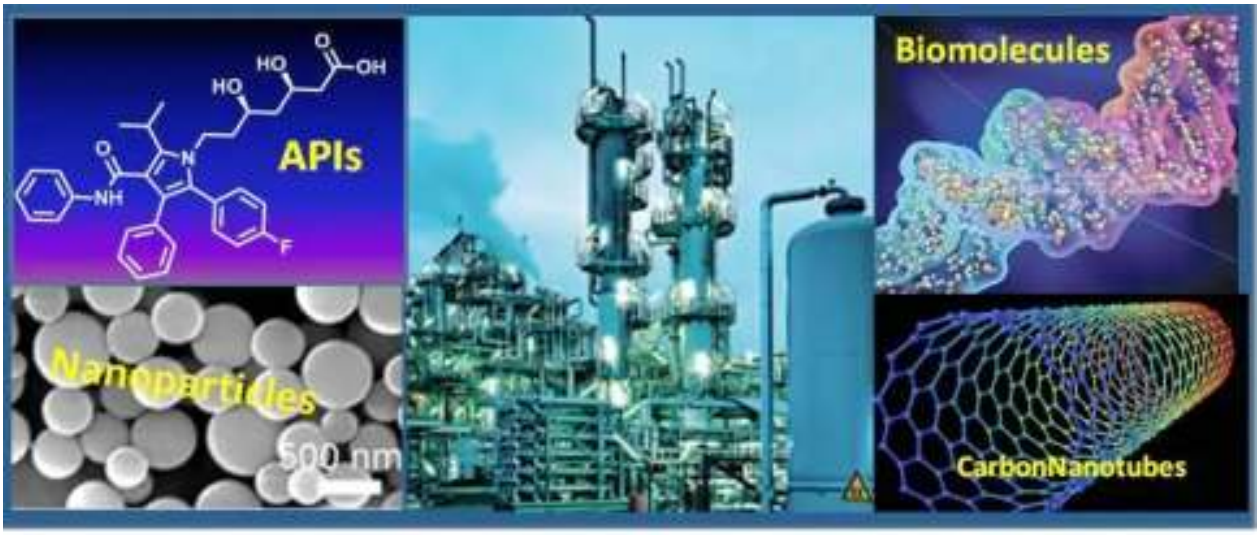
FEDERAL UNIVERSITY LOKOJA



DEPARTMENT OF
INDUSTRIAL CHEMISTRY

UNDERGRADUATE STUDENTS' HANDBOOK
2019/2020 – 2023/2024

FACULTY OF SCIENCE
FEDERAL UNIVERSITY LOKOJA

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Preface

The students' Handbook is a guide for the Bachelor of Science degree in the Department of Industrial Chemistry at the Federal University Lokoja. It contains information about the University in general, and the Department, in particular. It is hoped that students would find the Handbook useful as a primary reference for consultation from time to time, to ensure that they are in good academic standing, and that they meet all requirements for graduation at the end of the 4-year study.

The primary vision of the Department is to produce well trained graduates in Industrial Chemistry that would propel the nation forward economically via proper manning of our chemical and allied industries. This, we hope to achieve via a crop of expert industrial chemists and a well-structured curriculum that covers theory, practical and industrial training during the course of the programme.

Our students are encouraged to read this Handbook along with the University Students' Handbook, so that they can have a hitch free period of study at the Federal University Lokoja.

On behalf of all members of the academic, the technical and the administrative staff of the Department, I welcome you to the Department of Industrial Chemistry.

Benjamin M. Dauda
Professor & Head of Department

Staff List

Academic Staff

S/No.	Name	Rank/Area of Specialization	Academic Qualification(s)
1.	Prof. Benjamin M Dauda	Professor, Polymer Science & Engineering	B.Sc. (ABU) M.Sc. (Leeds) PhD (Manchester)
2.	Dr. Salehdeen Mohammed Umar	Senior Lecturer, Polymer Chemistry	B.Sc. (ABU/ATBU) M.Sc. (ATBU) PhD (ATBU)
3.	Dr. Stephen Chinenyeze Agwuncha	Lecturer I, Polymer Science and Technology	B.Sc. (FUT, Minna) M.Sc. (UI) PhD (TUT, Pretoria)
4.	Dr. Etchie Tunde Ogbemi	Lecturer II, Environmental Chemistry & Pollution Control	B.Sc. (DELSU) M.Sc. (UI) PhD (UI)
5.	Dr. Olusegun Amos	Lecturer II, Industrial Chemistry	B.Sc. (Unilorin) M.Sc. (Unilorin) PhD (Hull)
6.	Dr. Osigbemhe Izuagbe Gilbert	Lecturer II, Organic Chemistry	B.Sc. (UniBen) M.Sc. (NSUK) PhD (UniBen)
7.	Dr. Helen Obianuju Ofor	Asst. Lecturer, Polymer Chemistry and Technology	B.Sc. (AAU, Ekpoma) M.Sc. (COOU) PhD (COOU)
8.	Ms. Esther Izihyi Ibrahim	Graduate Assistant, Industrial Chemistry	B.Sc. (KASU)

Technical Staff

S/No.	Name	Rank/Area of Specialization	Academic Qualification(s)
1.	Jerome Onemolease Aitomun	Principal Laboratory Technologist	B.Sc., M.Sc.
2.	Ossai Chukwudi Prince	Senior Technologist	HND (Auchi Poly)
3.	Alfa Atayi Gabriel	Technologist 1	HND (Benue Poly)

Administrative Staff

S/No.	Name	Rank/Area of Specialization	Academic Qualification(s)
1	Mrs. Helen Shamaki	Senior Asst. Registrar	NCE, B.Ed (ABU)
2	Amana Ibrahim Adams	Administrative Officer	B.Sc. (UniAbuja)
3.	Mrs. Grace Asido Yusuf	Secretary	HND (Kogi Poly)
4.	Mr. Ahmed Muazu	Higher Executive Officer	HND (Kogi Poly)
5	Mrs Rebecca Taiwo	Clerical Officer	ND (Kogi Poly)
6.	Isah Adinoyi Muhammed	Clerical Officer	HND (Kogi Poly)

1. History of the Department

Industrial Chemistry is the index of industrial development everywhere in the world. The enormous strides made by man in the understanding, exploitation of nature and synthesis of new products all have their roots in chemistry and chemical technology. For economic sustenance and technological breakthrough, the Industrial Chemistry undergraduate programme is designed to encompass an appreciation of the centrality of chemical sciences in the entire undergraduate curricula.

The Department of Industrial Chemistry is one of the newly established (2019) departments in the Federal University, Lokoja, under the Faculty of Science, offering a Bachelor of Science degree in Industrial Chemistry.

2. Philosophy

The programme is designed to equip students for employment in virtually all types of industries. Consequently, a lot of emphasis is placed on practical work and industrial training during the course of the programme which runs as a 4-year post-secondary programme (or a 3-year programme for A-level graduates). Students are to undertake one industrial attachment of 24 weeks during their 300 level second semester and the long vacation. The programme is also planned to arouse entrepreneurial spirit needed for self-employment and economic emancipation.

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 Physical Chemistry, Inorganic Chemistry, Organic Chemistry, Polymers, Petro-chemistry, Cosmetics and Cleansing products, Environmental Chemistry, Food Chemistry, Agrochemicals 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 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 twenty-four (24) weeks during their 300 level second semester and the long vacation,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 molded to enable them go into the society with a positive, responsible, and responsive attitude.

3. Aim

To produce graduates with sound knowledge of fundamentals of chemistry who also have the ability to apply this knowledge in the conversion of nationally available raw materials into useful products in commercial quantity.

4. Objectives

The objectives of the Industrial Chemistry Programme are as follows:

a. To provide students with a thorough grounding in principles and sound knowledge of scientific methods of the chemical sciences.
b. Arouse a sense of curiosity and enquiring mind, in order to encourage and develop creative thinking and research aptitude.
c. Generate in students an awareness of the enormous resources in their immediate environment so as to enhance solutions to the challenges of our time in a march towards nation building.
d. To educate and train chemists, particularly applied chemists, who can think fundamentally about their subject and who can acquire as graduates, a meaningful picture of the chemical industry.
e. Inculcate in students appropriate skills and abilities to manage and administer technological operations within the field of chemistry and allied areas.
f. Prepare students for professional participation in chemical industries. It is intended that graduates of this programme will be able to adapt themselves to jobs which are problem solving or results oriented in the chemical, petrochemical, biochemical and allied technological fields e.g. food, environmental, textiles, polymer etc.

5. Prospects and Employment Opportunities

Graduates of B.Sc. Industrial Chemistry in Federal University Lokoja (FUL) are equipped with adequate skills in Applied Chemistry that will enable them to:

a. Fit into different sectors of the economy.
b. Be able to compete favourably with graduates of Industrial/Applied Chemistry of any University in the World.
c. Pursue Postgraduate programme in chemistry or any other related fields.

Graduates find employment in government agencies, research and development institutes, chemical production industries, biotechnology, quality control, pharmaceutical industry, fertilizer production industry, plastics industry, pulp and paper industry, tanning industry, and petroleum industry, textile industry, dyes and paints industry, cosmetics industry, cement industry, glass industry, water purification and wastewater purification engineering.

6. Admission and Graduation Requirements

6.1 UTME & Direct Entry Admission Requirement

In addition to the general requirement for admission into the university, candidates intending to study B.Sc. Industrial Chemistry must fulfill any of the conditions below:

A. 4-year Full-Time Degree Programme (UTME)

(a) **O-Level Requirement**: Candidates must have at least credit level passes in five (5) subjects including English Language, Mathematics, Chemistry, Physics and Biology (or any other science subject) at the SSCE/GCE/WAEC/NECO or its equivalent in not more than two (2) sittings.

(b) **UTME Subjects:** Furthermore, an acceptable pass in the Unified Tertiary Matriculation Examination (UTME) is required for admission into 100-level. The subject combinations for UTME are English Language, Chemistry, and any other two of the following: Mathematics, Physics or Biology.

B. 3-year Full-Time Degree Programme (Direct Entry)

For direct entry admission, candidates in addition to having the relevant five O-level credits must possess:

i. A-Level candidates with a minimum of two (2) A-level passes (graded A-E) at the GCE Advanced Level (or its equivalent) in relevant subjects (Chemistry, Mathematics and Physics (or any other science subject) is required to be considered for admission into 200-level.
ii. Candidates with National Diploma (ND) with a minimum of Lower credit grade (CGPA of 2.5).
iii. Candidate with NCE Chemistry Education certificate with a minimum of "Merit" (CGPA of 2.4).

6.2 Requirement for Graduation

Graduation requirement for B.Sc. Industrial Chemistry is shown below:

	100 Level	200 Level	300 Level	400 Level	Total
Core Courses	39	43	27	34	143
Elective Courses	7	3	2	8	20
Total	46	46	29	42	163

7. Requirements for the Award of the Degree

For a candidate to be eligible for the award of a degree of Bachelor of Science in Industrial Chemistry, the candidate must have successfully completed all prescribed courses as contained in the course description. As shown in the Table (section 6.3), the minimum number of units for the award of degree shall be 163 units and 117 units for a 4-year and 3-year degree programme, respectively.

8. Registration of Courses

Students should note that registration of courses commences on resumption for both the first and second semesters at the beginning of every session. The specific procedure is as follows:

- After payment of school fees, students should proceed to the Bursary with proof of bank payment for a PIN code for on-line registration.
- Students are expected to collect registration forms from the Department and fill it in consultation with the course adviser.
- Courses which are considered as pre-requisites to others must be taken and passed before registering for a course in which they are pre-requisites.
- The minimum and maximum work load per semester is 15 and 24 credit units respectively.
- Thereafter, the forms are to be forwarded to the University-Portal for proper documentation.
- A student is at liberty to withdraw from a course within the time frame stipulated by the Senate, and on completion of the add/delete form.
- Any student who withdraws from a course without permission will be deemed to have failed the course.

9. The Course Credit System

This is the grading system by which students results are computed at the end of every semester. It is important for students to have a good understanding of the computation of Grade Point Average (GPA) at the end of a semester and Cumulative Grade Point Average (CGPA) at the end of two or more semesters or sessions. As such, the basic data needed for this computation are:

-the course credit unit(s)
-the total registered credit units
-the letter grade assigned to the mark
-the points assigned to the letter grade
-the total credit points obtained.

These data are of paramount importance and students are advised to know their meanings and how to determine them.

(i) Credit Units	(ii) Percentile Scores	(iii) Letter Grades	(iv) Grade Points (GP)	(v) Grade Point Average (GPA)	(vi) Cumulative Grade Point Average (CGPA)	(vii) Class of Degree
Vary according to contact hours assigned to each course per week per semester, and according to workload carried by student	70 – 100	A	5	Derived by multiplying (i) and (iv) and dividing the sum of these by the total Credit Units	4.50 – 5.00	First class
	60 – 69	B	4		3.50 – 4.49	Second Class Upper
	50 – 59	C	3		2.40 – 3.49	Second Class Lower
	45 – 49	D	2		1.50 – 2.39	Third Class
	40 – 44	E	1		1.00 – 1.49	Pass
	0 – 39	F	0		0.00 – 0.99	Fail

NB

- **Course Credit Unit(s)**: the contact hour(s) assigned to the course per week per semester
- **Total Registered Credit Units (TRCU)**: the sum total of all credit units registered by a student in a semester
- **Mark obtained in a course**: the sum of scores awarded after taking prescribed test(s) and examination expressed in percentage at the end of the semester
- **Grade**: the letter grade 'A' to 'F' assigned to the percentage marks (0 – 100) obtained in a course
- **Carry-Over:** a failed core-course (0 – 39% score) will have to be carried over, i.e. repeated and passed before graduation
- **Grade Point**: the numerical point assigned to a letter grade which ranges from 0 – 5 points
- **Total Credit Point (TCP)**: obtained by multiplying the course credit unit(s) by the grade points earned in a course
- **Grade Point Average (GPA)**: obtained by dividing the sum of total credit points (**TCP**) by the sum of total registered credit units (**TRCU**)
- **Cumulative Grade Point Average (CGPA)**: obtained by dividing the sum of total credit points (TCP) for two or more semesters by the sum of total registered credit units (TRCU) for two or more semesters under consideration

Example 1: A typical Student's performance at the end of 100 level first semester

X1	X2	X3	X4	X5	X6
Course Code	Credit Units	Mark obtained	Letter Grade	Grade points	Total Credit points (X2 multiplied by X5)
ICH 141	2	76	A	5	10
ICH 113	3	65	B	4	12
ICH 161	1	79	A	5	5
PHY 111	2	82	A	5	10
PHY 161	1	41	E	1	1
MTH 111	3	71	A	5	15
CSC 101	2	54	C	3	6
GST 101	2	46	D	2	4
GST 103	2	50	C	3	6
GST 107	2	63	B	4	6
	TRCU = 20				TCP = 75

The Grade Point Average (GPA) for the result above can be calculated as follows:

$$GPA = \frac{TCP}{TRCU} = \frac{75}{20} = 3.75$$

Example 2: A typical student's performance at the end of 100 level second semester

X1	X2	X3	X4	X5	X6
Course Code	Credit Units	Mark obtained	Letter Grade	Grade points	Total Credit points (X2 multiplied by X5)
ICH 142	2	58	C	3	6
CHM 124	3	42	E	1	3
CHM 134	3	86	A	5	15
ICH 162	1	70	A	5	5
PHY 122	2	66	B	4	8
PHY 162	1	51	C	3	3
MTH 112	3	52	C	3	9
CSC 102	2	48	D	2	4
GST 102	2	62	B	4	8
GST 104	1	40	E	1	1
GST 110	1	46	D	2	2
	TRCU = 21				TCP = 64

The Grade Point Average (GPA) for the result above can be calculated as follows:

$$GPA = \frac{TCP}{TRCU} = \frac{64}{21} = 3.05$$

However, the CGPA at the end of the second semester is a combination of first and second semester results and this can be calculated as follows:

$$CGPA = \frac{75 + 64}{20 + 21} = 3.39$$

Please note: while the student was a second class (upper) student at the end of the first semester, his/her relatively poor second semester result led to a drop to the second class (lower) division.

This same procedure is used to compute CGPA for subsequent levels.

10. Procedure for Conducting Examination

10.1 Pattern of Examination

A student's performance in each course is examined at the end of the semester. The examination may be theory (essays or multiple-choice questions), practical (or alternative to practical) or oral interview, as is the case with seminar and project. The assessment methods are:

1. Continuous Assessment (40%), comprising unannounced quiz, class tests, homework assignments and mid-semester examinations.
2. End of Semester Examination (60%)

Students on SIWES are assessed using the contents of their logbooks, submitted technical reports and seminar presentations. Final year projects are examined at the end of the second semester.

10.2 Duration of Examination

The number of credit units for a course determines the time allowed for the examination. One credit unit is examined for one hour, two credit units for two hours and three credit units for three hours.

10.3 Eligibility for Examination

To qualify to sit for the University Examination, candidates must:

i. Be registered for the approved course
ii. Satisfy the attendance requirement of 75%
iii. Pay all prescribed charges by Senate
iv. Comply with any requirements prescribed by Senate, Faculty, or Department, regarding satisfactory attendance/completion of course-work, assignments, practical, project etc.

10.4 Examination Rules

Candidates must obey the following examination rules:

1. Must bring their identification card and examination card to the examination hall
2. Must have 75% lecture attendance in a particular course before he/she be allowed to write the exam.
3. Must be at the examination venue 30 minutes before the examination is due to begin and must enter the examination hall only at the invitation of the invigilator.
4. Are required to sign the attendance slip and register.
5. Must write their matriculation number on the answer script and every additional answer sheet.
6. Must provide their writing materials **(Pens and pencils)**. The only materials students are allowed to have at their desks during the exam are their writing materials and approved calculators.
7. Shall not remove from the examination room or mutilate any paper or other materials supplied.
8. Must do all rough work in their answer books or supplementary answers sheet and cross out neatly. Use of scrap paper is also prohibited.
9. Shall not write on the answer script, examinations number belonging to another candidate.
10. Shall not take his or her answer script out of the examination venue.
11. Shall not take any electronic devices **(including cell phones)** to the examination hall. All cell phones must be turned-off and kept away during exams. If a cell phone is on and it rings during the exam, the supervisor will be required to report the incident to the Head of the Department. This may result in the disqualification of the candidate (owner of the cell phone) from the examination.
12. Must not communicate with other candidates, make noise or cause disturbance during exam.
13. May attract attention of the invigilator by raising his/her hand. Total silence must be maintained.
14. Must not directly or indirectly accept assistance from any other candidate or use his or her papers.
15. Must not take any book, paper, document or any unauthorized object into the examination room.
16. It is a serious misconduct for a student, staff or any person to impersonate a candidate in exam.
17. Candidate who unlawfully obtains pre-knowledge of any examination questions or influences the marking of script or the award of marks shall be liable to disciplinary action.
18. Consumption of food during exam is prohibited except for medical reasons. Authorization letter must be provided for medical cases.
19. No additional time will be given to candidates who are absent for part of an exam regardless of the reason for their absence.
20. Candidates must stop writing when instructed to stop.
21. Hats, caps and earphones must not be worn into an exam except for health or religious reasons. Simple phone earplugs may be allowed for candidates with a hearing problem. Such devices must be properly checked by the invigilators before admitting the candidates into the exams.
22. The ability to hear all verbal instructions including exam start and stop times is the responsibility of the candidate, regardless of the use of earplugs.
23. Any student that violates any of the above rules has committed an examination misconduct and disciplinary action shall be taken appropriately.

10.5 Sections for Examination Misconduct

Students registered for the B.Sc. (Hons) Industrial Chemistry of the Federal University Lokoja are governed by the Examination Regulations of the University currently in force, and as may be amended

by the Senate from time to time. Details of these regulations are contained in the University Students' Handbook obtainable from the Student Affairs Department of the University.

In general, punishment for all proven cases of examination misconduct is severe.

i. Rustication (suspension from the University): A student may be rusticated, that is, suspended from class attendance, removal from a hall of residence and the use of University facilities for a specific period. The action means that the student must immediately leave the campus.

ii. Expulsion: This is permanent withdrawal by or on the authority of the University Senate of students' privileges of registration, class attendance or hall of residence. The privilege of the use of all other University facilities is withdrawn by these sanctions. The student affected loses membership of the University community and must leave the campus immediately. For example, the involvement of any student in secret cult activities or stealing/theft attracts expulsion. Others are specified in the Table below:

S/N	MISCONDUCT	PENALTY
1	Disobedience/insubordinate, rudeness and insult of a first offender.	Rustication for on academic session
2	Found with relevant textbook(s), notebook(s), prepared material(s), a piece of paper.	Expulsion from the University
3	Seeking for and getting assistance in the examination hall	Expulsion from the University
4	Assisting in the examination hall	Expulsion from the University
5	Impersonation/writing for another candidate	Expulsion from the University
6	Found with University answer Booklet/sheet with written materials in an examination	Expulsion from the University
7	Assaulting, threatening an examination Officer/supervisor during an examination	Expulsion from the University
8	Copying from one another exchanging questions/answer sheets	Expulsion from the University
9	Collaborating with the invigilator/Lecturer (which involves the lecturer providing written oral answers to a student in the examination hall	Expulsion from the University
10	Oral communication between and amongst the student	Rustication for two (2) semesters and result for that course shall be cancelled
11	Illegal removal of answer script from the examination hall. Non-submission of answer script at the end of the examination	Rustication for two (2) semesters and the result for that course shall be cancelled
12	Bringing in prepared answers, copying from textbooks, laboratory specimens and any other instructional aides smuggling into the hall relevant to the examinations	Expulsion from the University
13	Receiving information whether written or oral from any persons within and outside an examination	Expulsion from the University
14	Impersonation	Expulsion from the University
15	Physical assaulting and intimidating the Invigilator/examiner inside the examination hall	Expulsion from the University
16	Use of handset, electrical and electronic devices during an examination	Expulsion from the University

17	Writing of projects, laboratory and other field reports/reports for a student	The candidate shall be disqualified and rusticated for two (2) semesters.
18	Verbally assaulting and intimidating the invigilator/examiner outside the examination hall	The candidate shall be disqualified and rusticated for two (2) semesters.
19	Destruction of evidence of examination malpractice	Expulsion from the University
20	Colluding with staff and others to submit a new prepared answer sheet as a substitute for the original script after an examination.	Expulsion from the University
21	Secretly breaking into a staff or departmental office to obtain questions /answers sheet or substituting a fresh answer sheet for the original copy	Expulsion from the University
22	Refusal to cooperate with investigating panel in the alleged examination malpractice	Expulsion from the University.

11. Deferment

Deferment of a semester can be sought on the following grounds:

- Admission related issues
- Health issues
- Emotional stress
- Other special circumstances

Application for deferment shall pass through the registrar to the senate after payment of all fees.

12. Probation and Withdrawal

The minimum requirement for good academic standing is a CGPA of 1.0 minimum at the end of a semester. A student shall be placed on "PROBATION" if his/her CGPA is less than 1.0 at the end of a session. Furthermore, a student on probation who fails to improve on his/her CGPA of less than 1.0 in the subsequent two semesters will be withdrawn from the Department.

13. Course Nomenclature

The course coding system guide will be:

- **ICH** = Industrial Chemistry courses. Each course code contains ICH plus three digits.
- The first digit represents the level i.e. 100, 200, etc.
- The second digit represents stress area in the discipline:

Project/Seminar/Workshop/SIWES/General courses (0)
Physical Chemistry (1)
Inorganic Chemistry (2)
Organic/Polymer Chemistry (3)
Industrial/Environmental/Analytical Chemistry (4)
Chemical Process Technology (5)
Practical (6)

- The third digit signifies the semester. These 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, ICH 141 shows a 100 level course in the stress area of Industrial Chemistry offered in the first semester of the session and CHM 161 shows a 100 level course in the stress area of Practical Chemistry offered in the first semester of the session.

14. Course Structure

The duration of B.Sc. Industrial Chemistry programme is four years for UTME entry students, and three (3) years for direct entry students. At the end of 300 level first semester, students are expected to go for six (6) months of Student Industrial Work Experience Scheme (SIWES) covering the 300 level second semester and the long vacation. Students are expected to write, present and defend a report on what they learnt in the industry. At 400 level, students will undertake a one-year project in any field of interest besides the usual prescribed courses, and a report will be presented and defended.

14.1 100 Level: (Minimum of 46 CU)

- **Core courses: 39 CU**
- **Electives 7 CU**
- **Total 46 CU**

100 Level: FIRST SEMESTER

Course Code	Course Title	Credit Unit	Status	Pre-requisite
ICH 113	*Basic Physical Chemistry	3	C	O/L Chemistry
ICH 141	Introduction to Industrial Chemistry I	2	C	O/L Chemistry
ICH 161	Basic Practical Chemistry I	1	C	O/L Chemistry
PHY 111	General Mechanics	2	C	O/L Physics
PHY 161	General Physics Practical I	1	C	O/L Physics
MTH 101	Sets and Number System	2	C	O/L Maths
MTH 105	Trigonometry and Co-ordinate Geometry	2	C	O/L Maths
CSC 101	Introduction to Computer Science	2	C	O/L Maths
GST 101	Communication in English & Use of Library	2	C	O/L English
GST 103	Nigerian Peoples and Cultures	2	C	O/L English
GST 107	Philosophy, Logic & Human Existence	2	C	O/L English
	Sub – Total	**21 units**		
BOT 101	Plant Biology	2	E	O/L Biology
STA 111	Descriptive Statistics	3	E	O/L Maths

NB: C = Core course; E = Elective course; O/L = Ordinary Level *2019/2020 students took it as CHM in Chemistry Department

100 Level: SECOND SEMESTER

Course Code	Course Title	Credit Unit	Status	Pre-requisite
ICH 124	Basic Inorganic Chemistry	2	C	O/L Chemistry
ICH 134	Basic Organic Chemistry	2	C	O/L Chemistry
ICH 142	Introduction to Industrial Chemistry II	2	C	O/L Chemistry
ICH 162	Basic Practical Chemistry II	1	C	O/L Chemistry
PHY 122	Electricity, Magnetism & Modern Physics	2	C	O/L Physics
PHY 162	General Physics Practical II	1	C	O/L Physics
MTH 102	Algebra	2	C	O/L Maths
CSC 102	Introduction to Computer Applications	2	C	O /L Maths
GST 102	Communication in English II	2	C	O/L English
GST 104	Communication in French/Arabic	1	C	O/L English
GST 110	History & Philosophy of Science	1	C	O/LEnglish
	Sub-Total	**18 units**		
BOT 102	Introductory Ecology	2	E	O/L Biology
MTH 104	Conic Sections and Applications of Calculus	2	E	O /L Maths
PHY 124	Geometric Wave Optics	1	E	O/L Maths

14.2 200 Level: (Minimum of 46 CU)

- **Core courses: 43 CU**
- **Electives 3 CU**
- **Total 46 CU**

200 Level: FIRST SEMESTER

Course Code	Course Title	Credit Unit	Status	Pre-requisite
ICH 213	Electrochemistry	3	C	ICH 113 (CHM 113)
ICH 215	Physical Chemistry	2	C	ICH 113 (CHM 113)
ICH 221	Inorganic Chemistry	2	C	ICH 124
ICH 231	Macromolecular Chemistry	2	C	ICH 134
ICH 241	Process Science I	2	C	ICH 141
ICH 243	Analytical Chemistry	2	C	ICH 113 (CHM 113)
ICH 245	Quality Control & Industrial Safety	2	C	
ICH 255	Introduction to Material Science	2	C	ICH 134
ICH 261	Physical/Analytical Chemistry Practical I	1	C	ICH 161
BTC 201	Biotechnology and Society	2	C	
GST 205	Environmental Health	1	C	
	Sub – Total	**21 units**		
BIO 201	General Ecology	2	E	BOT 102
PHY 231	Properties of Matter	2	E	PHY 131
MTH 201	*Mathematical Methods	3	E	MTH 112

200 Level: SECOND SEMESTER

Course Code	Course Title	Credit Unit	Status	Pre-requisite
ICH 214	Industrial Raw Material Resource Inventory	2	C	ICH 141
ICH 224	Structure and Bonding	2	C	ICH 122
ICH 232	Organic Chemistry	2	C	ICH 134
ICH 242	Process Science II	2	C	
ICH 244	Process Engineering Drawing	2	C	
ICH 246	Environmental Chemistry	2	C	
ICH 258	Management & Chemical Industry I	2	C	ICH 141
ICH 262	Physical/Analytical Chemistry Practical II	1	C	ICH 162
STA 216	Statistical Methods	3	C	O/L
GST 202	Peace and Conflict Resolution	2	C	O/L
GST 204	Entrepreneurial Skill	2	C	O/L
	Sub – Total	**22 units**		
MTH 208	Linear Algebra II	3	E	MTH 112 (MTH 102)
MTH 222	*Elementary Differential Equations I	3	E	MTH 112 (MTH 102)
PHY 212	Vectors & Tensors	1	E	PHY 124

14.3 300 Level: (Minimum of 29 CU)

- **Core courses: 27 CU**
- **Electives 2 CU**
- **Total 29 CU**

300 Level: FIRST SEMESTER

Course Code	Course Title	Credit Unit	Status	Pre-requisite
ICH 313	Separation Methods and Analysis	2	C	ICH 241
ICH 335	Cosmetics and Cleansing Products	2	C	ICH 232
ICH 337	Atomic and Molecular Structure and Symmetry	2	C	ICH 232
ICH 339	Polymer Chemistry	2	C	ICH 232
ICH 341	Instrumental Methods of Analysis	2	C	
ICH 343	Petroleum Chemistry	2	C	ICH 232
ICH 345	Colour & Textile Chemistry	2	C	ICH 232
ICH 347	Cement Chemistry	2	C	ICH 221
ICH 358	Management and Chemical Industry II	2	C	ICH 258
ICH 361	Organic Chemistry Practical	1	C	ICH 262
ICH 363	Inorganic Chemistry Practical	1	C	ICH 261
ICH 369	Glass blowing Practical	1	1	
	Sub – Total	**21 units**		
ICH 317	*Photochemistry	2	E	ICH 221
ICH 319	Surface and Colloidal Chemistry	2	E	ICH 221
ICH 331	*Stereochemistry and Organic Chemistry Functional Groups	2	E	ICH 232

300 Level: SECOND SEMESTER

Course Code	Course Title	Credit Unit	Status	Pre-requisite
ICH 300	SIWES – Industrial Attachment (24 Weeks)	6	C	
	Sub – Total	**6 units**		

14.4 400 Level: (Minimum of 42 CU)

- **Core courses: 34 CU**
- **Electives 8 CU**
- **Total 42 CU**

400 Level: FIRST SEMESTER

Course Code	Course Title	Credit Unit	Status	Pre-requisite
ICH 401	Seminar in Industrial Chemistry	2	C	
ICH 431	Polymer Technology	2	C	ICH 339
ICH 435	Applied Spectroscopy	2	C	ICH 232
ICH 443	Chemistry of Industrial Processes	3	C	
ICH 445	Heavy Inorganic Chemicals and Utilization of Wastes	2	C	
ICH 447	Food Chemistry	3	C	ICH 232
ICH 448	Mineral Processing	3	C	
	Sub – Total	**17 units**		
ICH 421	*Organometallic Chemistry	3	E	ICH 313
ICH 433	Organic Reactions and Synthesis	3	E	ICH 331
GEY 415	*Geochemistry	2	E	-

400 Level: SECOND SEMESTER

Course Code	Course Title	Credit Unit	Status	Pre-requisite
ICH 400	Research Project	6	C	
ICH 430	Natural Product Chemistry	3	C	
ICH 434	Agrochemicals	2	C	
ICH 436	Medicinal Chemistry	3	C	
ICH 454	Chemical Process Technology	3	C	
	Sub – Total	**17 units**		
ICH 412	*Theory of Molecular Spectroscopy	3	E	ICH 339
ICH 414	Nuclear & Radiochemistry	2	E	ICH 339
ICH 432	Physical Organic & Reaction Mechanisms	2	E	ICH 331

15. Description of Courses

15.1 ICH 113 (CHM 113) – Basic Physical Chemistry (3 CU)

Measurement involving accuracy and precision. Significant figures. Error determination. Atomic theory. Cathode rays, mass spectrometer. Thompson, Mosley, Rutherford and Bohr contributions to Atomic theory. Electronic structure – Aufbau principles, Hund's Rule. Quantum numbers and Pauli Exclusion Principles. Electronic Configuration. Simple formula. Molecular formula. Standard solution. Redox reactions. Mass action. Equilibrium constant, pH of acids, bases and buffer solution. Solubility Product, common ion effect. Enthalpy, entropy and free energy change, Hess's law. Faraday laws of electrolysis. Galvanic cells, half-cell potential and reactions. Nernst equation. Cells and battery. Definition of order of reaction and molecularity. Rate of simple reaction, rate constant, activation energy and Arrhenius equation.

15.2 ICH 124 – Basic Inorganic Chemistry (2 CU)

Test for simple cations and anions e.g. Copper, Sodium, Potassium sulphate, chloride, nitrate, sulphide ions, etc. Molecules and chemical bonding – ionic, covalent, dative or coordinate, metallic and complex bonding. Intermolecular forces – permanent dipole and random or dispersion forces and H-bonding. Concept of hybridization in simple molecules or ions. Periodic Table structure. Periodicity in Periodic Table or properties such as atomic radii, ionization energy, electron affinity,

electronegativity. Oxidation states and oxidation numbers. Balancing of simple redox reactions. Hydrides and oxides of metals and non-metals, types of oxides, Hydroxides. Definition of acids and bases and salts with examples. Methods of metal extraction – iron, steel and alloys. Hydrolysis, Deliquescence, Efflorescence, Hygroscopy. Introduction to the d-block and f-blocks, the representative elements. Introduction to nuclear chemistry – nomenclature (nuclide, isotopes, isobar, isotone) nuclear particles and nuclear chemistry equations. Nuclear fusion and fission.

15.3 ICH 134 – Basic Organic Chemistry (2 CU)
Scope of organic chemistry. Isolation and purification. Qualitative test for organic compounds containing nitrogen, sulphur and halogens. Quantitative analysis using Dumas, Kjeidahl and Carious compounds. IUPAC nomenclature and classification of organic compounds. Homologous series, hybridization of carbon atom to reflect single double and triple bonds. Electronic theory in organic chemistry. Empirical and molecular formula. Saturated hydrocarbons, their basic chemistry and uses in petroleum; unsaturated hydrocarbons, alkenes, cycloalkenes, simple electrophilic, nucleophilic reactions. Soap and detergent. Benzene and aromaticity.

15.4 ICH 141 – Introduction to Industrial Chemistry I (2 CU)
Introduction to Industrial Chemistry; Nomenclature, generic and trade names; Raw materials for organic compounds – petroleum, Natural gas, fractionation of crude oil, cracking, reforming, hydroforming; Coal –types, properties, calorific value, distillation of coal, chemicals derived from coal. Renewable natural resources of plant and animal origin; starch – occurrence, structure, wheat, maize, rice, etc. modification of starch and industrial chemicals derived – alcohols, oxalic acid and furfural. Surface chemistry and Interfacial phenomena – Adsorption isotherm, Sols, Gels, Emulsions, Micro emulsions, Micelles, Aerosols, effect of surfactants, Catalysis – introduction, Types, Basic principles, mechanisms, factors affecting performance, introduction to phase transfer catalysis, Enzyme catalyzed reactions, rate model, industrial reactions. Material balance without chemical reaction – flow diagram for material balance, simple balance with or without recycle or bypass; Chemical engineering operations such as distillation, absorption, crystallization, evaporation, extraction, etc.

15.5 ICH 142 – Introduction to Industrial Chemistry II (2 CU)
Energy balance- heat capacity of pure gases and gaseous mixture at constant pressure; sensible heat changes in liquids; Enthalpy change. Fluid flow and heat transport in chemical industry; Distillation-introduction, batch and continuous distillation; separation of azeotropes; plate columns and packed columns. Absorption- introduction, equipment, packed columns, spray columns, bubble columns, mechanically agitated contactors. Evaporation- introduction, equipment, short tube evaporator, forced circulation evaporators, falling film evaporators, wiped (agitated) film evaporators. Filtration-introduction, equipment, plate and frame filter press; Nutch filter; rotary drum filter; sparkler filter; bag filter; candle filter. Drying- introduction; free moisture, bound moisture and drying curve. Equipment – tray dryer, rotary dryer, flash dryer, fluid bed dryer, drum dryer, spray dryer. Utilities in industries. Fuel- types of fuel, advantages/disadvantages. Boilers- types and their functions. Water-specifications for industrial use, various water treatments. Steam– generation and use. Air-specification for industrial use and processing of air. Fluid flow- fans, blowers, compressors, vacuum pumps, centrifugal pumps, ejector pumps, reciprocating pumps, gear pumps. Heat transfer- heat exchangers, shell and tube type, finned tube heat exchanger, plate heat exchangers, refrigeration cycles.

15.6 ICH 161 Basic Practical Chemistry I (1 CU)
General laboratory instructions. Measurements and weighing. Identification of cations and anions. Flame/wet tests. Recrystallization and melting point determination. Volumetric analysis. Simple Acid-Base titrations. Evaluation of components of a mixture. Redox titration. Use of primary standard

in redox titration. Gravimetric analysis. Determination of empirical formula. Estimation of iron in a compound. Estimation of sulphates in an impure compound

15.7 ICH 162 – Basic Practical Chemistry II (1 CU)
Analysis of organic compounds. Physical examination. Ignition test
Solubility test. Detection of component elements qualitative and quantitatively – C, H, N, halogens, S. Test for ionic nitrogen, Sulphur and halogens (for NO_3^-, SO^{2-}, Cl^-, Br^-, I^-). Identification of functional groups to reflect unknown that requires the following tests to identify the unknown: Solubility. Test for primary amines. Test for carboxylic acid. Test for phenols. Test for ketones and aldehydes. Test for esters. Iodoform test. Identification of ionic components of organic compounds. Preparation of aspirin (acetylsalicylic acid). Preparation of soap.

15.8 ICH 213 – Electrochemistry (3 CU)
Electrode potential, standard electrode potential, electrochemical cells, electrochemical series, half cells and its combination. Conductivity, specific conductivity, molar conductivity and degree of dissociation, Kohlrausch's law, Nernst equation, free energy and cell e.m.fs. Electrolyte and electrolytic solution, ionic theory, mechanism of electrolysis, Faraday's laws, electrolysis of water, CuSO4 and brine, selective discharge of ions during electrolysis. Applications of electrochemistry: corrosion, its mechanism and prevention. Fuel cells; lead-acid battery; extraction and purification of metals; electroplating; redox titration and indicators; potentiometric titration.

15.9 ICH 214 – Industrial Raw Material Resources Inventory (2 CU)
Survey of Nigeria's industries and their raw material requirements. Mineral chemistry. Fossils and their uses. Plant and animal products. Nuclear, Solar, aerodynamic/wind and hydrodynamic sources of energy. Potentials and applications of locally available raw materials as industrial feedstock.

15.10 ICH 215 –Physical Chemistry (3 CU)
Kinetic theory of gases. Thermodynamics – first law of thermodynamics. Introduction to second law of thermodynamics. Bond energies. Hess's law and Born – Haber cycles. Chemical equilibrium – Dynamic equilibrium K_{eq}, K_c and K_p and Le Chatelier's principle. Ionic equilibrium – Kw, pH, pOH, buffer solution, indicators theory. Solubility product. Kinetics – first order, second order reactions, mechanisms of reaction. Rate equation and rate law. Electrochemistry – single electrode potential, cell thermodynamics and calculations, conductivity and molar conductivity.

15.11 ICH 221 – Inorganic Chemistry (2 CU)
Hydrogen: structure of ice and water. The hydrogen ion, protonic acid, Oxo-acids, hydrides. Group 1A: Electronic structure and general properties. Anomalous behaviours of lithium, alkali metals in liquid ammonia, binary and complex compounds of alkali metals. Group IIA: Electronic structure and general properties, properties of beryllium compounds 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 structures. Concept of hard and soft acids and bases. Chemistry in aqueous and non-aqueous media. Complexes – nomenclature and isomerism. Redox reactions in inorganic chemistry, disproportionation reactions and examples.

15.12 ICH 224 – Structure and Bonding (2 CU)
Shapes of orbitals, energy degeneracy (s, p, d, f). Simple valence bond theory (electronic-pair repulsion model, VSEPR) and molecular orbital theory – homonuclear and heteronuclear molecules as examples to include discussion of bond angle, bond length and bond order. Atomic spectra – Rydberg constant, Balmer, Lyman, etc. series and calculation of energy and Bohr radius. Structure of ionic crystals of types AB, AB2, AB3 and A2. Crystal lattice, crystal defect and crystal growth. Introduction to X-ray, neutron and electron diffraction methods. Isomorphism and polymorphism. Polarization of ions (Fajan's Rule) and effects on bond types.

15.13 ICH 231 – Macromolecular Chemistry (2 CU)
Classification of macromolecules; polymers and copolymers as natural, modified natural or synthetic substances. Polymer formation processes; methods, kinetics and mechanisms. The characterization of macromolecules; molar mass and distribution, molecular size and shapes, stereochemistry. Crystallinity and methods of determination. Structural classification in natural macromolecules. Bulk structure, crystalline, amorphous, glassy and rubbery states. Inter-relation of structure and properties. Degradation of polymers: by thermal, oxidative, photochemical and chemical environments. Kinetics and mechanism of degradation. Inhibitors and retarders. Biopolymers: organization in protein and nucleic acid structures.

15.14 ICH 232 – Organic Chemistry (3 CU)
Factors affecting structure and properties of organic compounds. Atomic orbitals, bonding, factors affecting availability of electrons; inductive, mesomeric and steric effects. Preparation, properties. Uses and reaction mechanisms of alcohol, ethers, epoxides, aldehydes, ketones, carboxylic acids and their derivatives. Methane, energy of activation and free radical substitution reaction in alkanes. Alkyl halides, preparations, properties, nucleophilic and electrophilic substitution reactions, elimination reactions. Aromaticity and electrophilic reactions.

15.15 ICH 241 – Process Science I (2 CU)
Commercial process, problems of scale and cost. Process flow sheet and stoichiometry. Handling of fluids; conservation laws and dimensional analysis applied to a moving fluid. Process heat transfer, mechanisms of heat transfer coefficients in batch and continuous processes. Use of mean temperature difference. Change of phase correlation of heat transfer data. Distillation differential, batch, fractional distillation; number of stages; effects of operating variables.

15.16 ICH 242 – Process Science II (2 CU)
Mass transfer processes; single phase and inter-phase, mass transfer drying as a heat-mass transfer process. Extraction and absorption; solvent extraction in mixer settlers and columns; number of ideal stages; number of stages in gas absorption by HTU method; gas and liquid film rate determining steps. Solid-liquid separation by filtration and sedimentation. Stoichiometry for systems involving recycles.

15.17 ICH 243 – Analytical Chemistry (2 CU)
Theory of error and statistical treatment of data. Classical methods of analysis. Expression of concentrations – mole, normality, molarity and ppm. Sampling techniques and sample collection. Pretreatment of sample. Application of organic precipitating agents – oxime, 8-hydroxy quinolone, drug and sodium teraphenylborate. Volumetric analysis – Volhard, Mohr and Fajan precipitation titration.

15.18 ICH 244 – Process Engineering Drawing (2 CU)
Projections of lines and surfaces, letters, numerals, scales; Process engineering symbols; Chemical process flow diagrams; Sketching and orthographic projections; Projection and isometric drawing; Sectioning; Dimensioning, fits and tolerance; detail assembly drawing; introduction to Computer Aided Design (CAD).

15.19 ICH 245 – Quality Control and Industrial Safety
Quality Control: - Sampling and raw material analysis; production line inspection, sampling and analysis; final product sampling and analysis; statistical analysis of results, batch code operation, quality control charts for process monitoring (design and development of xbar-chart ans s-chart).
Industrial Safety:- Toxic substances and poisonous gases, acute and chronic exposition, maximum working place concentration, Inflammable chemicals, Use of fire extinguishers and inert gas systems. Handling of high pressure equipment, Protective clothing and sanitary amenities for employees, Industrial safety signs and codes.

15.20 ICH 246 – Environmental Chemistry (2 CU)
Concept of elementary cycles. Characteristics of the atmosphere. Sources, types and effects of environmental pollution. Humic substances and heavy metals in surface water. Water pollution and waste water treatment, composition of domestic water. Waste management, recycling, and uses of waste products. Common environmental pollutants. Global warming and Ozone depletion. Modern Agricultural practice and its effect on water quality. The effect of agro-chemicals and industrial effluents in environmental media.

15.21 ICH 255 – Introduction to Material Science (2 CU)
Classification and properties of industrial materials. Type of bonding and its influence on both structure and properties of materials. Manufacture and properties of solid solutions (alloys). Structure of crystalline materials, coordination number, crystallography. Stress-strain relationship in materials, elastic and inelastic regions, mechanical, thermal and electrical properties of materials. Crystal growth and imperfections (defects). Material transformation-deformation, strengthening, electroplating and corrosion.

15.22 ICH 258 – Management and Chemical Industry I (2 CU)
The nature of management and the role with the chemical industry management theory. Managerial association and specialization. Line and staff structure; relationship. The manager's roe. Organizational structure and management structure. Authority and organization. Corporate policy and organizational constraints on management process. The decision process, techniques and supportive information system. Managerial Economics: Risk and uncertainty in decision making. The theory of production, cost and demand analyses and sales forecasting. Pricing. Investment decision; product diversifications. Theory of business behavior.

15.23 ICH 261 – Physical/Analytical Chemistry Practical I (1 CU)
Areas to be covered are basic techniques in physical and inorganic chemistry. Estimation of errors, processing of experimental data to yield best curve or linear fits and error limit. Quantitative inorganic analysis by volumetric and gravimetric methods to include (a) pH measurement and buffer solution preparation (b) oxidation – reduction titration (c) Mixed – base titration requiring the use of more than one indicators. Thermal analysis involving measurement of heat of reaction, heat of solution and heat of mixing. Measurement of reaction rate and activation energy Construction of simple cells and measurement of e.m.f. Simple inorganic synthesis.

15.24 ICH 262 – Physical/Analytical Chemistry Practical II (1 CU)
Chromatographic separation, purification and identification of organic compounds by solvent extraction, distillation, crystallization, followed by determination of physical constant. Simple organic synthesis. Use of UV spectrophotometer for quantification of organic compounds.

15.25 ICH 300 – Industrial Attachment I (6 CU)
Students will be attached to some industries (preferable a chemical or allied processing industry) for 24 Weeks, the whole of the second semester in 300 level and during the long vacation for real-time relevant industrial experience. Students will be assessed based on seminar presentations, their reports and assessment by industry-based and institution-based supervisors.

15.26 ICH 313 – Separation Methods and Analysis (2 CU)
Intermediate theory and laboratory techniques in analytical and physical chemistry. Advanced data analysis methods and goodness-of-fit criteria. Solvent extraction – partition co-efficient, pH effect and extraction with metal chelator. Type of chromatography. Spectroscopic methods and instrumentation. Separation methods: ion exchange, gas, paper, liquid and column chromatography; electrophoresis.

15.27 ICH 317 – Photochemistry (2 CU)
Photochemical equivalence, light absorption by atoms and molecules, photochemical kinetics and experimental studies, photosynthesized reactions, flash photolysis, laser, photochemical equilibrium, fluorescence, phosphorescence, chemiluminescence and photolysis with different examples, deactivation routes. Quenching. Photochemical reactions and photochemical yields. Photosynthesis, vision and photography.

15.28 ICH 319 – Surface and Colloidal Chemistry (2 CU)
Surface chemistry: surface and interfacial tension. Solid-gas and liquid-solid interface. Surface thermodynamics, spreading and wetting, and application to agriculture and animal husbandry. Detergents and soaps. Adsorption and adsorption isotherms. Micellar systems and their applications. Heterogeneous catalysis. Colloids: colloidal state, classification, structure, preparation and purification. Lyophilic, lyophobic, hydrophobic and hydrophilic systems. Light scattering for particle size measurement. Donnan equilibrium.

15.29 ICH 331 – Stereochemistry and Organic Chemistry Functional Groups (2 CU)
Introductory stereochemistry, optical activity, conformational isomers, chirality, etc E-Z system of naming geometrical isomers. Conformational analysis of open chain and ring systems. α β – unsaturated carbonyl compounds. Rearrangement reactions. Carbanion I: acidity of α hydrogen, claisen and crossed claisen condensation, tautomerism and reformatsky reactions, carbanion II: malonic ester and aceto-acetic ester synthesis, decarboxylation of α-keto acids, chemistry of amines. Organic diols, hydroxyl-acids, and amino acids. Polynuclear aromatic hydrocarbons (PAHs) and their carcinogenic effects.

15.30 ICH 335 – Cosmetics and Cleansing Products (2 CU)
Introduction to cosmetics; constituents of cosmetics – water, emulsifiers, preservatives, thickeners, emollients, colour, fragrance, pH stabilizers; Soaps and Detergents – cleaning mechanism, chemicals, processing conditions, production; Bleaching agents; Anti-septics – chemicals, equipment & synthesis; Body cream lotion – chemicals, equipment and compounding; Hot balm – uses, chemicals, equipment and synthesis

15.31 ICH 337 – Atomic and Molecular Structure and Symmetry (2 CU)
Schrodinger equation. Helium atom, ground and excited states, Spin and Pauli Principle. Hydrogen molecule; Comparison of molecular orbital and valence bond theory, concept of resonance and configuration interaction. Coulson Fischer function. Molecular orbitals for diatomic molecules. Simple pi electron theory, Huckel theory. Walsh rules. Rotational, Vibrational and Electronic Spectra, Russell-Saunders coupling, orbital and spin angular momentum. Use of symmetry in chemistry.

15.32 ICH 339 – Polymer Chemistry (2 CU)
The nature of Polymer nomenclature. Outline of sources of raw materials for polymers, Polymerization process and condensation polymerization 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. Polymerization mechanisms; detailed treatment of addition processes. Stereospecific reactions, copolymerization 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

15.33 ICH 341 – Instrumental Methods of Analysis (2 CU)
Emission and atomic absorption spectrometry, Beer-Lambert law and deviation from Beer-Lambert law. UV, atomic and molecular absorption, emission and fluorescence spectrophotometry.

Electroanalytical techniques. Quantitative analysis. X-ray methods, refractometry, interferometry, polarimetry, polarography & thermoanalytical methods.

15.34 ICH 343 – Petroleum Chemistry (2 CU)
Petroleum in the contemporary energy scene. Nature, classification and composition of crude Petroleum and natural gases. Distribution of petroleum and natural gas resources (the global and Nigerian situations). Natural product chemical markers of petroleum and geological sediments. Petroleum technology, survey of refinery products and process. Petrochemicals in industrial raw materials, prospects for the petrochemical Industry in Nigeria.

15.35 ICH 345 – Colour and Textile Chemistry (2 CU)
Classification of dyes and textile fibres. Natural regenerated and synthetic fibres. Physical and structureal properties of fibres. Preparatory processes: Singeing, desizing, scouring, bleaching, mercerization and optical brightening. Colour and constitution. Theory of dyeing. Dyeing preparation, structure, and application of dyes. After treatments and quality control: Colour fastness. Print paste formulations and application. Paint formulation and application.

15.36 ICH 347 Cement Chemistry (2 CU)
Introduction; History and Types of Cement; Portland Cement, its phases, their functions and structure; Hydration of OPC phases, properties of CSH, hydrated Microstructure; Supplementary Cementious Materials (SCMs); Cement manufacture – raw materials & extraction. Preparation of Kiln mix, calculations. Clinker production – Comminution raw meal homogenization. Cement grinding and homogenization. Clinker reactions and high temperature chemistry. Pyroprocess – firing systems – fuels, preheaters, calciner & bypass systems, clinker coolers; thermodynamics and chemistry of kiln. Other types of cement – white Portland cement, calcium aluminate cement, calcium sulfoaluminate cement, oil-well cement, etc., their uses, properties and reactions; Novel concrete materials – SCC, HPC, UHPC, DUCTAL, ECC, etc. Fibre reinforced cement based composites. Durability of cement.

15.37 ICH 358 – Management & Chemical Industries II (2 CU)
An introduction to the anatomy of management; Industrial Relation; Public Relations; Industrial Psychology; Organizational Design; Management of Personel; An introduction to the production functions; planning for productivity; General Problem solving processes and creative thinking; Analytical methods of investigation.

15.38 ICH 361 – Organic Chemistry Practical (1 CU)
Experiments in colligative properties, thermodynamics, kinetics, spectroscopy, electrochemistry, chromatography, IR and electronic spectral analysis. Synthesis and characterization of inorganic compounds.

15.39 ICH 363 – Inorganic Chemistry Practical (1 CU)
Multi-stage organic compound synthesis, separation and purification of organic compounds. Identification of organic compounds by combined (chemical & spectroscopic) techniques, complexiometric of metal estimation, spectrophotometric determination as a method of separating matrices (e.g. $Cr_2O_7^{2-}$ and MnO_4^- mixture). Use of pH meter to determine equilibrium constants (e.g. K1, K2, K3 of H_3PO_4). Use of selective –ion electrodes for sensitivity/selectivity principles.

15.40 ICH 369 – Glass blowing Practical (1 CU)
Properties of glass in general use. Manufacturer's symbols and what they represent. Types of glass used for laboratory wares. Identification methods, working temperatures. Coefficient of expansion, annealing, thermal resistance, correlation of these factors. Identification of basic tools, Gas supplies, safety measures, cutting, rotation techniques, drawing and reaming, ring seal and side grinding and polishing.

15.41 ICH 400 – Research Project (6 CU)
Research projects into selected topics in industrial chemistry. Students will be expected to carry out literature survey on chosen topics, perform experiments and produce reports. Students will be subjected to both seminar and oral examinations on their projects.

15.42 ICH 401 – Seminar in Industrial Chemistry (2 CU)
Restricted Special topics to be covered include the following:

(1) Mining and Metallurgy: Mineral Processing: performance and separation criteria. Crystalline and non-crystalline structures. Metal solidification and heat treatment. Phase transformation and microstructure. Fabrication and uses of materials
(2) Ceramics and Glasses: The crystal structure of ceramic materials including silicates, phosphates and nitrides, crystallization of glass formation, glass forming materials. Forming process of glass and ceramic. Chemotherapeutic agents.
(3) Chemistry of Paints and Adhesives: Classification of paints in terms of use and constitution. The manufacturing process and principles of formulation. The paints and their physical properties. Composition and classification of adhesives. Physical properties, formulation and application of paints and adhesives.
(4) Cement Chemistry: Classification of cements, cement raw materials and process of manufacture. Structure of cements. Physical and chemical properties of cement. Cement production processes.
(5) Leather Chemistry: Chemistry of animal skin. Theory of tanning. Pretanning processes. Vegetable tanning process. Materials, their properties and chemistry. Synthetic tanning materials: chrome and other tannages. Leather/Tanning.
(6) Chemistry of Brewing: Bio-organic chemistry of malting and mashing. Chemistry of hop constituents, wart boiling and hop extraction. Techniques in the brewing process. Fermentation. Additive and preservatives. Quality control in Brewing.
(7) Soaps and Non-Soap Detergents: introduction to surface chemistry. Micelle formation and the detergency process. The manufacturing processes of soaps and detergents. Synthetic surfactants Anionic, cationic and non-ionic surfactants. Synthetic surfactants. Soaps and Detergents.
(8) Polymer Material: synthetic and natural polymer materials, pulp and paper, cellulose, nanocellulose, lignin and their applications. Material characterization.
(9) Environmental Chemistry & Pollution Control: Industrial emissions monitoring and control devices; wastewater treatment processes; hazardous waste management; industrial/municipal solid waste management.
(10) Writing Research Proposals

15.43 ICH 412 – Theory of Molecular Spectroscopy (3 CU)
Electromagnetic spectrum and interaction with matter. Microwave spectroscopy, infra-red spectroscopy, Raman spectroscopy, ultra-violet/visible spectroscopy, nuclear magnetic resonance spectroscopy. Introduction to electron spin resonance, esr, Mossbauer effect, nuclear quadruple resonance and other modern techniques. Photo electron and x-ray photo electron spectroscopy.

15.44 ICH 414 – Nuclear and Radiochemistry (2 CU)
Revision of proton-neutron nucleus, neutron excess, shell model and nuclear spin. Alpha, megatron, positron, electron capture, gamma and internal conversion decay modes. Properties of particles produced – annihilation, range, shielding etc. Health effects, permissible dose level risk estimates. Kinetics of decay, half-life and decay curves. Detectors – ionization chamber, Geiger Muller, solid and scintillation counters. Quenching and channels ratio correction. Natural radioactivity. Induced radioactivity – mass energy balance including recoil. Nuclear stability and binding energy. Fission

and fusion. Reactor types classified by fuel, moderator coolant. Introduction to activation analysis. The use of isotopes in reaction mechanism and everyday life.

15.45 ICH 421 – Organometallic Chemistry (2 CU)
Definition. Classification of organometallic compounds. Preparation, reactions, structure and bonding of organometallic compounds of alkali, alkaline and transition metals including the abnormal behaviours of organometallic compounds. Organosulphur, organotin and organophosphorus compounds. Electron-transfer and charge-transfer processes in the cleavage of alkyl metals. Generation and detection of free radicals from organometallic compounds. The organic chemistry of ferocenes and related compounds. Classification of ligands, the 18-electron rule bonding in transition metal clusters. Organometallic catalysis. Application of organometallic compounds to organic synthesis.

15.46 ICH 430 – Natural Product Chemistry (3 CU)
General methods of isolation, separation, purification and structural determination of natural products. Classification and biogenesis. Chemistry of terpenoids, steroids, alkaloids, antibiotics, flavonoids. Prostaglandins and chlorophylls. Other natural products of pharmaceutical importance. Cholesteryl benzoate, liquid crystals and digital displays in computer screens.

15.47 ICH 431 – Polymer Technology (3 CU)
Polymer classification:- thermosetts; thermoplastics; elastomers. Polymer Processing Techniques:- injection moulding; compression moulding; extrusion moulding; rotational moulding. Polymer degradation:- thermal; photo-induced and chemical degradation. Physical and mechanical properties of polymers:- tensile strength; flexural strength; tensile/flexural modulus; stiffness; hardness; water absorption. End use application of polymers.

15.48 ICH 432 – Physical Organic and Reaction Mechanisms (2 CU)
Aromaticity and Huckel (4n+2) rule. Method of the study of organic reaction mechanism, non-kinetic methods, kinetic methods. Nucleophilic substitution reactions, elimination and reactions, re-arrangement reactions, preparation and reaction of stereoisomers, stereo selectivity, neighbouring group effects. Hammet equation. Reactive intermediates in organic compounds. Hyper conjugation effect.

15.49 ICH 433 – Organic Reactions and Synthesis (3 CU)
Synthesis of aromatic compounds. Introduction of terms like disconnection, synthons, target molecule, analysis or retrosynthetic analysis, reagent, synthetic equivalent, functional group interconversion, etc. Order of events in electrophilic, aromatic substitution. One-group C-X disconnection in carbonyl derivatives. RCOX, alcohols, ethers, alkyl halides and sulphides. Two-group C-X disconnections, 1,1-difunctionalized compounds, 1,2-difunctionalised compounds, 1,3-difunctionalised compounds. One group C-C disconnection: alcohols, aldehydes, ketones – Michael addition, carboxylic acids; 12-C-C disconnections. Carbonyl compounds. Stereo-selectivity; use of acetylene two-group disconnection. Diels-Alder reactions. Difunctionalised compounds and para-unsaturated carbonyl compounds. Two-group disconnection 1.5 difunctionalized compounds, Robinson annulations. Emphasis is placed on mechanisms where applicable.

15.50 ICH 435 – Applied Spectroscopy (2 CU)
Principles and application of UV, IR, NMR, and Mass Spectroscopy to the determination and elucidation of structures of organic inorganic and organometallic compounds. Complimenting spectroscopic methods with chemical methods for structural elucidation.

15.51 ICH 434 – Agrochemicals (2 CU)
Pesticides, fungicides, and insect sex attractants. Survey of modern approaches to pest and fungal growth control. Naturally occurring pesticides – rotenoids, pyrethrenoids. Survey of synthetic

chlorinated hydrocarbon insecticides. Insect pheromones – techniques of identification, isolation and structural determination and configuration – some synthetic analogues. Herbicides and growth regulation substances. Review of chemical groups used in growth control. Plant growth regulators. Some nitrogen containing herbicides – a review. Synthesis of selected nitrogen containing herbicides.

15.52 ICH 456 – Medicinal Chemistry (3 CU)
Biochemical pharmacology: Introduction. Absorption and distribution. The blood-brain barrier; placental transfer of drugs. Biotransformation of drugs, their conjugation and excretion. Factors affecting metabolism. The microsomal enzymes system. Drug-receptor interactions. Bioassay of drugs, pharmacokinetics, and the importance of plasma levels of a drug. Drug discovery, design and development. Drug action: neurohumoral transmission: neuromuscular and ganglionic blockage sympathominetics; adrenalin receptors; adrenergic neuron antagonists. Autocoids; Histamine; Serotonin; polypeptides; prostaglandins and related substances; antiallergic, antinflamatory and antipyretic agents. Generally-acting drugs. Opites, receptors and antagonists; Dopamine receptors and antipsychotic drugs; antidepressants; anti-anxiety drugs. Selective toxicity; the basis of selective toxicity. Survey of host defense mechanisms and the use of chemotherapy. The bacterial cell membrane, effect on its permeability – role of antifungals. Folic acid and the role of anti-metabolites. Drug resistance, protein synthesis and its interference. Protozoology – parasites, life cycle of material parasite – other examples of protozoal infestations. Viruses, their definition and classification. The biochemistry of viral replication. The role of interferon and other antivirals. Neoplasia – role of anticancer agents.

15.53 ICH 443 Chemistry of Industrial Processes (3 CU)
Overview of chemical processes and products with on the nature, origin and application of the products of the chemical and allied industries. Raw materials; availability, location, energy, primary chemical products; Industrial reactions, chemical plant, process costing. Consumer and Secondary products; main uses of primary products. Legal aspects; Factory Acts, etc. Case studies based on industries and/or chemical networks e.g. Industries: Oil, fertilizer, plastics, Detergents, etc. chemical networks; Alkali, Chlorine, Flourine, Coal/Oil, etc.

15.54 ICH 445 Heavy Inorganic Chemicals and Utilization of Wastes (2 CU)
The nitrogen based manufacturing industries including acids, fertilizers, Urea and methano-formaldehyde; Sulphuric acid industry, potash extraction processes; Sylvimite, local ores and dead sera sources; the phosphorus industry, borax industry and glass cement, and asbestos industry. Chemical plant materials. Recyling of waste household and Industrial waste.

15.55 ICH 447 – Food Chemistry (3 CU)
The nature of food; vitamins, additives and adulterants; chemistry and microbiology of production processes and control; food preservation and spoilage; processing and preservation of local food stuffs; formulation and practice of food standard.

15.56 ICH 448 – Mineral Processing (3 CU)
Physical processing of minerals and their classification. Mineral concentration. Basic metallurgical operations – pulverization, calcination, roasting, refining of metals. Physicochemical principles of extraction of Coal, Iron, Copper, Lead, Silver, Sodium, Aluminum and Zinc. Inorganic materials of industrial importance: availability, forms, structure and modifications of Alumina, Silicates, Clay, Mica, Carbon, Zeolites. Liquid-solid separation and aggregation. Chemical processing of minerals – unit operations, hydrometallurgical processes. Halogen processes and metallurgy; high temperature processing and metallurgical thermochemistry.

15.57 ICH 454 Chemical Process Technology (3 CU)
Unit operations. Mixing and agitation; liquid-liquid, solid-liquid and gas-liquid systems. Scale up. Residence distribution functions for continuous flow systems. Correlation of heat transfer data. Use

of effectiveness number of transfer units applied to heat exchangers. Solvent extraction with partially mixable liquids, selection of suitable extracting agents. Column height and cross section in gas washing. Multi-component vapour-liquid equilibria, bubble points and dew points; key components partial material balances. The approximate design of multi-component distillation columns. Minimum reflux ratio, minimum number of theoretical stages; feed point location. Rigorous simulation procedure; multi-component composition profiles. Small refinery configurations. Optimization. Case studies covering fluid mechanics, heat and mass transfer processes. Linear programming. The need for process control. Types of control; open loop, feed forward, feed-back, cascade feedback and adaptive control. Primary elements, final elements. Nature of offset; one, two and three tem algorithms. Response to disturbances. Controller optimization. Control of systems with non-linear response characteristics. Direct digital control. Programmed control regimes. Reactor design & optimization.