: Pharmaceutical Microbiology****(2 Units LH: 45)**

Concepts of growth and death in microorganisms; The chemistry of synthetic chemotherapeutic agents and antibiotics; Production and synthesis of antibiotics and antiseptics; Relationship of antimicrobial agents to different microbial groups: Gram positives, Gram negatives, spore-formers etc.; The mode of action and assay of antibiotics and antiseptics; Sensitivity and resistance as related to microbial physiology; Microbiological quality control in the pharmaceutical industries

**CHM 4222: Polymer Chemistry II****(3 Units: LH 45)**

The nature of Polymer nomenclature. Outline of sources of raw materials for polymers; Polymerisation process, condensation polymerisation in details. Solubility and solution properties of polymers. Structure and properties of polymers. Electrical conducting organic wires, smart/sim cards, flat screen televisions. Fibre forming polymers. Bullet proof vests and vehicle bodies from polymers.

Polymerisation mechanisms; detailed treatment of addition processes. Stereospecific reactions, copolymerisation reactions. Phase systems for reactions. Industrially important thermoplastic and thermosetting polymers: Polyurethanes. Rubber elasticity. Mechanical properties of polymers. Analysis and testing of polymers. Degradation of polymers.

**CHM 4223: Colour Chemistry and Technology II (2 Units: LH 30)**

The chemistry and theory of dyeing; Chemistry and application of reactive dyes; Preparation and dyeing of man-made fibres; Dyeing machineries; Printing; Colouring matters for food, drugs and cosmetics; Dyes used in paper industry and colour photography.

**FRS 4302: Chemical Pathology (3 Units: LH 45)**

The course in Chemical Pathology shall be taught in three parts, namely: Clinical Chemistry, Human Nutrition and Immunology. The course in Clinical Chemistry is designed to highlight to the student the central role which abnormalities of biochemical functions of cells, tissues and organs play in the diagnosis, management and prognosis of disease states and how these abnormalities of biochemical functions may be recognized by measurements of components of biological fluids, blood, urine, cerebrospinal fluid, secretions, excretions, tissues or organs.

**MAJOR COURSES:**

**FRS 4225: Applied Forensic Chemistry (2 Units: LH 30)**

Drugs (Sedatives, Narcotics, Stimulants and Hallucinogens) and Crime; Signs and symptoms of addiction, the identification of an addict, interpreting drug findings; Barbiturates: Classification, administration, symptoms, postmortem findings, detection and medico-legal aspects; Narcotic Drugs & Psychotropic Substances Act; Drugs Control Act, Drugs & Cosmetics Act and any other relevant act (national and international); Food adulteration: Introduction, Prevention of food adulteration, Analytical techniques for analysis of exhibits involved in food and other material cases; NAFDAC Act 2004: Prevention of Food Adulteration; Arson: Chemistry of fire, investigation and evaluation of clue material, analysis of arson exhibits by instrumental methods: Management of Arson cases.

**FRS 4226: Digital and Cyber Forensics (2 Units: LH 30)**

Introduction to Digital forensic: Digital evidence, Increasing awareness of Digital evidence, challenging aspects of Digital evidence; Cyber trail: challenging aspects of the cyber trail, brief history of computer crime investigation, evolution of investigative tools, language of computer crime investigation, the role of computers in crime; Technology and law: jurisdiction, pornography and obscenity, child pornography, privacy, copyrights and the “theft” of Digital intellectual property; investigative process and reconstruction with Digital evidence; Applying forensic science to computers, forensic examination of windows systems, Unix system, handheld devices and network basic for Digital investigators; applying forensic science to networks; Digital evidence on physical and data-link layers, network and transport layers and the internet.



Forensic Botany: Identification of Plant specimens, Techniques for dating specimens and Algal colonization, Applications of plant ecology, botanical evidences of forensic significance (Leaves, seeds, etc); Diatoms: Classification, basic structure and morphology, Isolation and forensic significance; Wild Life Forensics: Introduction and importance of wild life, Protected and endangered species of Animals and Plants; Identification of wild life materials such as skin, fur, bones, nails, horn, teeth and flowers by conventional and modern methods; Identification of Pug marks of various animals and census of wild life populations; Forensic Palynology: Study of spores, powdered minerals and pollens of forensic importance; Use of pollen grains & spores in criminal or civil investigations; Applications of Forensic Palynology; Hair: Importance, nature, location, collection, evaluation, its biochemical properties; Phases of hair growth and types of hair; Differences between animal and human hairs; Forensic examination of different types of hair.

#### **PART D: ADDITIONAL INFORMATION**

##### **Orientation**

At the beginning of each session, new students are welcomed in to the University during orientation programme, which usually last for about three days. A lot of activities are arranged to familiarize the students with the new environment and the University System. Such activities include lectures by the Vice Chancellor, the Registrar, University officials such as Medical Officer, the Librarian and the Dean Student Affairs.

During this period, students are taught how to use the library and are shown various parts of the campus. Social activities feature prominently during the orientation programme. This programme is normally followed by registration of students for the courses they shall offer in the session. The Faculty and other associations also conduct orientation to the newly admitted students.

##### **Matriculation**

All students entering the University for the first time to undergo the first year of their degree course will be required to matriculate at a formal ceremony (Presided over by the Vice Chancellor), which normally takes place after the registration.

The Dean of each Faculty present students from his faculty for matriculation while the Registrar administers the matriculation oath. Students are made to solemnly undertake the swear to observe and respect the provisions of the Bayero University law and the statutes, ordinances and regulations which are, now in force or which may be brought in to force.

After matriculation, no student will be allowed to register fresh into level I and II of any programme in the faculty. The matriculation signifies the completion of registration. Any student whose name is not in the matriculation booklet is not registered student of the University.

##### **“Adding”/ “Dropping” of Courses**

**“Dropping”** a course means removing it from student’s record whether it is replaced by another course or not. **“Adding”** means taking on a course in addition to (or as a replacement for) the course earlier registered. The exercise may be carried out within the period of normal registration or during a given period of grace (normally two weeks). A course successfully dropped is not reflected in student’s record at all.

When dropping a course, it is advisable to contact the Head of Department whose course is to be dropped first. If when he approves a “dropping” that a student may proceed to the next page. It is the duty of a student to make sure that such changes are correctly recorded by his/her coordinator.

Course already pursued beyond limits set cannot be dropped or added. Of course, a student may abandon the course later if the result is unfavourable and substitute with another, but his record will reflect his performance in the course, which will be part of his credit load.

### **Suspension of Studies**

Students are entitled for suspension of studies when the need arises. An application should be written to the Dean stating the reason(s) for the suspension. The application should be made before the consideration of the semester result by the faculty board (i.e. not later than four weeks after the semester examination). If the application is approved by the board, recommendation to that effect would be sent to the Senate for final approval.

### **Inter Faculty/Department Transfer**

Transfer from one faculty to another is not normally allowed. However, transfer from one department to another within the same faculty is allowed usually on completion of 100 level. The requirement of the transfer is for student to obtain a form from the faculty office in which the approval of the student's head of department and the head of department to which the transfer is sought are required before the final approval by the Deanery.

### **Voluntary Withdrawal from Studies**

A student can withdraw voluntarily from the programme being pursued at any time of the study. Level Coordinator is required to be informed for the withdrawal

### **Withdrawal**

Withdrawal from the university shall be recommended by the Faculty board to the Senate on any of the following grounds:

- a. Failure to obtain a G.P.A of at least 1.00 after probation period.
- b. Failure to attend class for a period, which exceeds 30 consecutive days except upon, certified medical grounds.
- c. Failure to sit for the entire semester examinations without any admissible reason.
- d. Failure to satisfy Faculty regulations.

### **Lecture Time-Table**

At the beginning of each semester, a draft time table is placed by each department in the faculty on their various notice boards. Students are required to reach the various departments whose courses are being offered to copy the lecture time and venue for the courses. Where clashes are observed, the time table officers of both departments should be informed before the final Time-tables are prepared. In a situation where the clash could not be resolved, the Sub dean should be informed for further necessary action.

### **Examination Time-Table**

Prior to commencement of examination at the end of each semester, two (2) examinations Time-Tables are normally released by the Faculty Examination Office on the notice boards as follows:-

- **Draft (Tentative) Time - Table**

This is the first Time-Table released for students and staff to observe and immediately forward any genuine complain of omission or clash to the Examinations Office for necessary action. This is normally changed after effecting all the corrections.

- **Final Time-Table**

The final Time-Table is the one that will be followed for the conduct of all the examinations in the semester. Students are therefore reminded that for no reason they should miss any examination based on the draft Time- Table.

### **Transcript/Partial Transcript**

On completion of studies, students are entitled to apply for transcript which will show their general performance from the year of entry to graduation including the grades and various Cumulative Grade Point Average (CGPA) and the class of degree obtained. However, where a student has not finished the programme, he is still entitled to his record of study at any point of the study. For obtaining either of the transcripts, an application is made to the Dean, Faculty of Science after making necessary payment at the University Bursary unit.

### **List of Prizes in the Department**

Best students of the Department that excel in their examinations and score a CGPA of 3.50 and above are qualified for university scholarship in each of the degree programme being offered at the Department. In addition, the following two prizes are available in the department.

1. Michael Collins Prize for the best graduating student in Chemistry.
2. Michael Collins Prize for the best B.Sc. Level II student in Physical Chemistry.

### **Notification of Examination Results**

Students are to note that examination results shall be made known to them only after passing through the Department Board, Faculty Board of Examiners, Senate Business Committee and finally approved by the Senate.

Level coordinators normally issue their students with end of session result slip. Students are advised to re-do the GPA/CGPA calculations to ensure that their performance is correctly reflected in the slip.

### **Correction of Results**

A result may be corrected by course lecturer and Department. Genuine correction of results are entertained from students and handled as appropriate from the departments through the Senate.

### **Verification of Results**

Where a student is sure that he has sat for an examination and he/she is recorded absent, he/she can verify through his Departmental Examinations Officer. In such a case, the Department Examination Officer fills in a Verification Form and send it to the appropriate Department duly signed and containing details of the student's information and the course(s) to be verified.

No student is allowed to convey his/her Verification Form in person to the Department in which the verification is intended to be carried out, or to take back the verified result to the Department.

## **GRADING SYSTEM**

Bayero University, Kano operates the Course Unit System. Consequently, the University uses the GPA/CGPA grading system. The following are some of the important features of the system.

1. **Grade Point (GP):** Each letter grade is assigned a Grade point as follows: A = 5, B = 4, C = 3, D = 2, E = 1 and F = 0.
2. **Points:** All points obtained in a course are the product of the credit value of the course and the grade point obtained in the course. E.g. if a student obtains 'A' in a three credits course, the points are  $5 \times 3 = 15$ .

3. **Grade Point Average (GPA):** The Semester Grade Point Average (GPA) is defined as the weighted average of all the grade points obtained in the semester, with the credits as the weights. It is an indication of the student average performance in the semester.

In computing the GPA, credit values of course(s) graded incomplete are not counted.

$$\text{Thus GPA} = \frac{\text{Total Semester Points}}{\text{Total Semester Credits}}$$

4. **Cumulative Grade Point Average (CGPA):** The cumulative Grade point Average is defined as weighted average of all the grade points obtained by student from the time he/she joined the programme of study up to the time of computation. Thus, the CGPA gives an indication of the student's overall performance in the programme of study. The CGPA is therefore computed as follows

$$\text{CGPA} = \frac{\text{Total Points for all Semesters}}{\text{Total Credits for all Semesters}}$$

### Scoring and Grading Systems

(i) Credit Units	(ii) Percentile Scores	(iii) Letter Grades	(iv) Grade Points (GPA)	(v) Grade Point Average (CGPA)	(vi) Cumulative Grade Point Average	(vii) Class of Degree
The second digit of each course code	70 – 100	A	5	Derived by multiplying (i) and (iv) and dividing by total Credit Units	4.50 – 5.00	First Class
	60 – 69	B	4		3.50 – 4.49	2 <sup>nd</sup> Class Upper
	50 – 59	C	3		2.40 – 3.49	2 <sup>nd</sup> Class lower
	45 – 49	D	2		1.50 – 2.39	Third Class
	40 – 44	E	1		1.00 – 1.49	Pass
	00 – 39	F	0			No Degree

## EXAMINATION ADMINISTRATION AND CODES OF CONDUCT

### EXAMINATION ADMINISTRATION

- (i) It shall be the responsibility of each student to make sure that he/she is registered for the appropriate examinations and be sure of the date, time and places of the examination. To ensure that he is in possession of any identity document prescribe for the examination.
- (ii) A student shall be at the examination hall at least fifteen minutes before the advertised time of the examination. Each student is also required to supply his/her own pen, pencils, rulers etc.
- (iii) A student may be admitted up to fifteen minutes after the start of the examination but he shall not be allowed extra time.
- (iv) If a student arrives later than fifteen minutes after the start of the examination, an invigilator may at his/her discretion admit him if he is satisfied that the student had a good reason for his/her lateness, provided no student writing the examination has left the examination venue.
- (v) No student shall normally be allowed to leave during the first hour or last fifteen minutes of examinations.
- (vi) A student must handover his/her script to the invigilator before leaving if he does not intend to return.

- (vii) A student who leaves the examination room shall not be re-admitted unless throughout the period of his/her absence he has been continually under the supervision of an invigilator or assistant invigilator.
- (viii) A student shall bring his/her examination card and identity card to each examination and display them in a prominent position on his/her desk.
- (ix) A candidate must show his full face when asked to do so by the invigilator for the purpose of identification.
- (x) A candidate must show both ears when asked to do so by the invigilator.
- (xi) A student shall complete an attendance form with his/her number, name and signature, which shall be collected by the invigilator of each examination.
- (xii) During an examination, no student shall speak to any other student, or accept as essential, to the invigilator, or make any noise or disturbance.
- (xiii) No book, printed paper, or written document or unauthorized aid may be taken into the examination room by any student, except as may be stated in the rubrics of any examination paper.
- (xiv) Introduction of unauthorized ICT devices (mobile phones, programmed calculator, iPad, etc.) into the examination venue is totally banned.
- (xv) A student must not while writing an examination, directly or indirectly give assistance to any other student or permit any other student to copy from or otherwise use his/her papers. Similarly, a student must not directly or indirectly accept assistance from any other student or use any other student's paper.
- (xvi) If any student is suspected or found to be infringing any of the provisions of the examination, or in any way cheating or disturbing the conduct of the examination, a report shall be made as soon as possible to the faculty examinations officer and the Dean. The Dean will cause the circumstance to be investigated and reported to the board of examiners. All steps necessary for the smooth conduct of examinations must be taken. The student concerned shall be allowed to continue with the examination provided he caused no disturbance but the board of examiners may subsequently recommend to the faculty board and the senate whether his/her paper should be accepted and as to any action that should be taken in the case.
- (xvii) The use of scrap paper is not permitted. All rough work must be done inside the answer booklet and crossed out neatly. Except for the printed question paper, a student may not remove from the examination hall/room or mutilate any paper or other material supplied.
- (xviii) At the end of the time allowed, each student shall stop writing when instructed to do so and shall gather his/her script together to be collected by the invigilator.

### **CATEGORIES OF PUNISHMENT FOR EXAMINATION MALPRACTICE**

The following offences shall carry the punishment of expulsion:

1. Impersonation at the examination. This may involve the exchange of examination numbers or names on answer sheets or the intentional use of someone's examination number.
2. Introduction of relevant foreign materials and notes into the examination hall and exchange of relevant materials in examination hall which may involve
  - (a) The exchange of question paper containing relevant materials or
  - (b) Collaborating/Copying from each other or
  - (c) Exchange of answer script.
3. Theft/removal of examination script or materials.
4. Mischief by fire to examination script or materials.
5. Copying from cheating notes.
6. Consulting relevant notes inside the examination hall.
7. Facilitating/abetting cheating.

## **RUSTICATION FOR ONE ACADEMIC YEAR**

The following offences shall carry the punishment of rustication for one session.

- (i) Introduction, but not use, of relevant unauthorised materials to the examination hall.
- (ii) Facilitating/abetting/aiding cheating by another candidate.
- (iii) Using mobile phones and other ICT devices in the examination hall for things unrelated to the on-going examination

After the first warning, a student involved in another case of examination malpractice that warrants warning shall be restricted for one year.

## **WRITTEN WARNING**

The following offence shall attract a written warning:

- (i) Speaking/conversation during examinations.
- (ii) Writing on question papers/Scripts.

## **DRESS CODE**

All students should note that the authorities of all tertiary institutions in the country have been directed by government to check the prevalence of indecent dressing, which is identified as one of the problems afflicting the nation tertiary institutions. Just as the war on cultism, the government in the same vein directed for an all-out war against the menace of indecent dressing. In view of this, all students are strongly advised to adhere to the following dress code.

- (i) No short and skimpy dresses e.g. body hugs, show me your- chest, spaghetti wears and dresses exposing sensitive parts.
- (ii) No tight shorts and skirts that are above the knees/except for sporting purposes and medical grounds.
- (iii) No tattered jeans and jeans with holes.
- (iv) No transparent and see-through dresses.
- (v) No tight fittings e.g. Jeans, hip star, Patra, lactra etc. that reveal the contour of the body.
- (vi) No dressing that makes it impossible to wear laboratory coats during practical sessions.
- (vii) No long but tight skirts which are slit in front or at the sides, which reveals sensitive parts as the person moves.
- (viii) No wearing t-shirts with obscene captions.
- (ix) No Shirts without buttons or not properly buttoned, leaving the wearer bare-chested.
- (x) No wearing of coloured eye goggles in the lecture theatres (except on medical grounds).
- (xi) Wearing trousers that stop between knees and ankle (three- quarter). Infringement of the dress code will, however, attract the following sanctions:
  - (a) 1<sup>st</sup> Offender: To appear before unit dress code implementation committee for counselling.
  - (b) 2<sup>nd</sup> Offender: To be sent out of lecture theatre, library, office laboratory, studio, workshop, clinic etc.
  - (c) 3<sup>rd</sup> Offender: to appear before an advisory committee on students' discipline

## **MISCONDUCT**

Any action that is contrary to university regulations is an act of misconduct. These regulations cover every aspect of life on campus. The misconducts include among others the following offences:

<b>OFFENSE</b>	<b>PENALTY</b>
False claims and forgery	Expulsion
Rape	Expulsion
Embezzlement	Refund, warning to expulsion
Drug abuse and the use of a prohibited substance	Expulsion and handing over to appropriate security agency
Possession of and drink of alcohol on campus, misappropriate and unauthorized use of university premises/buildings and other properties	Warning to expulsion, replacement of damaged or missing university property
Belonging to or participating in the activities of the unregistered association, including secret cults	Expulsion and handling students to appropriate security agency
Possession of firearms and/or any dangerous weapons	Expulsion and handling students to appropriate security agency
Organizing and/or taking part in an unlawful demonstration	Expulsion
Harbouring and accommodating an unauthorized person	Expulsion from hall
Male entry into the female hostel at anytime	Warning to expulsion
Female entry into male rooms after 10.00pm	Warning to expulsion
Persistent rowdy and/or anti-social behaviour	Warning to expulsion
Unauthorized transfer of bed spaces	Expulsion from hall
Illegal rallies and assembly	Expulsion
Disturbances such as inter and intra clubs and scouts conflict	Warning to expulsion
Religious fanaticism and intolerance processing and/or distribution of illegal handbills, and provocative materials	Warning, rustication or expulsion
Fighting fellow students	Rustication to expulsion
Fighting staff in pursuit of his or her legitimate duties, willful damage to university property	Replacement of damaged property at the current value in cash/kind, warning or expulsion, and denial of facility at the point of damage
Stealing	Expulsion
Failure to return/release university property	Withholding of results
Violation of the university's dress code	Refusal for entry into classes, offices, library etc.
Any action likely to bring the university or its officers and/or student to disrepute	Expulsion

### List of Academic Staff

<b>S/NO</b>	<b>NAME</b>	<b>RANK</b>	<b>HIGHEST QUALIFICATION</b>	<b>AREA OF SPECIALIZATION</b>
1	Prof. A. A. Audu	Professor	PhD	Analytical Chemistry
2	Prof. H. N. Aliyu	Professor	PhD	Inorganic Chemistry
3	Prof. O. A. Al-Mubarak	Professor	PhD	Organic Chemistry
4	Prof. J. Na'aliya	Professor	PhD	Inorganic Chemistry
5	Prof. S. M. Gumel	Professor	PhD	Colour/Polymer Chemistry
6	Prof. M. B. Ibrahim	Professor	PhD	Physical Chemistry

7	Prof. S. Y. Mudi	Professor	PhD	Organic Chemistry
8	Prof. M. I. Muhammad	Professor	PhD	Analytical Chemistry
9	Prof. M. D. Sa'id	Professor	PhD	Analytical Chemistry
10	Prof. H. Musa	Professor	PhD	Colour/Polymer Chemistry
11	Prof. U. I. Gaya	Professor	PhD	Physical Chemistry
12	Prof. K. Abdu	Professor	PhD	Organic Chemistry
13	Prof. I. T. Siraj	Professor	PhD	Inorganic Chemistry
14	Prof. U. Sani	Professor	PhD	Inorganic Chemistry
15	Prof. A. S. Muhammad	Professor	PhD	Physical Chemistry
16	Dr. M. M. Idris	Associate Professor	PhD	Organic Chemistry
17	Dr. M. S. Musa	Associate Professor	PhD	Analytical Chemistry
18	Dr. Bishir Usman	Associate Professor	PhD	Physical Chemistry
19	Dr. A. Muhammad	Associate Professor	PhD	Organic Chemistry
20	Dr. M. I. Bala	Associate Professor	PhD	Organic Chemistry
21	Dr. A. A. Muhammad	Associate Professor	PhD	Physical Chemistry
22	Dr. A. A. Yakasai	Senior Lecturer	PhD	Organic Chemistry
23	Dr. M. Ladan	Senior Lecturer	PhD	Physical Chemistry
24	Dr. M. D. Garba	Lecturer I	PhD	Industrial Chemistry
25	Dr. M. R. Abdullahi	Lecturer II	PhD	Industrial Chemistry
26	Dr. Z. Abdullahi	Senior Lecturer	PhD	Analytical Chemistry
27	Dr. Atika M. Ibrahim	Lecturer II	PhD	Industrial Chemistry
28	Engr. Dr. M. S. Suleiman	Lecturer I	PhD	Industrial Chemistry
29	Dr. A. U. Katsina	Lecturer II	PhD	Physical Chemistry
30	Mal. N. S. Ibrahim	Lecturer II	MSc	Organic Chemistry
31	Mall. M. M. Ali	Lecturer I	MSc	Organic Chemistry
32	Mal. A. Sadiq	Lecturer I	MSc	Organic Chemistry
33	Mall. B. L. Abdullahi	Lecturer I	MSc	Inorganic Chemistry
34	Mal. K. S. Amin	Lecturer I	MSc	Physical Chemistry
35	Mal. I. A. Bala	Lecturer II	MSc	Industrial Chemistry
36	Mal. I. A. Sadiq	Lecturer I	MSc	Inorganic Chemistry



37	Mal. S. A. Hassan	Lecturer I	MSc	Inorganic Chemistry
38	Mal. G. N. Umar	Lecturer II	MSc	Organic Chemistry

### List of Technologist

S/No	Name	Highest Qualification	Rank
1	Ibrahim Abubakar Marmara	MSc	Principal Chief Technologist,
2	Mohd Musa Usman	MSc	Chief Technologist,
3	Lawal Salihu Salisu	PGDC	Chief Technologist,
4	Hafizu Muhammad	HND	Chief Technologist,
5	Joshua Kubai Madauchi	HND	Assist. Chief Technologist,
6	Wasilat M Bello	PGDC	Assist. Chief Technologist,
7	Auwal Musa Abdullahi	MSc	Assist. Chief Technologist
8	Habibu Ado Musa	MSc	Assist. Chief Technologist
9	Adamu Ibrahim Chigari	MSc	Assist. Chief Technologist
10	Hussaini Salihi	MSc	Assist. Chief Technologist
11	Ayuba Sulaiman	MSc	Assist. Chief Technologist
12	Ahmed A. Abdulrahman	MSc	Assist. Chief Technologist
13	Yusuf Abdu Fagge	PGDC	Assist. Chief Technologist
14	Umar Aminu Kabara	BSc	Technologist I
15	Suleiman Goma Yahaya	BSC	Technologist I
16	Amira A. Haruna	MSc	Technologist I
17	Ummukulthum Aliyu	MSc	Technologist I
18	Suraj Mahmood Ahmed	MSc	Technologist I
19	Firdausi M. Yusuf	MSc	Technologist I
20	Hasina MujiburRahman	BSc	Technologist I
21	Saifullahi Mustapha Hassan	HND	Laboratory Technician
22	Abubakar K. Rabil	BSc	Laboratory Technician
23	Hassan Abdullahi	SSCE	Senior Lab Assistant
24	Dauda Sani	SSCE	Senior Lab Assistant

**List of Admin Staff**

S/No	Name	Designation
1	Fa'iza Abubakar Abba	Senior Executive Officer.
2	Usman Isah	Higher Store Officer
3	Umar A. Muhammad	Store Officer
4	Bashir Aminu	Data Analyst
5	Yakubu A. Isa	Senior Library Officer
6	Muhammad Falalu Aminu	Clerical Officer
7	Ishaq Musa Idris	Executive Officer
8	Ado Umar Salanta	Head Messenger/Cleaner
9	Umar Rabi'u Ubale	Head Messenger/Cleaner
10	Ahmad Garba	Head Messenger/Cleaner
11	Bilkisu Ahmad	Cleaner