

## **A. A BRIEF HISTORY OF THE DEPARTMENT**

Madonna University Okija, Anambra State Nigeria was founded on April 20<sup>th</sup> 1999 by the Congregation of Fathers and Brothers of Jesus the Saviour, Ugwuoba, Awka, Anambra State.

Chemistry activities and teaching took off immediately amongst other courses in science, arts and engineering.

At the beginning of 1999/2000 academic year, a total of 20 students were admitted into the then Science Department. New Departments soon emerged out of it. One such Department was the Department of Chemistry and Biochemistry programmes led by coordinators. In 2002/2003 the Industrial Chemistry programme graduated its first pioneer graduate named KevinIbe, with Verla, A.W. as the coordinator of the programme. The period between 2002 to 2004 witnessed an increase in students population. This catalyzed the creation of a full Department of Industrial Chemistry in 2004/2005 academic year with Ikueze S.U. as acting HOD.

### **1. PHILOSOPY AND OBJECTIVES**

Undergraduate studies in the Department of Industrial Chemistry seek to expose students to the broad area of theory and practice of the fundamental aspects of all branches of Chemistry. Modern Society requires an all round individual as a result of increasing interdependency of the sciences. The Department therefore aims to offer a thorough grounding in theoretical, experimental and operational aspects of Chemistry, as it relates to the Chemical Industry. This will enable Nigeria and Africa to have a new breed of well-trained high-level manpower that can apply Chemistry principles to national and international development. The use of modern analytical tools and their applications to the environment are equally emphasized. In a nutshell the Industrial Chemistry programme focuses on the search for and application of chemical knowledge to solving man's problems.

#### **The objectives include but are not limited to the following:**

- i. Development of high calibre industrial chemists who will be equipped to man responsible industrial positions as well as self reliant ventures.
- ii. Chemists who will probe into the vast natural resources of Nigeria in order to accumulate relevant chemical data.
- iii. Chemists capable of pursuing postgraduate studies and research in Chemistry.
- iv. Chemists capable of collaborative efforts with other scientists in inter-disciplinary areas.

- v. Chemists capable of utilizing chemical knowledge and skill in the service of developing national economy and improving man's environment and his general well-being.

## **2. SCOPE OF PROGRAMME**

Undergraduates in the Department of Industrial Chemistry will take prescribed core courses which lay emphasis on exposing students to fundamental areas of interest such as Inorganic Chemistry, Organic Chemistry, Physical Chemistry, Nuclear Chemistry, Environmental Chemistry, Food Chemistry, and Pharmaceutical Chemistry. Seminars and Workshops may sometimes be organized by the Department. Final year seminar is compulsory for all the students.

During the study programme, students are expected to visit centres of Chemical Industries and write reports. They are expected to deliver seminars in the first semester of final year. Industrial Chemistry students are also required to participate in the students Industrial Work Experience Scheme (SIWES) for a period of six (6) months as part of their academic programme. They are to submit and defend a type - written comprehensive report to the Department. The inclusion of Research Project which emphasizes the use of local raw materials as industrial feed-stock will go a long way to achieve some of the objectives. It is hoped that students' intellectual growth is properly modelled to enable them go into the society with a positive, responsible, and responsive attitude in line with Madonna University Philosophy of Decency in Education and Morals.

## **3. TYPE AND DURATION OF PROGRAMME**

The Department of Industrial Chemistry offers a four year degree programme leading to the award of a Bachelor of Science (B.Sc) Honours degree in Industrial Chemistry. However Direct Entry candidates with the required qualification may complete the programme within three years, i.e. they enter the programme at 200 level. In line with the University policies, students who are unable to graduate after three years of normal graduation year will be asked to withdraw from the programme.

## **4. ADMISSION REQUIREMENTS**

The Department offers two modes of admission: UTME and Direct Entry

### **4.1 UTME**

Candidates seeking admission into Bachelor of Science (B.Sc) in Industrial Chemistry Programme, by UTME in addition to University requirements, are required to obtain credits in English language, Chemistry, Physics, Mathematics and Biology or any other Science

subject in West African School Certificate Examination or its equivalent (GCE, SSCE, NECO).

#### **4.2 DIRECT ENTRY**

- i. Chemistry, Physics at least with a grade above pass at the Advanced Level (GCE), H.S.C (Principal level) in addition to their five credits at the ordinary level.
- ii. Teacher's grade 1 examination from any Department to Industrial Chemistry must show proof of all entry requirements as required by the University. The students must be released and must be accepted into the programme with the consent of the HOD.

#### **5. SERVICE COURSES**

Students from other Departments wishing to take courses in Chemistry must have credit in chemistry and at least a pass in mathematics or its equivalent

#### **6. JOB OPPORTUNITIES/CAREER PROSPECTS**

The successful graduate of Industrial Chemistry is adequately equipped to take up jobs that generally relate to Vegetable oils, Petroleum, Soaps and Detergents, Paints, Chloroalkali Industry, Vanishes, Brewing, Pharmaceuticals and Cosmetics, Sugar, Paper and Pulp, Textiles, Fertilizer, Ceramics, Iron and Steel Industry, Coal, Dyestuff and Explosives etc. specifically, career opportunities abound in the following areas.

##### **6.1 INDUSTRIAL RAW MATERIAL RESEARCH AND DEVELOPMENT.**

Nigeria and Africa have a lot of unexploited raw materials. This rich natural endowment still lacks the required man-power for efficient exploitation of the raw materials such as hides and skin, natural fibers, new oil sources, gum, resins and other lucrative areas. (Problems associated with the improper exploitation and utilization of these resources area challenge to our economy).

##### **6.2 BUSINESS AND SELF EMPLOYMENT**

Industrial Chemists can supply quality equipment and chemicals and can equally trade in finished chemical products. They are better equipped for business in such goods and services. (More important is the fact that graduates are equipped with knowledge regarding self employment.)

##### **6.3 OIL AND GAS SECTOR**

The application of Chemical knowledge and skill in this sector is not limited to laboratory work only. Field work involving Environmental Impact Assessment (EIA), Bioremediation studies and other areas like

Environmental Management are increasingly in demand for Chemistry programme.

#### **6.4 FORENSIC STUDIES AND CRIMINAL JUSTICE**

The detection of criminals by use of analytical Chemistry tools as well as studies of such chemicals that cause harm to man and society will not be complete without individuals who have undergone a rigorous study of Chemistry.

#### **6.5 LAW AND POLITICS**

It should be recalled that policy formulation for the government requires scientists of all fields. Chemist by virtue of their training can adapt to any field. One such example is the fact that a former president of the Federal Republic of Nigeria, Umaru Musa Yar'Adua, was an Analytical Chemist. Chemists can find jobs even in politics.

#### **6.6 OTHER AREAS INVOLVE**

- i. The Academic Teacher/Lecturers.
- ii. The Ministries of Environment, Education, Health and Agriculture.
- iii. Agriculture.
- iv. Laboratories.

### **B. CURRICULUM DEVELOPMENT**

According to the University Senate Committee on Curriculum, curriculum development at Madonna University is based on identified needs of student and the needs of the society as well as the system of values of all concerned. From these needs and values, the objectives of the curriculum content and the organized content give rise to the syllabus.

In drawing up the curriculum for B.Sc Industrial Chemistry, efforts were made to ensure that the requirements of the National Policy on Education and the Minimum Academic Standards as laid down by the NUC were considered.

#### **METHODS OF LECTURE DELIVERY IN THE DEPARTMENT**

1. Lecture: The Department has over the years developed a novel pedagogic method of imparting knowledge. Here the lecturer leads and guides students in formal and informal cooperative learning. Students may jot down as much as possible but notes may be given to students at the end of each topic.
2. Demonstration: The students are divided into groups while questions and discussion are made along the development of lectures. The lecturer uses models or instruments to explain his points. This is mostly applicable in practical oriented classes.

3. Discussion: This involves the totality of the students and lecturers. The lecturer uses models or instruments to explain his points. This is mostly applicable in practical oriented classes.
4. Tutorial: There is closer intimacy between the students and the course lecturer. This is intended to deal with capacity to find out the extent of understanding about a given topic or concept. Questions are asked and students answer but the lecturer compliments and gives further explanation.
5. Seminar and Workshop: Here the students are divided into panels and lecturer discusses the topic with contributions from the students. At the end, panels come together to finalize the discussion by considering the highlighted points of the various panels.
6. Field Work: This is in case where adequate laboratory is not available or situated far away from the immediate reach of students. Students go on a day visit to the Industry along with their lecturer.

### **C. FUNCTIONS OF ACADEMIC ADVISER**

- i. Mapping out programme for individual students
- ii. Ensuring effective enrollment of students during registration periods.
- iii. Checking of academic load of students with regard to the number of credit units to be carried per session.
- iv. Changing of courses for degree programmes.
- v. Making sure that the regulations of the Academic Departments and the University are duly observed by the students.
- vi. Effective keeping of folders for students.
- vii. Keeping regular office hours for students
- viii. Interviewing their students at least once a semester
- ix. Making a sectional academic appraisal on the work of each student.
- x. Consulting the Dean of student's affairs office where students have any social or psychological problems.

### **D. ROLES OF THE HEAD OF DEPARTMENT**

- i. Appointment of Advisers
- ii. Ensuring that the Advisers do their work effectively.
- iii. Meeting students and staff in order to explain Departmental procedures, especially before registration.
- iv. Receiving Adviser's recommendations and suggestions and considering other special cases referred by Advisers. The type of recommendations to be checked include programmes for individual students, credit unit loads and change of subjects or degree programme.
- v. Promulgation of Department and University regulations.
- vi. Mapping out all Departmental degree programmes, including the compulsory credit unit load required by the Department.

- vii. Maintaining files on the students and giving Departmental staff access to such files. Also making sure that their Advisers get duplicates of academic records of students.
- viii. Making inter Departmental arrangements which concern staff and students in the Department. Keeping the Dean and the Registrar informed about what allocation of academic advisers they have made in respect of every student in the Department.

## **E. GRADING SYSTEM**

### **1. Students Work**

A student's work will be graded as follows on a five point scale

| <b>Score (%)</b> | <b>Letter Grade</b> | <b>Points</b> |
|------------------|---------------------|---------------|
| 70 and above     | A                   | 5.00          |
| 60 - 69          | B                   | 4.00          |
| 50 - 59          | C                   | 3.00          |
| 45 - 49          | D                   | 2.00          |
| 40-44            | E                   | 1.00          |
| 0-39             | F                   | 0.00          |

- i. Continuous Assessment shall carry 30% weight of the marks to be awarded to students in the course offered by the Department. The continuous assessment shall comprise tests, quizzes, term papers and essays as may be approved by the Board of Examiners.
- ii. The minimum pass grade for all course (including electives and general studies) shall be 'E'
- iii. At any point in time, a student's cumulative grade point average is obtained by multiplying the credit load of each course taken by the points appropriate to the letter grade obtained for the course (see i) Summation of the total points and dividing by the total credit load of the courses offered for the session gives the cumulative grade point for the session.

| <b>C.G.PA</b> | <b>Degree</b>                                  | <b>Certificate</b> |
|---------------|--|--------------------|
| 4.50 - 5.00   | 1 <sup>st</sup> Class Honours (Distinction)    | Distinction        |
| 3.50 - 4.49   | 2 <sup>nd</sup> Class Honours (Upper Division) | Credit             |
| 2.40 - 3.49   | 2 <sup>nd</sup> Class Honour (Lower Division)  | Merit              |
| 1.50 - 2.39   | 3 <sup>rd</sup> Class Honour                   | Pass               |
| 1.00-1.49     | Pass   | Pass               |
| Below 1.00    | Fail   | Fail               |

## 2. Project Grading System

|      | <b>Contributions</b>   | <b>Score %</b> |
|------|------------------------|----------------|
| i.   | Supervisor             | 30             |
| ii.  | Departmental Appraisal | 20             |
| iii. | External Examiner      | 50             |
|      | Total                  | 100            |

It is compulsory that the supervisor be present during the assessment of his/her student.

| <b>F. Stress Areas</b>        | <b>Codes</b> |
|-------------------------------|--------------|
| General Theoretical Chemistry | 0            |
| Inorganic Chemistry           | 1            |
| Organic Chemistry             | 2            |
| Physical Chemistry            | 3            |
| Analytical Chemistry          | 4            |
| Chemical Process Technology   | 5            |
| Chemical Industry/Environment | 6            |
| Practical Chemistry           | 7            |
| Seminar/Workshop              | 8            |
| Research Project              | 9            |

The course coding system guide

- ICH = Industrial Chemistry core courses
- CHM = Pure Chemistry core courses
- Each course code contains ICH or CHM plus three digits
- The first digit represents the level i.e. 100, 200 etc.
- The second digit represents stress area in the discipline.
- The third digit signifies the semester. This digits could be odd signifying first semester or even signifying second semester.

At a glance, one can tell the level, the stress area and semester in which a course is offered.

Thus CHM111 shows a 100 level course in the stress area of Inorganic Chemistry offered in the first semester of the session and CHM 101 shows a 100 level course in the stress area of General Chemistry offered in the first semester of the session.

## **INSTRUCTION TO DIRECT ENTRY STUDENTS**

Students who gained admission by direct entry into the 200 level will ensure that they register and pass the following General Studies Courses in addition to all the courses in the Faculty/Departmental curriculum, as applicable.

### **FIRST SEMESTER (FOR DIRECT ENTRY STUDENTS)**

| <b>Course Code</b> | <b>Course Title</b>                                     | <b>Unit</b> |
|--------------------|---|-------------|
| GST 111            | Communication in English I                              | 2           |
| GST 113            | Nigerian Peoples and Culture                            | 2           |
| GST 121            | Use of Library, Study Skills and Information Technology | 2           |
| GST 123            | Communication in French                                 | 2           |
| GST 125            | Introduction to Entrepreneurship Studies I              | 2           |

### **SECOND SEMESTER (FOR DIRECT ENTRY STUDENTS)**

| <b>Course Code</b> | <b>Course Title</b>                   | <b>Unit</b> |
|--------------------|---------------------------------------|-------------|
| GST 104            | Fundamental Philosophy                | 1           |
| GST 112            | Logic, Philosophy and Human Existence | 2           |
| GST 122            | Communication in English II           | 2           |
| GST 142            | Communication in German               | 2           |
| GST 162            | Introduction to Social Science        | 2           |



## Course offered in the Programme

### 100 LEVEL FIRST SEMESTER

| Course Code                       | Course Title                               | Units     |
|-----------------------------------|--|-----------|
| <b>Core Courses</b>               |  |           |
| CHM 101                           | General Chemistry I                        | 3         |
| CHM 171                           | Practical General Chemistry I              | 1         |
| <b>Required Ancillary Courses</b> |  |           |
| BIO 101                           | General Biology I                          | 3         |
| MTH 101                           | General Mathematics I                      | 3         |
| PHY 101                           | General Physics 1                          | 3         |
| PHY 105                           | General Physics Laboratory I               | 1         |
| <b>General Study Courses</b>      |  |           |
| GST 111                           | Communication in English I                 | 2         |
| GST 113                           | Nigerian Peoples & Culture                 | 2         |
| GST 121                           | Use of Library, Study Skill & ICT          | 2         |
| GST 123                           | Communication in French                    | 2         |
| GST 125                           | Introduction to Entrepreneurship Studies I | 2         |
|                                   | <b>TOTAL</b>                               | <b>24</b> |

### 100 LEVEL SECOND SEMESTER

| Course Code                       | Course Title                         | Units     |
|-----------------------------------|--------------------------------------|-----------|
| <b>Core Courses</b>               |                                      |           |
| CHM 102                           | General Chemistry II                 | 3         |
| CHM 122                           | Organic Chemistry I                  | 1         |
| CHM 172                           | Practical General Chemistry II       | 1         |
| <b>Required Ancillary Courses</b> |                                      |           |
| BIO 102                           | General Biology I                    | 3         |
| BIO 172                           | Practical Biology II                 | 1         |
| MTH 102                           | General Mathematics II               | 3         |
| PHY 102                           | General Physics II                   | 3         |
| PHY 106                           | General Physics Laboratory II        | 1         |
| <b>General Study Courses</b>      |                                      |           |
| GST 102                           | Fundamental Philosophy               | 1         |
| GST 112                           | Logic, Philosophy & Human Existence. | 2         |
| GST 122                           | Communication in English II          | 2         |
| GST 142                           | Communication in German              | 1         |
| GST 162                           | Introduction to Social Sciences      | 2         |
|                                   | <b>Total</b>                         | <b>24</b> |

## 200 LEVEL FIRST SEMESTER

| Course Code                       | Course Title                                | Units     |
|-----------------------------------|---|-----------|
| <b>Core Courses</b>               |   |           |
| CHM 221                           | Organic Chemistry II                        | 2         |
| CHM 231                           | Physical Chemistry I                        | 2         |
| CHM 241                           | Nuclear Chemistry                           | 2         |
| CHM 271                           | Practical Chemistry I                       | 1         |
| ICH 251                           | Cement & Fertilizer                         | 1         |
| ICH 261                           | Introduction to Industrial Chemistry        | 2         |
| <b>Required Ancillary Courses</b> |   |           |
| BCH 201                           | General Biochemistry I                      | 2         |
| PHY 211                           | Electromagnetic.& Atomic Physics.           | 2         |
| MTH 231                           | Linear Algebra                              | 2         |
| <b>General Study Courses</b>      |   |           |
| GST 211                           | Fundamental Theology                        | 1         |
| GST 215                           | Introduction to Entrepreneurship Studies II | 2         |
|                                   | <b>Total</b>                                | <b>19</b> |

## 200 LEVEL SECOND SEMESTER

| Course Code                       | Course Title                         | Units     |
|-----------------------------------|--------------------------------------|-----------|
| <b>Core Courses</b>               |                                      |           |
| CHM 212                           | Inorganic Chemistry I                | 2         |
| CHM 222                           | Structure & Bonding                  | 2         |
| CHM 242                           | Analytical Chemistry I               | 2         |
| CHM 272                           | Practical Chemistry II               | 1         |
| ICH 252                           | Industrial Raw Materials & Inventory | 2         |
| ICH 262                           | Chemical Process Principle.          | 2         |
| <b>Required Ancillary Courses</b> |                                      |           |
| BCH 202                           | General Biochemistry                 | 2         |
| PHY 224                           | Electric Circuits and Electronics    | 3         |
| FST                               | Food Science & Technology            | 2         |
| <b>General Study Courses</b>      |                                      |           |
| GST 222                           | Peace & Conflict Resolution          | 2         |
| GST 224                           | Fundamental Ethics                   | 1         |
|                                   | <b>Total</b>                         | <b>21</b> |

### 300 LEVEL FIRST SEMESTER

| Course Code         | Course Title                            | Units     |
|---------------------|---|-----------|
| <b>Core Courses</b> |   |           |
| CHM 301             | Atomic & Molecular Structure & Symmetry | 2         |
| CHM 311             | Inorganic Chemistry II                  | 2         |
| CHM 321             | Organic Chemistry III                   | 2         |
| CHM 323             | Organometallic Chemistry I              | 2         |
| CHM 325             | Natural Products Chemistry              | 2         |
| CHM 331             | Physical Chemistry II                   | 2         |
| CHM 341             | Instrumental Methods of Analysis        | 1         |
| CHM 351             | Chemical Process Technology             | 2         |
| CHM 361             | Environmental Chemistry                 | 2         |
| CHM 371             | Practical Chemistry III                 | 2         |
| ICH 363             | Petroleum Chemistry & Petrochemicals    | 1         |
|                     | <b>Total</b>                            | <b>20</b> |

### 300 LEVEL SECOND SEMESTER

| Course Code | Course Title        | Units     |
|-------------|---------------------|-----------|
| CHM 382     | Industrial Training | 15        |
|             | <b>Total</b>        | <b>15</b> |

## 400 LEVEL FIRST SEMESTER

| Course Code         | Course Title                         | Units     |
|---------------------|--------------------------------------|-----------|
| <b>Core Courses</b> |                                      |           |
| CHM 421             | Organic Synthesis                    | 2         |
| CHM 423             | Heterocyclic Chemistry               | 2         |
| CHM 431             | Electrochemistry                     | 2         |
| CHM433              | Reaction Kinetics and Photochemistry | 2         |
| CHM 435             | Quantum Chemistry                    | 2         |
| CHM 437             | Theory of Molecular Spectroscopy     | 2         |
| CHM 441             | Analytical Chemistry II              | 2         |
| CHM 471             | Practical Chemistry IV               | 2         |
| CHM 481             | Seminar and Research Methods         | 2         |
| ICH 461             | Corrosion Chemistry                  | 2         |
|                     | <b>Total</b>                         | <b>20</b> |

## 400 LEVEL SECOND SEMESTER

| Course Code                           | Course Title   | Units     |
|---------------------------------------|--|-----------|
| <b>Core Courses</b>                   |  |           |
| CHM 412                               | Inorganic Chemistry III                                  | 2         |
| CHM 422                               | Organometallic Chemistry II                              | 2         |
| CHM 424                               | Colour Chemistry & Technology                            | 2         |
| CHM 426                               | Polymer Chemistry & Technology                           | 2         |
| CHM 492                               | Research Project   | 6         |
| ICH 452                               | Industrial. Chemical Technology                          | 2         |
| ICH 454                               | Industrial Chemical Process                              | 2         |
| ICH 462                               | Pharmaceutical Chemistry.                                | 2         |
| <b>Electives (student choose one)</b> |  |           |
| ICH 464                               | Oil, Fats Detergents & Chloroalkal/Paper & Pulp Industry | 1         |
| ICH 466                               | Sugars & Fermentation Industry/Paper & Pulp Industry     | 1         |
|                                       | <b>Total</b>   | <b>21</b> |

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**FIRST SEMESTER (FOR DIRECT ENTRY STUDENTS)**

| <b>Course Code</b> | <b>Course Title</b>                                     | <b>Units</b> |
|--------------------|---|--------------|
| GST 111            | Communication in English I                              | 2            |
| GST 113            | Nigerian Peoples and Culture                            | 2            |
| GST 121            | Use of Library, Study Skills and Information Technology | 2            |
| GST 123            | Communication in French                                 | 2            |
| GST 125            | Introduction to Entrepreneurship Studies I              | 2            |

**SECOND SEMESTER (FOR DIRECT ENTRY STUDENTS)**

| <b>Course Code</b> | <b>Course Title</b>                   | <b>Units</b> |
|--------------------|---------------------------------------|--------------|
| GST 104            | Fundamental Philosophy                | 1            |
| GST 112            | Logic, Philosophy and Human Existence | 2            |
| GST 122            | Communication in French               | 2            |
| GST 142            | Communication in German               | 2            |
| GST 162            | Introduction to Social Science        | 2            |

## **COURSE DESCRIPTION OF CORE COURSES**

### **(INDUSTRIAL CHEMISTRY)**

#### **100 LEVEL FIRST SEMESTER**

##### **CHM 101: General Chemistry I (3 Units)**

Atomic structure and periodic table. Development of configuration of elements. Stoichiometry and mole concept. Electronic theory of atoms and valence. Chemical bonding. Formula and IUPAC basic nomenclature of compounds. Concept of matter, Laws of chemical combination by mass. Wave theory, principles of quantum mechanics. Periodic table and periodicity of fundamental properties. Hydrogen. Nuclear Chemistry and Radioactivity and its Application. General study of groups to emphasize periodicity. Selected transition elements.

##### **CHM 171: General Chemistry Practical I (1 Unit)**

The theory and practice of simple volumetric and qualitative analysis e.g., Acids-bases complexometric and REDOX titrations. Simple organic preparations, reaction of functional groups. Laboratory safety and techniques in the laboratory.

#### **100 LEVEL SECOND SEMESTER**

##### **CHM 102: General Chemistry II (3 units)**

Structure of solid. Kinetic theory of gases and laws. Colligative properties of dilute solutions. Raoult's law, Henry's law and molecular weight determination. Thermo chemistry and Hess's law. Chemical Equilibrium. Law of mass action, reaction rate and chemical energetic. Electrochemistry. Ionic equilibrium. Theory of acids bases and indicators. Catalysis. Ionics, phase equilibrium, one and two component system. Enthalpy Entropy and free energy.

##### **CHM 122: Organic Chemistry I (1 Unit)**

Historical survey of the development and importance of organic chemistry. IUPAC nomenclature and classification of organic compounds. Homologous series Elemental analysis and molecular formula, structural Isomerism Isolation and purification methods concept of functional group resonance and aromaticity. Electronic theory in organic chemistry (brief). Saturated and unsaturated hydrocarbons, cyclic hydrocarbons, alcohols, alkyl halides, ethers, aldehydes and ketones, carboxylic acids, amines and aromatic compounds, comparison on phenols with alcohols.

## **CHM 172: General Practical Chemistry II (1 Unit)**

### **Pre-requisite: CHM 171**

Qualitative analysis of inorganic salts. Physical determination e.g. boiling point, inorganic preparations and enthalpy changes, etc.

## **200 LEVEL FIRST SEMESTER**

## **CHM 221: Organic Chemistry II (2 Units)**

### **Pre-requisite CHM (122)**

Factors affecting structure and physical properties of organic compounds; factors availability of electrons at the reaction site, including theory of organic chemistry, orbital theory and hybridization classification of reagents and their reactions, Aromaticity, Stereochemistry, methane, energy of activation and free radical substitution reaction in alkanes. Functional group chemistry, various organic reactions e.g. addition, free radical, elimination reaction, etc.

## **CHM 231: Physical Chemistry I (2 Units)**

### **Pre-requisite CHM 101, 102**

Revision on the elementary properties of gases and derivation of the gaseous laws. Introduction to thermodynamics, explanation of terms relating to thermodynamics (system, boundary, state functions, path function adiabatic process etc).the first law of thermodynamic concept of work contribution in a chemical process, work of expansion and comparison by a gas. The heat contribution in a chemical reaction, the enthalpy function and heat capacity. The second law of thermodynamics concept of entropy, phase transition relationship between heat capacities and entropy etc. the free energy change in a chemical process (Cubb and Helmholtz), carnuf cycle. The various heat change associated with chemical process and chemical calculations. The third law of thermodynamics and colligative properties of solutions.

## **CHM 241: Nuclear Chemistry (2 Units)**

Introduction: History of Radioactivity. Nature of nuclear chemistry radioactivity. Proton-neutron concept of the atom, the nucleon, atomic number, mass number and the neutron number. Isotopes, isobars and isotones. Nature and characteristics of radiation-alpha, beta particles and gamma rays. Characteristics of the various particles emanating from the nucleus. Natural and induced Radioactivity-fission and fusion reactions. Nuclear reactions and chemical reactions-a comparison. Balancing nuclear reactions. Introduction to half-life of radioisotopes; some uses of radioisotopes.

### **ICH 251: Cement and Fertilizer (1 Unit)**

Introduction to cement, Portland cement, properties of cement, types of cement, safety issues, cement and safety. Portland cement. Raw materials for cement manufacture, manufacture of cement, cement weathering, plant nutrients, chemistry of plant nutrients, macro and micro nutrient, NPK production of Ammonia and Urea, fertilizer and the environment.

### **ICH 261: Introduction to Industrial Chemistry**

Chemical process industry major characterizations, of the chemical process industry. Scale of operations, major sectors and major chemical producing countries, transformation of precursor to end products, source and processing of industrial chemical. World major chemical industries. Introduction to chemical process calculations. Stoichiometry, material and energy balance fundamentals. Sources, types and utilization of energy by the chemical industry. Environmental and pollution control profiles of some major chemical industries.

### **CHM 271: Practical Chemistry I (1 Unit)**

#### **Pre-requisite: CHM 171 and CHM 172**

1. Select experiments in physical chemistry in the area of thermo chemistry, chemical kinetics, phase equilibrium, colligative properties.
2. Organic synthesis and characterization, (% yield, melting, point, freezing point, solubility, formation of derivatives etc.) Characterization of given organic compounds using physical and chemical properties and reactions.
3. Use of gravimetric analysis. Qualitative analysis of six radical in a mixture.
4. Experiments from the environment and chemical industry.

### **CHM 212: Inorganic Chemistry I: (2 Units)**

#### **Pre-requisite: CHM 101**

Chemistry of first row transition metals. Introduction to coordination chemistry including elementary treatment of crystal field theory, ionization potential, electron affinity and electro negativity comparative chemistry of the following elements:

- (a) Ga, Tl, (b) Ge, Sn, Pb, (c) As, Sb, Bi, (d) Se, Te, Po and role of metals in biochemical systems.

### **CHM 222: Structure and Bonding: (2 Units)**



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

### **CHM 242: Analytical Chemistry I (2Units)**

Introduction to theory of errors; Statistical treatment of data: theory of sampling. Chemical methods of analysis including volumetric, gravimetric and physiochemical methods, Optional methods of analysis; separation methods. Selected experiments from food , soil water and oil.

### **CHM 272: Practical Chemistry II (2 Units)**

#### **Pre-requisite: CHM 171 and CHM 172**

Preparation of organic compounds such as bromonitro benzene, dinitrotoluene etc and other related compounds including their purification, separation of colored compounds using chromatographic techniques e.g. paper and thin-layer chromatography; practice of solvent extraction techniques for liquids etc, preparation of double salt e.g. Ahem's, experiment drawn from foods, oil water and oil analysis.

### **ICH 252: Industrial Raw Materials & Inventory (2 Units)**

Survey of Nigeria's industries and their raw materials requirements. Mineral chemistry. Fossils and their uses. Plant and animal products. Nuclear solar and hydrodynamic source of energy. Potentials and applications of locally available raw materials and industrial feedstock. Other sources of energy for Nigeria.

### **ICH 262: Chemical Process Principles (2 Units)**

#### **Pre-requisite: ICH 261**

Material and energy balance calculation. Combustion calculations and fuel economy or relative volatility. Use of phase and chemical equilibrium data for process calculations. Application of materials and energy balance to unit operation and process. Concepts of stage and continuous contact processes recycle and bypass. Equilibrium and idea stage and stage efficiency. Corrosion and material of construction

## **300 LEVEL FIRST SEMESTER**

### **CHM 301: Atomic and molecular structure and symmetry (2 Units)**

#### **Pre-requisite: CHM 222**

### **CHM 301: Atomic and Molecular Structure and Synthesis**

The structure and spectrum of atomic hydrogen. The hydrogen atom. Atomic orbitals. The ground state of orbitals and the various orbitals. Energy size and shape of the orbitals. The wave functions spectral selection rule. Structure of many electron atoms. Ionization potential. The spectra of complex atoms. Spin orbit interaction. Term symbols and selection rule Clebsch Gordon series. Effect of magnetic fields. Molecular structure. The structure of hydrogen molecular ion. Born Oppenheimer approximation. Molecular orbital theory of  $H_2^+$ . Bonding and antibonding orbitals. Structure of Diatomics' Homonuclear molecular orbitals.

### **CHM 311: Inorganic Chemistry II: (2 units)**

#### **Pre-requisite: CHM 212**

The noble gases, Hydrogen. Electronic structure and general properties and comparative study of group 1A and group 11A elements. Chemistry of Boron; Carbon and Silicon; Nitrogen and phosphorus; Oxygen and sulphur. The Halogens Transition elements separation of metals. Coordination chemistry. Ligand and Crystal field theories. Introduction to Radiochemistry. Radioactivity and the Periodic table.

### **CHM 321: Organic Chemistry III (2 Units)**

#### **Pre-requisite: CHM 221**

Carboxylic acids and their derivatives. Aldehydes and ketones. Carbon and ketones. Carbanion, and  $\pi$  – unsaturated compounds, carbon II. Amines; Aromatic and Alicyclic Chemistry. Polyfunctional Compounds. Heterocyclic chemistry.

### **CHM 323: Organometallic Chemistry I: (2 Units)**

Classification, organometallic compounds. Preparation, structure and reactions including abnormal behavior of Organometallic compounds. Synthetic utility of Organometallics. Generation and detection of free-radicals, free Organometallic compounds. Application and uses of Organometallic compounds.

### **CHM 325: Natural Products Chemistry (2 Units)**

Classification of structure and nomenclature of sugar, lipids and protein and Antibiotics, flavonoids prostaglandins, General reactions. Preparation and reaction mechanisms. Configurations. Epimerization.

### **CHM 331: Physical Chemistry II( 2 Units)**

#### **Pre-requisite: CHM 231**

Chemical thermodynamics. The second and third laws of thermodynamics'. The carnot cycle and quantitative meaning of entropy. Entropy changes in various processes dependence of entropy on temperature and pressure. The third law and absolute entropies. Standard entropies' free energy and chemical equilibrium. Variation of free energy with temperature and pressure. Thermodynamics of multicomponent systems. Chemical potential and partial molar quantities. Ideal mixtures colligative properties. Non ideal solutions phase equilibrium. Chemical kinetics. Rates of reaction and rate laws. Order of reactions, half life. Theories of reaction rates.

### **CHM 341: Instrumental Methods of Analysis (1 Unit)**

Spectroscopic techniques. Quantitative analysis. Xray methods. Flouorescence methods. Nuclear Magnetic resonance and Electron spin resonance, refractometry and interferometry. Polarimetry: polarography. Calorimetry. Instrumental layout, operational principles, applications, state of instruments and research in Nigeria.

### **CHM 351: Chemical Process Technology (2 Units)**

Chemical Transport-Fluidflow. Types of steady flow velocity distribution in pipes. Flow measurement. Application of total energy balance equation to fluidflow systems. Total mechanical energy balance equation and application fluid flow equipment. Heat Transfer-conduction, convention, radiation resistance to heat flow. Practice of heat technology.

### **CHM 361: Environmental Chemistry/Chemical Industry (2 units)**

Concepts of elementary cycles. Characteristics of the atmosphere, sources, types and effects of environmental; pollution, waste water treatment. Composition of domestic waste. Water chemistry and analysis. Chemical and physical instrumentation in environmental sciences. Detergents, plastics, D.D.T and their impacts on environment.EIA making and importance.

### **CHM 371: Practical Chemistry III (2 Units)**

#### **Pre-requisite: CHM 171 and CHM 271**

1. Application of methods of analysis of ores, alloys. Separation of irons by ion-exchange chromatography. Solvents extraction by use of soxhlet extractor. Application and use of separator funnels.

2. Selected experiment in physical chemistry from electrochemistry. Reaction kinetics, phase equilibria, calorimetry, colourimetry, molecular refractivity.

### **ICH 363: Petroleum Chemistry and Petrochemicals (2 Units)**

Physical and chemical characteristics of crude oil. Chemistry of petroleum refining. Catalytic cracking, alkylation, polymerization, etc. crude oil essay. Current petroleum use, Natural gas, future of petroleum and petroleum industry, chemistry of conversion of natural gas and petroleum hydrocarbons to industrial chemicals. Utilization of olefins for industrial chemicals. Chemicals from BTEX, Nylon Intermediates.

### **300 LEVEL SECOND SEMESTER**

#### **CHM 382: Industrial Training (15 Units)**

The students Industrial Work Experience Scheme (SIWES) is compulsory for all students of Industrial Chemistry. It last for a period of six months during while students are attached to a recognized Industrial establishment. Students will be supervised by Industrial based as well as Departmental Supervisors. On return to the campus the students are expected to submit a comprehensive report and to be physically present for an oral defense before the Departmental colloquium.

### **400 LEVEL FIRST SEMESTER**

#### **CHM 421 Organic Synthesis (2 Units)**

##### **Pre-requisite: CHM 321**

Critical review of important reaction reagents, methods including the mechanisms. Applications to synthesis of important and complex organic compounds. Industrial applications.

#### **CHM 423: Heterocyclic Chemistry (2 Units)**

##### **Pre-requisite: CHM 321**

The synthetic and mechanistic aspects of fused heterocyclic system-particularly quinolines, Isoquinolines, Benzofurans, Benzothiophenes, Indoles, Benzopyrylium, salts, Coumarins, Chromonespyrole, pyridine. Application of heterocyclic systems in drug synthesis such as Isatin and derivations.

#### **CHM 431: Electrochemistry (2 Units)**

Electromotive force and Electrode potentials sign convention. Electrochemical. Cell emf and spontaneity. Nernst's

equation/concentration cells. Equilibrium constant from cell emf standard electrode potential. Thermodynamic data from cell potentials. Temperature dependence of emf applications of emf measurements- Solubility product, potentiometric titrations, pH and  $P_k$ .

Activities and standard states, Debye-Huckel Theory, ions in solution. Ionic atmosphere. Ion Transport. Ionic motion. Mobility of ions/Transport number conductivities and ionic interactions. Diffusion.

### **CHM 433: Reaction Kinetics and Photochemistry (2 Units)**

#### **Pre-requisite: CHM 331**

Review of first, second and third order rate equations. Rate constants and equilibrium constants. Collision theory, transition state theory, co-ordinates. Unimolecular reaction theory, bimolecular reaction mechanisms; chain reaction mechanisms; catalysis and heterogeneous reaction. Photochemical reactions and mechanisms and applications.

### **CHM 435: Quantum Chemistry (2 Units)**

#### **Pre-requisite: CHM 231 and CHM 331**

The quantum theory. Classical mechanics. Failures of classical physics. Planck's hypothesis. Experimental and theoretical studies in support of quantization of energy. Atomic and molecular spectra. Microscopic systems. The Schrodinger equation interpretation of wave functions. The uncertainty principle. Translational motion. Properties of the solution to Schrodinger equation. Rotational motion properties of angular momentum.

### **CHM 437: Theory of Molecular Spectroscopy (2 Units)**

#### **Pre-requisite: CHM 341**

Quantum theory rotation and vibration. Theory of microwave, IR, Raman, U.V.M. Visible and N.M.R. spectroscopy, general introduction to electron spin resonance, Mossbquer effect, nuclear quadrupole. Resonance and other modern techniques.

### **CHM 441: Analytical Chemistry II (2 Units)**

#### **Pre-requisite: CHM 242**

Theory of errors. Data handling. Potentiometric and pH methods. Conductometric methods. Electrolytic methods. Radiochemical methods.

Chromatography. Food, soil, water and oil analysis. Modern analytical methods.

### **CHM 481: Seminar and Research Methods (2 Units)**

Students will be taught basic research methods. A written and Oral Presentations on contemporary Industrial Chemistry chosen topics and under a Supervisor will deliver/present a Seminar to the Department.

### **CHM 471: Practical Chemistry IV (2 Units)**

Students are to synthesis (and samples synthesized tested and scored by senior lecturers of the department). One of the following: Soap, detergents, perfumes, paper gum, (adhesive) or any product of their choice, such as body cream, hair oil, shampoo, polish, vanish, etc. they are to submit the write up showing the methods raw materials, the cost of production and possible selling price, gain and an advert.

### **ICH 461: Corrosion Chemistry (2 Units)**

Principles and theory of corrosion, kinetics and thermodynamics, consequences/effects of corrosion, Dry/chemical corrosion (corrosion by oxygen, corrosion by hydrogen, liquid metal corrosion), pilling-bedworth rule, wet/electrochemical corrosion (Hydrogen evolution, oxygen absorption). galvanic corrosion, concentration cell corrosion, pitting corrosion, crevice corrosion, pipeline corrosion, factors influencing corrosion (Nature of the metal and Nature of the corroding environment), corrosion control (cathodic and Anodic protection), protective coatings (Paints, metallic coatings, electroplating or electro-deposition, electroless plating), corrosion monitoring techniques, laboratory corrosion tests.

## **400 LEVEL SECOND SEMESTER**

### **CHM 412: Inorganic Chemistry III ( 2 Units)**

Classification and general characteristics of non-aqueous solvents, solute-solvent interaction. Protonic solvents. Oxyhalidesolvetnts. Liquids halide. Dinitrogen tetroxide, sulphur dioxide. Applications and uses. Chemistry of lanthanides and actinides elements. Position and the elements in the periodic table. Physical and chemical properties, comparison of the two series. Uses of these elements, Abundance in nature for Co-ordination chemistry I.

### **CHM 422: Organometallic Chemistry II (2 Units)**

**Pre-requisite: CHM 323**

Introduction to Organometallic compounds of the transition elements. Classification of ligands, electron rule, bonding, preparation of organo-transition metal compounds. Reaction and structures of organometallic compounds of transition element. The organic chemistry of Ferrocene and related compounds. The role of organometallic compounds in some synthesis of industrial applications.

**CHM 424: Colour Chemistry and Technology (2 Units)**

Colour constitution. Properties of dyes and pigments. Classification of dyes and fibres. The chemistry and theory of dyeing. Chemistry and application of reactive dyes. Preparation and dyeing of man-made and natural fibres. Dyeing machineries. Printing and colouring matters for food, drugs and cosmetics. Dye uses in particular paper industry and colour photography. Quality control procedures and colouration industry. Colour fastness.

**CHM 426: Polymer Chemistry and Technology (2 Units)**

Polymerization mechanisms; detail treatment of addition polymerization. Stereospecific polymerization. Copolymerization. Phase systems for polymerization industrially important thermoplastic and thermosetting polymers: polyurethanes. Rubber elasticity. Mechanism properties of polymers. Analysis and testing of polymers. Degradation of polymers. Large scale industrial polymerization process. Polymer tech. polymer processing; injection, extrusion, compression and transfer moulding of thermoplastics, polymer additive. Polymeric surface coating and adhesive.

**CHM 492: Research project (6 Units)**

Students are assigned to different Lecturers to supervise for their projects. The project is scored according to the guidelines in Section E, No2 "Project Grading System".

**ICH 452: Industrial Chemical Technology (2 Units)**

Hydrogen and carbon monoxide synthesis, gas oxoprocess, water, gas, source of hydrogen and its application. Industrial organic materials, Raw Materials, technical and economic principles and processes and product routes. Flow diagrams, Chemical reactor theory, main types of reactors design and their field applications. Interpretation of batch reactor data. Introduction to reactor design. Single ideal reactor, multiple reactor design. Introduction to heterogeneous reactor design. Fluidized reactor, Principles and similarities in scale up methods, diffusion in solid and interphase mass transfer.

**ICH 454: Industrial Chemical Process**

### **Pre-requisite: CHM 351**

Processing of minerals. Hydrometallurgical and pyrometallurgical process. Methods used in mining and extraction of minerals. Use Iron as example, Manufacture of steel. Purification of minerals. Types of steel. Manufacture of some heavy inorganic compounds. Inorganic fertilizers.

Industrial electrochemistry. Electrical potential, Electrochemical cells, Cell emf. Uses of cell potential electrolysis' Applications of electrolysis. Faradays law. Refining of metals. Electrochemical Basis of Corrosion.

### **ICH 462: Pharmaceutical Chemistry (2 Units)**

Physicochemical properties in relation to biological activity. General drug metabolism. Medicinal chemistry of some selected classes of compounds, including their synthesis, steroids (including steroidal hormones) and vitamins. Analysis (antipyretic and narcotic). Local anaesthetics. Chemotherapeutic agents. E.g. sulphonamides, penicillin's, antimalaria and antchelomatics. Pharmaceutical and quality control procedures.

### **ELECTIVES**

#### **ICH 464: Oil, Fat, Detergent & Chloro Alkali Industries/Paper and Pulp Industries (1 Unit)**

**Oils and Fats:** Sources of oils and fats; physical and chemical properties; extraction and purification methods. Hydrogenation of oils and fats.

**Detergent:** Manufacture of soaps and other synthetic detergents.

**Chloro-alkali Industry:** Industrial production of chlorine; sodium hydroxide, sodium carbonate and potassium hydroxide and their uses in relevant industries. Basis for the paper and pulp industries and production of different types of paper and pulp.

#### **ICH 466: Sugar & Fermentation industries/Paper and Pulp Industries (1 Unit)**

Manufacture of cane sugar and beet sugar. Utilization of by-products of sugar industry for the production of alcohols and other materials. Basis for the paper and pulp industries and production of different types of paper and pulp.



**INDUSTRIAL CHEMISTRY**

**ACADEMIC PROGRAM**