NATIONAL UNIVERSITIES COMMISSION

BENCHMARK MINIMUM ACADEMIC STANDARDS FOR UNDERGRADUATE PROGRAMMES IN NIGERIAN UNIVERSITIES

SCIENCES

APRIL, 2007

PREFACE

Decree (Act) No. 16 of 1985 as contained in the National Universities Commission amended Decree (Act) No. 48 of 1988 empowers the Commission to lay down minimum standards for all programmes taught in Nigerian universities. Consequently, the Commission in collaboration with the universities and their staff developed minimum academic standards for all the programmes taught in Nigerian universities in 1989. The Federal Government subsequently approved the documents in 1989.

After more than a decade of using the Minimum Academic Standard (MAS) documents as a major instrument of accreditation, the Commission in 2001 initiated a process to revise the documents. The curriculum review was necessitated by the fact that the frontier of knowledge in all academic disciplines had been advancing with new information generated as a result of research. The impact of Information and Communication Technologies on teaching and learning and the competitiveness engendered by globalization were also compelling reason for the curriculum review.

Other compelling reasons included the need to update the standard and relevance of university education in the country as well as to integrate entrepreneurial studies and peace and conflict studies as essential new platforms that will guarantee all graduates from Nigerian universities the knowledge of appropriate skills, competences and dispositions that will make them globally competitive and capable of contributing meaningfully to Nigeria's socio-economic development.

Congnisant that the content-based MAS documents were rather prescriptive, a decision was taken to develop outcome-based benchmark statements for all the programmes in line with contemporary global practice. To actualize this, the Commission organized a stakeholders' statements were developed for each programme in all the disciplines taught in Nigerian universities. Subsequent to this exercise, it was discovered that the benchmarch-style statements were too sketchy to meaningfully guide the development of curricula and were also inadequate for the purpose of accreditation.

Given this scenario, the Commission therefore considered the merger of the Benchmark Style Statements and the revised Minimum Academic standards into new documents to be called Benchmark Minimum Academic Standards (BMAS) as an amalgam that crisply enunciates the learning outcomes and competences expected of graduates of each academic programme without being overly prescriptive while at the same time, providing the requisite flexibility and innovativeness consistent with a milieu of increased institutional autonomy.

Following this decision, the Commission initiated the process to produce the documents. The first, in the series, was the conduct of Needs Assessment Survey of Labour Market for Nigerian graduates. This was carried out for all the disciplines taught in Nigerian universities. The exercise involved major stakeholders particularly employers of Nigerian graduates. The objectives of the need assessment survey included identification of expected knowledge, attitudes and skills for graduates and their ability to fit into the requirements of the new national and global economy. Secondly, a workshop was held at which academic experts across Nigerian universities including vice-chancellors participated with the objective of effecting the merger. At the end of the workshop, draft BMAS documents were produced for the thirteen disciplines and the General Studies programme taught in Nigerian Universities. The documents were later sent to the Universities offering relevant disciplines

for comments and input. Following the return of the inputs and comments from the universities to the Commission, a one-day workshop was held at which invited academic experts studied and incorporated the comments and inputs into the draft document.

To ensure that the documents were free from technical errors, the documents were sent to another set of academic experts for editing who also attended a one-day workshop to finally harmonize the BMAS documents.

Following the aforementioned processes, BMAS documents were produced for the underlisted academic disciplines:

i) Administration; Management and Management Technology;
ii) Agriculture, Forestry, Fisheries and Home Economics;
iii) Arts;
iv) Basic Medical and Health Science
v) Education;
vi) Engineering and Technology;
vii) Environmental Sciences;
viii) Law;
ix) Pharmaceutical Sciences
x) Medicine and Dentistry;
xi) Science;
xii) Social Sciences;
xii) Veterinary Medicine.

The process has been a rather long and tortuous one but it is gratifying to note that the BMAS documents will for long be an enduring academic covenant between the universities and the students that will be enrolled to study in their different programmes.

On behalf of the National Universities Commission, I wish to express my sincere gratitude to all Nigerian universities and their staff for their cooperation and immense contribution towards the development of the BMAS documents.

PROFESSOR JULIUS OKOJIE
EXECUTIVE SECRETARY
NUC, ABUJA

APRIL, 2007

1.0 GENERAL

The Benchmark Minimum Academic Stardard is for undergraduate degree programmes in the Sciences.

1.1 List of Programme(s) and Degree(s) in View

Biochemistry	B.Sc.
Biological Sciences (with option in Botany, Zoology and Biology)	B.Sc.
Biotechnology	B.Sc.
Botany	B.Sc.
Brewing Science	B.Sc.
Chemistry	B.Sc.
Computer Science	B.Sc.
Environmental Management and Toxicology	B.Sc.
Geology	B.Sc.
Geophysics	B.Sc.
Industrial Chemistry	B.Sc.
Mathematics	B.Sc.
Meteorology	B.Sc.
Microbiology	B.Sc.
Physics	B.Sc.
Science Laboratory Technology	B.Sc.
Statistics	B.Sc.
Zoology	B.Sc.

1.2 PHILOSOPHY & OBJECTIVES

In educational planning and indeed any planning at all levels must relate to population distribution and trend; of particular importance are the annual rate of population growth, size of the population and probably the size of the labour absorbtive capacity of the population. In effect, the question could be asked whether we are producing scientists for the sake of it as an educational venture or we are involved in a strategy of human resources development with its broader goals of social and political modernization. We believe that we should be aiming at encompassing not only educational but cultural, social and political development, thereby contributing to the building of national identity and integrity.

From the above standpoint, it is felt that what has been approved for the training of scientists is right and should be encouraged.

Science disciplines are the bed-rock of technological development and therefore of national growth and maturity with attendant contribution to human welfare, health and progress.

The training of Scientists should involve the broad strategy of human resources development with its broader goals of social and political modernization. The provision of the milieu for the development of the disciplines in terms of funds, infrastructures; facilities, contented competent staff and employment outlets, aiming at encompassing not only educational but also cultural, social and political development, thereby contributing to the building of national identity and integrity.

The training in Science need to be thorough and of reliance which will assure our graduates employment opportunities or an environment whereby they could be creative innovative and seek self-employment.

These considerations lead to the concepts on which the following model curricula for Science disciplines are constructed:-

(a) The need for broad training in the Sciences i.e. Biology, Mathematics, Physics and Chemistry
(b) The need for freedom of choice, to forage in the wilderness of accumulated human knowledge for self-realisation and actualization;
(c) The need for skill acquisition to ensure competence in one's chosen field of study;
(d) The need for interdisciplinary orientation to imbibe the salutory rewards of inter-disciplinary approach to the solution of complex life problems;
(e) The need for social relevance, to ensure social acceptability and service to society.

1.3 BASIC ADMISSION REQUIREMENTS AND EXPECTED DURATION OF THE PROGRAMMES

The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, to form the core course with credit in three other relevant science courses Biology, Chemistry, Technical drawing Agricultural Science and Geography at the Senior Secondary School Certificate or its equivalent and atleast a pass in Physics. In addition, an acceptable pass in the University Matriculation Examination (UME) into 100-level is required.

1.3.1 Expected duration for UME candidates shall be 4 years.

1.3.2 Expected duration for Direct Entry (DE): Candidates with two A level passes (graded A-E) at the Advanced Level in one or more relevant subjects (Biology, Botany, Chemistry, Geography, Mathematics and Physics) may undertake the three – year degree programme into 200-level.

1.4 Graduation Requirement

Students are required to complete a minimum of 120 units for Graduation, 60 of which must come from the student's discipline.

1.4.1 **Degree Classifications**

This is as shown in Table 1 (vii).

1.4.2 **Probation**

Probation is a status granted to a student whose academic performance falls below an acceptable standard. A student whose Cumulative Grade Point Average is below 1.50 at the end of a particular year of study, earns a period of probabtion for one academic session.

1.4.3 **Withdrawals**

A candidate whose Cumulativbe Grade Point Average is below 1.50 at the end of a particular period of probation should be required to withdraw from the University. However, in order to minimize waste of human resources, consideration should be given to withdrawal from programme of study and possible transfer to other programmes within the same University.

1.4.4 **Repeating Failed Course Unit(s)**

Subject to the conditions for withdrawal and probation, student may be allowed to repeat the failed course Unit(s) at the next available opportunity, provided that the total number of credit units carried during that semester does not exceed 24, and the Grade Points earned at all attempts shall count towards the CGPA.

Table 1:Scoring and Grading Systems

(i) Credit Units	(ii) Percentile Scores	(iii) Letter Grades	(iv) Grade Points (GPA)	(v) Grade Point Average (CGPA)	(vi) Cumulative Grade Point Average	(vii) Class of Degree
Vary According to contact hours assigned to each course per week per semester and according to work load carried by student	70 – 100 60 – 69 50 – 59 45 – 49 0 – 44	A B C D F	5 4 3 2 0	Derived by Multiplying i and iv and dividing by total Credit Units	4.50 – 5.00 3.50 – 4.49 2.40 – 3.49 1.50 – 2.39	First Class 2nd Class Upper 2nd Class lower Third Class

1.4.5 **Course Credit System**

This should be understood to mean a `quantitative system of organization of the curriculum in which subject areas are broken down into unit courses which are examinable and for which students earn credit(s) if passed'. The courses arearranged in . progressive orderof difficulty or in levels of academic progress,e.g Levelor year 1 courses are100,101etc.,and Level II or Year II Courses are 200, 202 etc. The second aspect of the system is that courses are assigned weights refered to as Credit Units.

1.4.6 **Grade Point Average(GPA) and Cumulative Grade Point Average (CGPA)**

Performance in any semester is reported in Grade Point Average. This is the averageof weighted grade points earned in he courses taken dring the semester. The Grade Point Average is obtained by multiplying the Grade Point Average in each

courseby the number of Credit Units assigned to that course, and then summing these up and dividing by the total number of Credit Units taken for the semester.

This is the up-to-date mean of the Grade Points earned by the students in a programme of study. It is an indication of the student'soverall performance at any point in the training programme. To compute the Cumulative Grade Point Average, the total of Grade Points multiplied by the respective Credit Units for all the semesters are added and then divided by the total number of Credit Units for all courses registered by the student.

1.5 COURSE EVALUATION

1.5.1 Techniques of Students Assessment

Students should be examined by a combination of the following methods:

(a) Un-announced Quizzes
(b) Class Examinations
(c) Home-Work Assignments
(d) Mid-Semester and Final Semester Examinations.

The weights to be attached to these examinations should determined by the University provided that the final semester examination carried not less than 50% of the total weighting.

The above methods can be carried out through any of the established techniques such as:

(i) Term Papers;
(ii) Oral presentation at examinations;
(iii) Seminars;
(iv) Projects;
(v) Written essay or objective examinations etc.

1.5.2 External Examiner System

External Examiners should be used only in the final year of the undergraduate programme to assess final year courses and projects, and to certify the overall performance of the graduating students as well as the quality of facilities and teaching. However, the existing practice of using External Examiners for major subject areas in professional programmes should be continued.

1.5.3 SIWES Rating and Assessment

All students taking any degree in the sciences must undergo a minimum of six months Industrial Training with a minimum of 6 credit units. Students should be assessed using the Log Book, a report and a Seminar.

1.5.4 Students Evaluation of Courses

Students shall be encouraged to evaluate all courses they have completed before the final assessment of the course using an approved University format.

1.5.5 Maintenance of Curricula Relevance

The following actions are recommended:

(1) Review Benchmark statements every 5 years
(2) Relevant authorities should carry out periodic visitations to the programme
(3) Universities should routinely request for feedback from employers of their graduates

1.5.6 Performance Evaluation Criteria

(1) Periodic visitations to the programme by the relevant professional bodies and officials of the supervising government agencies.
(2) Periodic feedback mechanisms from employers and industrial training hosts.
(3) Evaluation of Academic staff performance by students through questionnaires.

1.6 Resource Requirements

1.6.1 Personnel – Academic

TABLE 2: Categories of Academic Staff

S/No.	CATEGORIES OF STAFF	QUALIFICATIONS
1.	Assistant Lecturer	A Master's Degree
2.	Lecturer Grade II	A Doctoral Degree, Promotional prospects for Assistant Lecturer with at least three (3) years experience
3.	Lecturer Grade I	A Doctoral Degree with at least three (3) years experience on the job. The three years period is for eligibility for consideration; i.e. apart from the stated period, the candidate will be assessed on quality of teaching, publications, contribution to the University and Community.
4.	Senior Lecturer	At least three (3) years after Lecturer Grade I. Adequate Publication, teaching and services to the University and the Community.
5.	Associated Professor	The position can be filled either by promotion or by appointment. At least three (3) years as Senior Lecturership with considerable publications. Outstanding research and

		teaching coupled with services to the University and the Community. External Assessment is required.
6.	Professor	At least three (3) years of University teaching experience as Associate Professor with considerable publications, outstanding research, including postgraduate supervision teaching and service to the University and community. The position can be filled either by promotion or appointment. External Assessment is required.

i. To start up any programme in Science, a minimum of five (5) Academic staff is required

ii. The ratio of Academic staff to students shall be 1:15

Non-Academic Staff

i. Ratio of Senior Technical Staff to Academic Staff shall be 1:10

ii. Ratio of Junior Technical Staff to Academic Staff shall be 1:5

iii. Ratio of Junior Admin Staff to Academic staff shall be 1:10

iv. Ratio of Senior Admin Staff to Academic Staff shall be 1:10

1.6.2 **Physical Facilities**

Adequate space must be provided for all departments in Sciences. All lecturers be provided with offices and laboratory space work. A definite and resolute effort must be made to provide each department with with at least:-

a. **Spaces**

Three (3) very large laboratories for second, third and fourth year classes respectively calculated according to NUC specifications of 7.5 m^2 per FTE; a minimum of three (3) preparatory rooms for each department at the NUC specifications of 7 m^2 each.

Two lecture rooms capable of sitting at least sixty students at the NUC specification of 1 m^2 per FTE.

A departmental conference room.

There should be staff common room for each department.

The Faculty itself should have the following:-

Two (2) large faculty lecture rooms capable of sitting up to two hundred and fifty (250) students each according to the NUC specification of 0.75 m^2 per FTE.

Every lecturer should be provided with adequate office cum laboratory cubicle of not less than 20 square meters.

b. **Equipment**

Please See Appendix

1.6.3 **Library and Information Resources**

The University Central Library should be well stocked with current journals, textbooks and reference materials for the use of staff and students. The library should be linked with internet for information sourcing.

1.7 **General Studies**

Goal

To produce a well-rounded, morally and intellectually capable graduates with vision and entrepreneurial skills in an environment of peace and social cohesiveness.

Objectives

The objectives of the General Studies programme consist of the following:

a) Acquisition development and inculcation of the proper value-orientation for the survival of the individual and society.

b) The development of intellectual capacities of individuals to understand, appreciate and promote peaceful co-existence.

c) Production graduates with broad knowledge of the Nigerian National and people with a view to inculcating in them mutual understanding and patriotism.

d) Exposing graduates of Nigerian Universities to the rudiments of ICT for computer literacy and ability to live usefully in this ICT age.

e) Preparing students for a post university life with opportunities for job creation and entrepreneurial skills.

f) Production of graduates capable of communicating effectively (both oral and written).

GST 111: **Communication in English (2 Units)**

Effective communication and writing in English, Language skills, writing of essay answers, Comprehension, Sentence construction, Outlines and paragraphs, Collection and organization of materials and logical presentation, Punctuation.

GST 112: **Logic Philosophy and Human Existence (2 Units)**

A brief survey of the main branches of Philosophy Symbolic Logic Special symbols in symbolic Logic-conjunction, negation, affirmation, disjunction, equivalent and conditional statements law of tort. The method of deduction using rules of inference and bi-conditionals qualification theory. Types of discourse, Nature or arguments, Validity and soundness; Techniques for evaluating arguments; Distinction between inductive and deductive inferences; etc. (Illustrations will be taken from familiar texts, Including literature materials, Novels, Law reports and newspaper publications).

GST 113: **Nigerian Peoples and Culture (2 Units)**

Study of Nigerian history, culture and arts in pre-colonial times, Nigerian's perception of his world, Culture areas of Nigeria and their characteristics, Evolution of Nigeria as a political unit, Indigene/settler phenomenon, Concepts of trade, Economic self-reliance, Social justice, Individual and national development, Norms and values, Negative attitudes and conducts (cultism and related vices), Re-orientation of moral Environmental problems.

GST 121: **Use of Library, Study Skills and Information Communication Technology (ICT) (2 Units)**

Brief history of libraries, Library and education, University libraries and other types of libraries, Study skills (reference services). Types of library materials, using library resources including e-learning, e-materials; etc, Understanding library catalogues (card, OPAC, etc) and classification, Copyright and its implications, Database resources, Bibliographic citations and referencing.

Development of modern ICT, Hardware technology Software technology, Input devices, Storage devices, Output devices, Communication and internet services, Word processing skills (typing, etc).

GST 122: **Communication in English II (2 Units)**

Logical presentation of papers, Phonetics, Instruction on lexis, Art of public speaking and oral communication, Figures of speech, Précis, Report writing.

GST 123 **Communication in French (2 Units)**

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

OR

GST 123: **Communication in Arabic (2 Units)**

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

GST 211: **History and Philosophy of Science (2 Units)**

Man – his origin and nature, Man and his cosmic environment, Scientific methodology, Science and technology in the society and service of man, Renewable and non-renewable resources – man and his energy resources, Environmental effects of chemical plastics, Textiles, Wastes and other material, Chemical and radiochemical hazards. Introduction to the various areas of science and technology. Elements of environmental studies.

ESP 223: **Introduction to Entrepreneurial Skills (2 Units)**

Introduction to entrepreneurship and new venture creation; Entrepreneurship in theory and practice; The opportunity, Forms of business, Staffing, Marketing and the new venture; Determining capital requirements, Raising capital; Financial planning and management; Starting a new business, Feasibility studies; Innovation; Legal Issues; Insurance and environmental considerations. Possible business opportunities in Nigeria.k, nails, screws making Dyeing/Textile blocks paste making.

ESP 311: **Introduction to Entrepreneurship Studies (2 Units)**

Some of the ventures to be focused upon include the following:

1. Soap/Detergent, Tooth brushes and Tooth paste making
2. Photography
3. Bric
5. Rope making
6. Plumbing
7. Vulcanising
8. Brewing
9. Glassware production/Ceramic, production
10. Paper production
11. Water treatment/Conditioning/Packaging
12. Food processing/packaging/preservation
13. Metal working/Fabrication – Steel and aluminum door and windows
14. Training industry
15. Vegetable oil/and Salt extractions
16. Fisheries/Aquaculture
17. Refrigeration/Air conditioning
18. Plastic making
19. Farming (crop)
20. Domestic Electrical wiring
21. Radio/TV repairs
22. Carving
23. Weaving
24. Brick laying/making
25. Bakery
26. Tailoring
27. Iron welding
28. Building drawing
29. Carpentry

30. Leather tanning
31. Interior decoration
32. Printing
33. Animal husbandry (Poultry, Piggery, Goat etc)
34. Metal Craft – Blacksmith, Tinsmith etc
35. Sanitary wares
36. Vehicle maintenance
37. Bookkeeping

GST 222: **Peace Studies and Conflict Resolution (2 Units)**

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

Dialogue/arbitration in conflict resolution, Role of international organizations in conflict resolution, e.g. ECOWAS, African Union, United Nations, etc.

GST 223: **Introduction to Entrepreneurial Skills (2 Units)**

Introduction to entrepreneurship and new venture creation; Entrepreneurship in theory and practice; The opportunity, Forms of business, Staffing, Marketing and the new venture; Determining capital requirements, Raising capital; Financial planning and management; Starting a new business, Feasibility studies; Innovation; Legal Issues; Insurance and environmental considerations. Possible business opportunities in Nigeria.

1.8 DEFINITION OF TERMS

1.8.1 Core/Compulsory Course:

A course which every student must compulsorily take and pass in any particular programme at a particular level of study.

1.8.2 Required Course

A course that you take at a level of study and must be passed before graduation.

1.8.3 Elective Course

A course that students take within or outside the faculty. Students may graduate without passing the course provided the minimum credit unit for the course had been attained.

1.8.4 **Optional Course**

A course which students can take based on interest and may count towards the minimum credit unit required for graduation.

1.8.5 **Pre-requisite Course**

A course which student must take and pass before taking a particular course at a higher level.

1.8.6 **Minimum Credit Load Per Semester**

The Minimum credit load per semester is 15.

1.8.7 **Course Credit Unit System**

This should be understood to mean a 'quantitative system of organization of the curriculum in which subject areas are broken down into unit courses which are examinable and for which students earn credit(s) if passed'. The courses are arranged in progressive order of difficulty or in levels of academic progress, e.g. Level or year 1 courses are 100, 101 etc. and Level II or Year II courses are 200, 202 etc.

The second aspect of the system is that courses are assigned weights allied Credit Units.

1.8.8 **Grade Point Average (GPA)**

Performance in any semester is reported in Grade Point Average. This is the average of weighted grade points earned in the courses taken during the semester. The Grade Point Average is obtained by multiplying the Grade Point average in each course by the number of Credit Units assigned to that course, and then summing these up and dividing by the total number of Credit Units taken for the semester.

1.8.9 **Cumulative Grade Point Average (CGPA)**

This is the up-to-date mean of the Grade Points earned by the student in a programme of study. It is an indication of the student's overall performance at any point in the training programme. To compute the Cumulative Grade Point Average, the total of Grade Points multiplied by the respective Credit Units for all the semesters are added and then divided by the total number of Credit Units for all courses registered by the student.

2.0 DEGREE PROGRAMMES

Common Courses for the B.Sc Programmes in the Faculty of Science

Course No.	Course Title	Units
BIO 101	General Biology I	3
BIO 102	General Biology II	3
CHM 101	General Chemistry I	3
CHM 102	General Chemistry II	3
MTH 101	Elementary Mathematics I	3
PHY 101	General Physics I	3
PHY 103	General Physics III	2
PHY 105	General Physics Laboratory	1
CSC 101	Introduction to Computer Science	3
GNS 101	Use of English	2
LIB 101	Library Studies	1
		27 Units

The General Study courses as listed in pages 10 to 13.

The Students' Industrial Work Experience Scheme (SIWES) is compulsory for the programmes.

2.1 B.Sc. DEGREE IN BIOCHEMISTRY

2.1.1 Philosophy, Aims and Obiectives of the Degree Programme

The main aims and objectives of the degree programme in biochemistry should be:

a. To provide students with a broad and balanced foundation of biochemical knowledge and practical skills

b. To develop in students the ability to apply knowledge and skills to solving theoretical and practical problems in biochemistry

c. To develop in students, a range of transferable skills that are of value in biochemical and non-biochemical employment

d. To provide students with knowledge and skills base from which they can proceed to further studies in specialized areas of biochemistry or multi-disciplinary areas involving biochemistry

e. To provide, through training and orientation, an appreciation of the solutory rewards of inter- and multi-disciplinary approach to the solution of complex life problems

f. To generate in students an appreciation of the importance of biochemistry in industrial, economic, environmental, technological and social development

g. To instill in students a sense enthusiasm for biochemistry, an appreciation of its application in different contexts and to involve them in an intellectually stimulating and satisfying experience of learning and studying.

2.1.2 Admission and Graduation Requirements

The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, to form the core course with credit in three other relevant science courses Biology, Chemistry, Technical drawing Agricultural Science and Geography at the Senior Secondary School Certificate or its equivalent and atleast a pass in Physics. In addition, an acceptable pass in the University Matriculation Examination (UME) into 100-level is required. For the B.Sc. Programme in Biochemistry, candidates must have credit level passes in Biology, Chemistry and Physics.

Expected duration for UME candidates shall be 4 years.

Expected duration for Direct Entry (DE) candidates with two A level passes (graded A-E) at the Advanced Level in one or more relevant subjects (Biology, Botany, Chemistry, Geography, Mathematics and Physics) may undertake the three – year degree programme into 200-level.

Graduation Requirements

Students are required to complete a minimum of 120 units for Graduation, 60 of which must come from Biochemistry.

2.1.3 Learning Outcomes

Biochemistry graduates are expected to develop a wide range of different skills and abilities. These are divided into three broad categories:

a. Regime of Subject Knowledge
Graduates of Biochemistry are expected to develop high cognitive abilities and skills related to Biochemistry.

b. Competencies and Skills
Biochemistry graduates are also to exihibit high practical skills in Biochemistry

c. Behavioural Attitudes
Graduates of Biochemistry are expected to be able to transfer this skill to non Biochemistry specific competencies.

2.1.4 Attainment Level

Graduates of Biochemistry are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in Biochemstry in relation to national and societal problems.

2.1.5 Resource Requirement for Teaching and Learning

a) Academic and non-academic staff. (See section 1.6)
b) Academic and Non-Academic Spaces (See section 1.6)
c) Academic and Administrative Equipment (See Appendix)
d) Library and Information Resources (See section 1.6)

2.1.6 **Course Contents and Descriptions**

YEAR I
100 LEVEL COURSES

Core Courses

Course No.	Course Title	Units
GST 101	Use of English	2
BIO 101	General Biology I	3
BIO 102	General Biology II	3
BIO 107/108	General Biology Lab. I	1
CHM 101	General Chemistry I	3
CHM 102	General Chemistry II	3
CHM 107/108	General Chemistry Lab.	1
PHY 101	General Physics I	3
PHY 103	General Physics II	2
PHY 107/108	General Physics Laboratory	1
MTH 101	Elementary Mathematics I	3
MTH 103	Elementary Mathematics II	3
LIB 101	Library Skills	1
CSC 100	Introduction to Computer Science	2
		31 Units

Electives: To be determined by the University

YEAR II
200 LEVEL COURSES

Course No.	Course Title	Units
GST 201	Communication Skills	3
BCH 201	General Biochemistry I	3
BCH 202	General Biochemistry II	3
BIO 201	Genetics I	2
BIO 204	Biological Techniques	2
CHM 210	Physical Chemistry II	2
CHM 212	Inorganic Chemistry II	2
CHM 211	Organic Chemistry II	2
CHM 215	Chemistry Practical	2
MCB 201	General Microbiology I	3
STA 202	Statistics for Biologists	4
GST 207	Communication Skill 1	2
GST 103	Social Science	2
CSC 200	Application of Computer in Science	3
EPS 201	Entrepreneurial Skills I	2
		36 Units

YEAR III
300 LEVEL COURSES

Course No.	Course Title	Units
BCH 301	Enzymology	3
BCH 302	Metabolism of Carbohydrates	2
BCH 303	Metabolism of Lipids	2
BCH 304	Metabolism of Amino Acids and Protein	2
BCH 305	Metabolism of Nucleic Acids	2
BCH 306	Methods in Bochemistry	2
BCH 307	Membrane Biochemistry	1
BCH 308	Food & Nutritional Biochemistry	2
MCB 306	Microbial Physiology & Metabolism	3
BCH 311	General Biochemistry Lab. I	1
BCH 310	Bioenergetics	1
CHM 301	Physical Chemistry III	2
CHM 303	Organic Chemistry III	4
MCB 301	Microbial Genetics/Molecular Biology	4
CHM 312	Instrumental Methods of Analysis	2
EPS 310	Entrepreneurial Skills II	2
BCH 399	Student Industrial Work Experience	3
		38 Units

YEAR IV
400 LEVEL COURSES

Course Number	Course Title	Units
BCH 401	Advance Enzymology	2
BCH 402	Biosynthesis of Macromolecules	1
BCH 403	Tissue Biochemistry	1
BCH 404	Bioinorganic Chemistry	1
BCH 405	Biotechnology & Genetic Engineering	3
BCH 406	Metabolic Regulations	2
BCH 407	Plant Biochemistry	2
BCH 408	Biochemical Reasoning	1
BCH 409	Special Topics/Seminar in Biochemistry	2
BCH 410	Advance Biochemical Methods	2
BCH 411	Research Project	6
BCH 412	Industrial Biochemistry	3
BCH 413	Pharmaceutical Biochemistry	2
MCB 303	Immunology	3
		31 Units

COURSE DESCRIPTION
BIOCHEMISTRY PROGRAMME

BCH 201 & 202, GENERAL BIOCHEMISTRY I&II: (6 Units) (L 60: P20: T10)
Chemistry of amino acids, proteins and their derivatives; methods of isolation and identification acidity and alkalinity, PH and PK_a values and their effects on cellular activities; Buffers. Chemistry/Structures of carbohydrates, lipids and nucleic. acids. Primary, Secondary, tertiary and quartenary structures of proteins; determination and biochemical applications of the structures. Nomenclature of nucleasides, and nucleotides; effects of acid and alkali on hydrolysis of nucleic acids. Structures and functions of major cell components; procaryotic versus eukaryotic organisms.

BCH 301 ENZYMOLOGY: (3 Units) (L 30: P0: T15)
Vitamins and co-enzymes. Fat and water soluble vitamins. Structures and functions of vitamins and co-enzymes. Classification and nomenclature of enzymes. Genetics of enzymes and inhibition. Mechanisms of enzyme-catalysed reactions. Effects of temperature, pH, ions and inhibitors on enzyme catalysed reactions. Michaelis-Menten Equation. Allosteric/Regulatory enzymes. Active sites of enzymes. Estimation of kinetic parameters -enzyme activities, Km, Vmax, Ki etc. Zymogen activation, digestive enzymes etc. Production, isolation, purification and characterization of enzymes. Recent advances in enzymology.

BCH 302 METABOLISM OF CARBOHYDRATES; (2 Units) (L30: P0 TO)
Degradation and digestion of carbohydrates - sugars, storage polysaccharides and cell walls. Reactions of sugars. Glycolysis, the Tricarboxylic acid cycle, the phosphogluconate pathway the glyoxylate pathway; the pentose phosphate pathway and the cori cycle: the calvin pathway. Gluconeogenesis and glyconeogenesis. Disorders of carbohydrate metabolism.

BCH 303 METABOLISM OF LIPIDS: (2 Units) (L30: P0: TO)
Classification of lipids - fatty acids, triglycerides, gycosylglyceroles, phospholipids, waxes, prostaglandins. Lipid micceles, monolagers bilayers Lipoprotein systems. Oxidation and synthesis of fatty acids; cholesterol synthesis. Formation of ketone bodies. Integration of lipid metabolism. Acetic acid as a central precursor for biosynthesis of lipids.

BCH 304 METABOLISM OF AMINO ACIDS AND PROTEINS: (2 Units) (L30:P0:TO)
Amino acids as building blocks of proteins; covalent backbone of proteins; Amino acid sequence of proteins. Protein isolation, fractionation, purification and characterization of proteins. Biological functions of proteins. Oxidative degradation of amino acids and metabolism of one carbon units. Biosynthesis of amino acids and some derivatives; the urea cycle; metabolism of inorganic nitrogen. Disorders of amino acid metabolism.

BCH 305 METABOLISM OF NUCLEIC ACIDS: (2 Units) (L30: P0: TO)
Genome organisation and biosynthesis of proteins. Metabolism of purines and pyrimidines, nucleosides and nucleotides; abnormalities in nucleic acid metabolism-xeroderma pigmentation and skin cancer.

(Pre-requisite BCHM 304)

BCH 306 METHODS IN BIOCHEMISTRY: (2 Units) (L 15: P0: TO)
Principles of instrumentation. Principles, methodologies and applications of dectrophonesis Chromatography, thin layer chromatography, spectroscopy and spectrophotometry centrifugation, (and isotopic techniques.

(Pre-Requisite BCH 201)

BCH 307 MEMBRANE BIOCHEMISTRY: (1 Unit) (L 15: P0: TO)
Structure, composition and functions of biological membranes. Isolation, characterization and classification of membranes; chemistry and biosynthesis of membranes. Molecular organization of membrane components. Natural and artificial membrane bilayers - the unit membrane hypothesis Membrane transport system - active versus passive transport systems. Transport of sugars and amino acids; ionophores.

BCH 308 FOOD AND NUTRITION BIOCHEMISTRY: (2 Units) (L 15: P0: TO)
An introduction to the theory and application of physical and chemical methods for determining the constituents of food. Food processing, preservation and storage of traditional foods – root and stem tubers, fruits and fruit drinks, seeds and grains, green and vegetables. Food poisoning and intoxication; prevention and cure. Food nutrients; Energy values of foods and energy expenditure by mammalians. Nutritive value of foods - carbohydrates, fats, proteins, vitamins, mineral elements and water. Nutritional disorders, prevention and therapy. Nutritional status and nutritional requirements. Recommended dietary allowances. Assessment of nutritional status. Nutrient requirements in relation to Physical, activity and ageing, diet and disease, obesity and under nutrition.

BCH 310 BIOENERGETICS: (1 Unit) (L 15: P0: TO)
High-energy compounds; Chemical potentials, Electrochemical potentials, Electron transport system and oxidative phosphorylation; Regulation of ATP production. Chemical thermodynamics; Oxidations and reductions.

BCH 311 GENERAL BIOCHEMICAL METHODS (PRACTICAL): (2 Units) (LO: P60:TO)
Practical laboratory exercises in areas of interest of academic staff to cut across a wide spectrum of general biochemistry. Laboratory practicals may be arranged on the basis of 6 hours or 3 hours per week for a second semester.

BCH 399 STUDENTS INDUSTRIAL WORK EXPERIENCE (SIWES) (3 Units)
Students will be attached to some industrial organizations for 3 months, the exact period being determined by the institution.

BCH 401: ADVANCED ENZYMOLOGY: (2 Units) (L 15: P0: T 15).
Steady state enzyme kinetics. Transcient kinetic methods. Chemistry of enzyme catalysis. Regulatory enzymes. Molecular models for allosterism. Multienzyme complexes. Enzyme assays. Criteria for determining purity of enzymes. Enzyme reconstitution. Regulation of enzyme activity and synthesis

(Pre-Requisite BCH 311)

BCH 402 BIOSYNTHESIS OF MACROMOLECULES: (1 Unit) (L 15: P0: T 0)

Structure and functions of macromolecules. Storage and structural polysaccharides; mucopolysaccharides, glycoproteins, bacterial cell wall synthesis of complex lipids, lippoproteins and nucleic acids.

BCH 403 TISSUE BIOCHEMISTRY: (1 Unit) (L 15: P0: T 0)
Biochemistry of muscles, kidney, liver, and adipose tissues. General metabolism of the brain and neuronal biochemistry. Biochemistry of reproductive tissues. Detoxification and excretion in tissues.

BCM 404 BIOINORGANIC CHEMISTRY: (1 Unit) (L 15: P0: TO)
Relationship between the physicochemical properties and biological functions of inorganic ions. Ligand complexes and their biochemical significance. Electrolyte metabolism. Nitrogen fixation and sulphur cycle.

BCH 405 BIOTECHNOLOGY GENETIC ENGINEERING: (3 Units) L 15: P0: T 0)
Replication, transcription and translation - a brief review. The genetic code and its relationship to cellular functions. DNA replication in a cell-free system. Genetic transformation, transfunction and conjugation. Gene mutation, mutagenic agents and thin applications to gene-transfer. Gene mapping. Structure of eucaryotic genome. Recombinant DNA and its application. Hybridomas.

BCH 406 METABOLIC REGULATIONS: (2 Units) (L 30: P0: TO)
The relationship of Krebs' Cycle to protein, carbohydrate, lipid and nucleic acids metabolism. Integration of metabolic pathways. Turn-over rates and metabolic pools. Regulation of enzymes of metabolic pathways-feed back inhibition versus enzyme synthesis. Catabolite repression, end product repression, the lactose operon and arabinose operon. Identification of different regulatory mechanism in metabolic pathways.

BCH 407 PLANT BIOCHEMISTRY: (2Units)L30:P0:TO)
Organization of plant cells, photosynthesis, alkaloids and flavonoids, Plant hormones. Biosynthesis of carotenoid Pigments, Biochemistry of Plant Development. The plant cell wall structure, formation and growth. Lignin formation. Free amino acids, pyrimidines, purines and nucleosides in plants. Metabolism of auxins, gibberelins and cytokinins. Synthetic growth regulators and herbicides. Structure - function relationship of plant hormones.

BCH 408 BIOCHEMICAL REASONING: [1 Unit] L 15: P0: T 0]
Evaluation and design of experimental biochemistry from available information and data. Analysis, interpretation and inference - drawing from biochemical research data.

BCH 409 SPECIAL TOPICS/SEMINAR IN BIOCHEMISTRY: (2 Units)
Hormones, immunochemistry, oncology, brain biochemistry, monoclonal antibodies. These may be taught or seminars may be given by academic Staff and Students.

BCH 410 ADVANCED BIOCHEMICAL METHODS (PRACTICAL): (2 Units) (L0: P60:TO):
The purpose of this course is to familiarise students with operations of latest biochemical equipment and with methods of research, assimilation and dissemination of information. Students will go therefore round lecturers and laboratories housing specialized equipment with the aim of exposing them to such equipment under the supervision of lecturer. Part of the course will also cover the effective use of the library, preparation of dissertations or theses, papers for journal publications and journal reviews. Special assignments and essays will be given to students.

BCH 411 RESEARCH PROJECTS: (6 Units)
Independent research findings into selected areas/topics of interest to the academic staff. Students will be required to carry out literature survey on the topics, perform experiments and produce reports (preferably at the end of second semester). Students will be subjected to both seminar and oral examination on the projects undertaken.

BCH 412 INDUSTRIAL BIOCHEMISTRY: (3 Units) (L 30: P0: T 15)
A short review of microbial physiology and genetics. A review of general metabolic pathways and application in industrial processes. Continuous culture methods, principles and applications. The chemostat and its application in industrial fermentations. Fermentations - alcoholic, amino acid antibiotics and other secondary metabolites. Primary and secondary metabolism. Process evaluation and development. Over production of metabolites - amino acids, taste enhancers, vitamms, toxin etc. Methods for screenmg and selecting micro-organisms of industrial importance. Induction of mutation in micro-organism and plants for the purpose of over production; Strain selection/development and enhancement. Gene dosage and its application in industrial processes.

BCH 413 PHARMACOLOGICAL BIOCHEMISTRY: (2 Units) (L.15: P0: T 15)
Cellular metabolism in infected cells. Biochemical aspects of host-parasite relationships. Metabolic factors affecting chemotherapeutic agents. Theories of the mechanism of drug action. Drug resistances and other factors affecting drug efficacy. The physiological and biochemical action of some selected drugs. Nigerian traditional medicinal plants in the management and therapy of common ailments in Nigerian - malaria, sickle cell anaemia, common cold, hepatitis etc.

2.2 B.Sc. DEGREE IN BIOLOGICAL SCIENCES

2.2.1 Philosophy, Aims and Obiectives of the Degree Programme

The main aims and objectives of the degree programme in biological sciences should be:

a. To provide students with a broad and balanced foundation of biochemical knowledge and practical skills

b. To develop in students the ability to apply knowledge and skills to solving theoretical and practical problems in biochemistry

c. To develop in students, a range of transferable skills that are of value in biochemical and non-biochemical employment

d To provide students with knowledge and skills base from which they can proceed to further studies in specialized areas of biochemistry or multi-disciplinary areas involving biochemistry

e. To provide, through training and orientation, an appreciation of the solutory rewards of inter- and multi-disciplinary approach to the solution of complex life problems

f. To generate in students an appreciation of the importance of biochemistry in industrial, economic, environmental, technological and social development

g To instill in students a sense enthusiasm for biochemistry, an appreciation of its application in different contexts and to involve them in an intellectually stimulating and satisfying experience of learning and studying.

2.2.2 Admission and Graduation Requirements

The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, to form the core course with credit in three other relevant science courses Biology, Chemistry, Technical drawing Agricultural Science and Geography at the Senior Secondary School Certificate or its equivalent and atleast a pass in Physics. In addition, an acceptable pass in the University Matriculation Examination (UME) into 100-level is required. For the B.Sc. Programme in Biological Sciences, candidates must have credit level passes in Biology, Chemistry and at least a pass in Physics.

Expected duration for UME candidates shall be 4 years.

Expected duration for Direct Entry (DE) candidates with two A level passes (graded A-E) at the Advanced Level in one or more relevant subjects (Biology, Botany, Chemistry, Geography, Mathematics and Physics) may undertake the three – year degree programme into 200-level.
Students are required to complete a minimum of 120 units for Graduation, 60 of which must come from the relevant option areas in Biological sciences.

2.2.3 **Learning Outcomes**

Biological Sciences graduates are expected to develop a wide range of different skills and abilities. These are divided into three broad categories:

a. *Regime of Subject Knowledge*
Graduates of Biological Sciences are expected to develop high cognitive abilities and skills related to Biological Sciences.

b. *Competencies and Skills*
Biological Sciences graduates are also to exihibit high practical skills in Biological Sciences.

c. *Behavioural Attitudes*
Graduates of Biological Sciences are expected to be able to transfer this skill to non Biological Sciences specific competencies.

2.2.4 **Attainment Levels**

Graduates of Biological Sciences are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in Biological Sciences in relation to national and societal problems.

2.2.5 **Resource Requirement for Teaching and Learning**

a) Academic and non-academic staff. (See section 1.6)
b) Academic and Non-Academic Spaces (See section 1.6)
c) Academic and Administrative Equipment (See Appendix)
d) Library and Information Resources (See section 1.6)

2.2.6 **Course Contents and Descriptions**

Biological Sciences (Biology Option)

YEAR I
100 LEVEL COURSES

Course No.	Course Title	Units
BIO 101	General Biology I	3
BIO 102	General Biology II	3
CHM 101	General Chemistry I	3
CHM 102	General Chemistry II	3
MTH 101	Elementary Mathematics I	3
PHY 101	General Physics I	3
PHY 103	General Physics III	2
PHY 105	General Physics Laboratory	1
CSC 101	Introduction to Computer Science	3
GNS 101	Use of English	2
LIB 101	Library Studies	1
		27 Units

YEAR II
200 LEVEL COURSES

Course No.	Course Title	Units
BIO 201	Genetics I	2
BIO 202	Introductory Ecology	2
BIO 203	General Physiology I	2
BIO 204	Biological Techniques	2
BIO 205	Introductory Developmental/Cell Biology	3
BOT 202	Seedless Plants	2
CHM 211	Organic Chemistry II	2
STAT 202	Statistics For Agricultural and Biological Sciences	4
ZOO 201	Lower Invertebrates	2
GES 201	Communication Skills I	2
EPS 201	Entrepreneurial Studies I	2
		25 Units

Electives:

To satisfy the 30 units minimum requirement, students could select any 4 units from the courses listed below:

BOT 203	Seed Plants	2
CHM 213	Analytical Chemistry I	2
MCB 201	General Microbiology I	3
ZOO 202	Coelomate Invertebrates	2
ZOO 200	Chordates	3

YEAR III
300 LEVEL COURSES

Course No.	Course Title	Units
BIO 301	Genetics II	3
BIO 302	Field Course I	1
BIO 303	General Cytology	3
BIO 304	General Ecology	3
BIO 305	Molecular Biology	3
BIO 306	General Physiology II	3
BCH 201	General Biochemistry I	3
BCH 202	General Biochemistry II	3
EPS 301	Entrepreneurship Studies II	2
BIO 399	Restricted Electives Industrial field experience in anyone of the following:	
	a) Aquatic Pollution	3
	(b) Pest Control	3
	(c) Public Health	3
		33 Units

Electives:

To satisfy the 30 units minimum requirement, students could select any 5 units from the courses listed below:

BIO 308	Evolution	2
MCB 303	Immunology and Immunochemistry	4
MCB 304	Environmental Microbiology (Sewage, Water, Pollution)	2
BIO 309	Introductory Nematology	2
EPS 301	Modern European Language	2

YEAR lV
400 LEVEL COURSES

Course No.	Course Title	Units
BIO 401	Population Genetics	3
BIO 402	Cytogenetics of Plants	3
BIO 403	Soil Ecology	3
BIO 404	Systematic Biology	3
BIO 499	Project	6
		18 Units

Electives:

To satisfy the 30 units minimum requirement, students could select any 12 units from the courses listed below:

BIO 405	Developmental Biology	3
BIO 406	Marine Biology	3
BIO 407	Hydrobiology	3
BIO 413	Field Course II	
BIO 414	Molecular Biology	
MCB 407	Industrial Microbiology	4
MCB 402	Food Microbiology	3
MCB 406	Virology	3
MCB 408	Microbial Ecology	2
ZOO 401	Parasito1ogy	3

COURSE DESCRIPTION

BIOLOGY PROGRAMME

BIO 101 GENERAL BIOLOGY I: (3 Units) (L 30: P0: T 30)
Cell structure and organization, functions of cellular organelles, diversity, characteristics and classification of living things, general reproduction, interrelationship of organisms; heredity and evolution, elements of ecology and types of habitat.

BIO 102 GENERAL BIOLOGY II: (3 Units) L 30: P0: T 30)
A generalized survey of the plant and animal kingdoms based mainly on study of similarities and differences in the external features, ecological adaptation of these forms.

B10 201 GENETICS I: [2 Units] [L 30: P0: T0]
Hereditable and non-hereditable characteristics. probability and tests of goodness of fit. quantitive inheritance; variation in genome structure, introduction to population genetics.

BIO 2O2 1NTRODUCTORY ECOLOGY: (2 Units) (L 30: P0: T0)
Concept and definition of ecosystem, ecology at community level, ecological classification of habitat types, terrestrial and aquatic biomas, specific features of each, biotic components of habitat. Natural distruction, factors of communities, success of community interaction, natural cycle, dynamics of population.

Practicals: to include among others community and population studies of each species in a habitat. Succession simply teated.

BIO 203 GENERAL PHYSIOLOGY I: (2 Units) (L 15:P0: T0)
Physical and chemical processes in basic plants and animal physiology. Basic elements of respiration, photosynthesis, transportation or circulation. Reproduction, germination, growth hormones and enzymology

BIO 204 BIOLOGICAL TECHNIQUES: (2 Units) (L 15: P0: T0)
Preparation of microscope slides, biological drawings, microtomy, colorimetry, photometry, cytological techniques, chromatography, collection and preservation of biological specimens. Herbarium Techniques, experimental design

BIO 205 INTRODUCTORY DEVELOPMENTAL CELL BIOLOGY (3 Units) (L 30: P0: P 15: T0)
History and present trends in cell biology. Reproduction, cell division, cell differentiation and growth of cells. A brief study of the molecular basis of cell structure and development. Organelles. Proteins and nucleic acids.

BIO 301 GENETICS II: (3 Units) (L 30: P15: T0)
Aspects of human genetics; pedigree analysis. Further consideration of various deviations from basic principles. Gene interaction. Pre- requisite -BIO 201.

BIO 302 FIELD COURSE I: (1 Unit) (L 15: P0: T0)
Sampling techniques in local habitats. Assessment by report. This could be in any area of specialization not necessarily ecology.

BIO 303 GENERAL CYTOLOGY: (3 Units) (L 30: P15: T0)
Light, Phase contrast, dark-field and electron microscopy, auto-radiography, florescence; cell cycle; introductory cytogenetics.

BIO 304 GENERAL ECOLOGY: (3 Units) (L 30: P15: T0)
The ecosystem approach to the study of ecology. Energy flow and nutrients cycling. Dynamics of populations and communities in ecosystem; influence of man.
Pre-requisite -BIO 202.

BIO 305 MOLECULAR BIOLOGY: (3 Units) (L 30: PO: T 15)
Biogenesis of microtubules, microfilaments, golgi and mitochondria. Membrane - membrane interactions. Introduction to bioenergetics and thermo-dynamics.
Pre-requisite -BIO 205.

BIO 306 GENERAL PHYSIOLOGY II: (3 Units) (L 30: P 15: T 0)
A general study of osmoregulation, excretion, transport, homeostasis and their co-ordination in animals. Plant water relation, growth and growth regulation. Physiological aspect of crop Yield Prequisite -BIO 203.

BIO 399 RESTRICTED ELECTIVES
Industrial field experience in any one of the following:
a) Aquatic Pollution (3 Units)
b) Pest Control (3 Units)
c) Public Health (3 Units)

BIO 309 INTRODUCTORY NEMATOLOGY: (2 Units) (L 30: P 15: T 0)
Principal characteristics of nematodes, morphology, position and outlines of classification of nematodes. Morphology and biology of important plant parasitic nematodes and their economic importance. Nematological techniques. General principles and methods of controlling nematodes.

Electives

BIO 308 EVOLUTION: (2 Units) L 30: P0: T0)
Current concepts in evolution. Geological periods and epochs. Genetic variation and speciation. Evolution of selected organisms.

BIO 401 POPULATION GENETICS: (3 Units) (L 30: P0: T0)
An introductory consideration of mathematics models for the analysis of gene frequencies and genetic variation in populations.

BIO 402 CYTOGENETICS OF PLANTS: (3 Units) (L 45: P0T0)
Aspects of cell and nuclear divisions. Morphology and behaviour of chromosomes. aberrations and polypidy.
Pre-requisite -BIO 205

BIO 403 SOIL ECOLOGY (3 Units) (L 45: P0: T0)
Physical and chemical nature of soil. Setritus organisms. Cycling of minerals and nutrient pools.

BIO 404 SYSTEMATIC BIOLOGY: (3 Units) (L 45: P0: T0)
A bio-systematic approach to the classification of organisms and nomenclature.

BIO 499 PROJECT: (6 Units) (LO: P90: TO)
A short research project involving an investigation on a selected biological probable. The project is to be written up in the form of a scientific report or paper.

Electives

BIO 405 DEVELOPMENTAL BIOLOGY: (3Units) (L30: P15: T0)
Molecular and genetic aspects of development. A detailed study of the cellular and multicellular bases of development.

BIO 406 MARINE BIOLOGY: (3 Units)
A study of the Biology of Marine fauna and flora. Economic importance of the marine organisms.

BIO 407 HYDROBIOLOGY: (3 Units)
Types of aquatic habitat; ecological adaptations to aquatic life.

BIO 413 FIELD COURSE II
This is designed to give students an opportunity to carry out a small independent research project dealing with plant matinal, approved by the Departmental Board and under the supervision of one or more members of the staff.

BIO 414 MOLECULAR BIOLOGY
The structure, conformation and other properties of proteins, with special reference to X-ray crystallography and other physical techniques. Polysaccharides, glycoprotein cell-wall structures etc. and related biological macromolecules. Structure and properties of DNA and RNA. No practicals.

The Botany and Zoology degree options in Biological Sciences follow the same format as above except that 60% of courses must come from the core options of Botany or Zoology.

2.3 B.Sc Biotechnology Degree

2.3.1 Philosophy, Aims and Objectives

Although there are existing programmes in Nigerian Universities that prepare graduates in the basics of traditional biotechnology, the nation has a dearth of the critical mass of human resources as well as infrastructural capacity for modern biotechnology research and teaching which is the current mainstay of global trend in biotechnology. The programme has been designed to provide a sound understanding of the concepts and methodologies of modern molecular biotechnology in key areas that meet the needs of society. The main objectives of the programme are to broadly educate students for positions in the modern Biotechnology industry and to prepare them for graduate and professional studies in the life sciences at the molecular level.

2.3.2 Admission and Graduation Requirement

The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, to form the core course with credit in three other relevant science courses Biology, Chemistry, Technical drawing Agricultural Science and Geography at the Senior Secondary School Certificate or its equivalent and atleast a pass in Physics. In addition, an acceptable pass in the University Matriculation Examination (UME) into 100-level is required.

Candidates with two A level passes (graded A-E) at the Advanced Level in one or more relevant subjects (Biology, Botany, Chemistry, Geography, Mathematics and Physics) may undertake the three – year degree programme into 200-level.

2.3.3 Learning Outcomes

All Bachelors honours degree student in Biotechnology are expected to develop the following abilities and skills:

a. *Regime of Subject Knowledge*
Cognitive abilities and skills relating to solution of problems in modern Biotechnology

b. *Competencies and Skills*
Practical skills relating to the conduct of Laboratory and Field work in modern Biotechnology

c. *Behavioral Attitudes*
General skills relating to non-subject specific competencies, communication, interpersonal, organization skills and ethical standards.

2.3.4 Attainment Levels

Graduates of modern Biotechnology are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in modern Biotechnology in relation to national and societal problems.

2.3.5 **Resource Requirement for Teaching and Learning**

a) Academic and non-academic staff. (See section 1.6)
b) Academic and Non-Academic Spaces (See section 1.6)
c) Academic and Administrative Equipment (See Appendix)
d) Library and Information Resources (See section 1.6)

2.3.6 **Course Contents and Descriptions**

B.Sc. BIOTECHNOLOGY

YEAR 1

100 LEVEL COURSES

Course No.	Course Title	Units
GST 101	Use of English	2
MTH 101	Elementary Mathematics I	3
PHY 101	General Physics I	3
PHY 102	General Physics III	2
BIO 101	General Biology I	3
BIO 102	General Biology II	3
CHM 101	General Chemistry I	3
CHM 102	General Chemistry II	3
CHM 107	Practical Chemistry I	1
CHM 108	Practical Chemistry II	1
BIO 107	Practical Biology I	1
BIO 108	Practical Biology II	1
PHY 107	Practical Physics I	1
PHY 108	Practical Phyisics II	1
LIB 101	Library Studies	1
CSC 101	Introduction to computer science	3
	Total	35

YEAR II

200 LEVEL COURSES:

Course No.	Course Title	Units
BIO 201	Genetics I	2
BIO 301	Genetics I	3
CHM 211	Organic Chemistry II	2
BCH 201	General Biochemistry I	3
BCH 202	General Biochemistry II	3
BIO 204	Biological Techniques	2
BCH 311	General Biochemistry Lab	1
GST 201	Communication Skills	1
EPS 201	Entrepreneurship Studies I	2

MCB 221	General Microbiology	3
BTG 202	Introduction to Biotechnology	1
CHM 201	Introductory Chemistry	4
MTH 102	Elementary Mathematics II (Calculus)	3
MTS 103	Elementary Mathematics III (Calculus)	3
CSC 204	Data Structures*	4
	Total	

* For Bioinformatics option only

YEAR III

300 LEVEL COURSES: CORE COURSES

Course No.	**Course Title**	**Units**
BTG 301	Molecular Genetics	3
BTG 302	Molecular Genetics Lab	3
STS 202	Statistics 202	4
EPS 301	Entrepreneurship II	2
GST 103	Social Science	3
Option's Required course	**	3
	Scientific writing	1
Option's Elective course	***	3
BTG 304	Molecular Cell Biology	3

** See Required Courses list for each option

*** See List of electives for each option

YEAR IV

400 LEVEL COURSES: CORE COURSES

Course No.	**Course Title**	**Units**
BTG 401	Biotechnology seminar	1
BTG 402	Project Seminar	2
BTG 403	Methods in recombinant DNA Technology	4
BTG 404	Industrial Biotechnology	3
BTG 405	Nucleotide sequence analysis	3
BTG 406	Metabolic Engineering	3
BTG 407	Research in Biotechnology	6
BTG 416	Bioresources Management	3
BTG 418	Biosafty issues	1
BTG 420	Intellectual Property Rights & Bioethnics	1
Option's Required course	**	3
Options elective	***	3
Free Electives		6
		25

At least 1 of the courses in the "Required Courses" list for each option must be offered each semester , starting from the 2nd semester of the third year.

Required Courses and Electives for Animal Biotechnology Option

Required Courses (at least 1 per semester starting from second semester of 3rd year) (9 – 10 units)

Course No.	Course Title	Units
BTG 308	Animal Microtechniques and Tissue Culture	3
MCB 303	Immunology	3
BTG 307	Advanced Nutrition I	3
BTG 424	Advanced Nutrition II	3

Electives (9 units)

Course No.	Course Title	Units
BTG 408	Biotechnology of Animal Reproduction	3
BCH 301	Protein and Enzyme Chemistry	3
BCH 306	Biochemical Separations	3
BTG 410	Comparative Virology	3
BTG 411	Process Biotechnology	3
BTG 412	Biotechnology Robotics	3
BTG 422	Biology of Cancer	3
BTG 413	Molecular Biology of Gene Regulation and Development	3+

Required Courses and Electives for Microbial Biotechnology Option

Required Courses

Course No.	Course Title	Units
BTG 305	Microbial Technology	3
BTG 306	Applied Microbiology	3
MCB 231	Basic Techniques in Microbiology	3
BTG 415	Analytical Methods in Microbiology	3

Electives (9)

Course No.	Course Title	Units
BTG 308	Animal Microtechniques and Tissue Culture	4
BTG 423	Plant Gene Transfer	4
BCH 301	Protein and Enzyme Chemistry	3
BCH 306	Biochemical Separations	3
BTG 410	Comparative Virology	3
BTG 411	Process Biotechnology	3
BTG 412	Biotechnology Robotics	3
BTG 415	Analytical Microbiology	4
MCB 329	Microbial Ecology and Diversity	3

MCB 303	Immunology	3
BCH 308	Food Physical Systems	3
MCB 407	Pathogenic Microbilogy	4
MCB 424	Bacterial Physiology	3
	Marine Microbiology	4+
	Molecular Biology of Gene Regulation and Development	3+

Required Courses and Electives for Plant Biotechnology Option

Required courses

Course No.	Course Title	Units
BTG 423	Plant Gene Transfer	4
BOT 202	Seedless Plants	3
BOT 203	Morphology of Seed Plants	3
BTG 425	Plant Microtechniques and Tissue Culture	
BOT 301	Plant Taxonomy	3

Electives (9)

Course No.	Course Title	Units
BCH 301	Protein and Enzyme Chemistry	3
BCH 306	Biochemical Separations	3
BTG 410	Comparative Virology	3
BTG 411	Process Biotechnology	3
BTG 412	Biotechnology Robotics	3
BTG 417	Plant Molecular Biology	3
BCH 318	Food Physical Systems	3
	Molecular Biology of Gene Regulation and Development	3
BOI 202	Principles of Applied Ecology	4
MCB 324	Microbial Ecology and Diversity	3
BOT 406	General Plant Pathology	3
BOT 311	Introduction to Ethnobotany	3
BOT 303	Plant Physiology	4
BOT 306	Plant Breeding	3
	Basic Statistics for Research	3

Required Courses and Electives for Bioinformatics Option

Required Courses (11)

Course No.	Course Title	Units
CSC 204	Data Structures	4
STA 211	Basic Probability and Statistics II	3
STA 112	Basic Probability and Statistics	3
	One of the following:	
	Homology Modeling of Proteins	3+
BTG 411	Process Biotechnology	3
CSC 482	Introduction to Molecular Modeling	3
BTG 427	Evolutionary Genetics	3

	At least one of the following:	
CSC 208	Introduction to Discrete Structures	4
CSC 314	Computer Architecture	4
CSC 304	Introduction to Information Systems	4+
CSC 201	Principles of Programming Languages	4
CSC 404	Principles of Database Management Systems	4

Required Courses and Electives for General Biotechnology Option

Required Courses (3-4)

Course No.	Course Title	Units
BTG 308	Animal Microtechniques and Tissue Culture	4
BTG 423	Plant Gene Transfer	4
BCH 301	Protein and Enzyme Chemistry	3
BCH 306	Biochemical Separations	3
BTG 411	Process Biotechnology	3
BTG 412	Biotechnology Robotics	3
BTG 415	Analytical Microbiology	4
MCB 303	Immunology	3

Electives (9-12)

Three additional electives from the lists of required and elective courses listed in the other four biotechnology curriculum options.

COURSE DESCRIPTION

BTG 202: **INTRODUCTION TO BIOTECHNOLOGY (1)**
Historical developments, Applications and Implications of molecular biology including ethical and social controversies.

BTG 301: **MOLECULAR GENETICS (3)**
Principles of genetics at the molecular level. Chemical nature of hereditary material. The genetic code, regulatory mechanisms, the molecular basis of mutation. DNA replication and recombination.

BTG 302: **MOLECULAR GENETICS LAB (3)**
Biochemical and molecular aspects of genefunction and gene recombination.

BTG 304: **MOLECULAR CELL BIOLOGY**
Genetics at the molecular level as related to gene structure, function variation and control with a comprehensive treatment of plant and animal cell structure and function. Basic concepts of cell physiology are treated.

BTG 305 **MICROBIAL TECHNOLOGY**
An integrated discussion of recent genetic biochemical and engineering approach
To microbial processing from antibiotics, biomass and citric acids to zymomonas.

BTG 306: **APPLIED MICROBIOLOGY (3)**
Applications of microorganisms in industry agriculture environment with emphasis on the physical and chemical factors of growth and control in relation to industrial and natural processes.

BTG 307 **ADVANCED NUTRITION I**
See Nutritions Synopses

BTG 308: **ANIMAL MICROTECHNIQUES (4)**
Microscopic structure of organism introductory microtechniques.

BOT 311: **INTRODUCTION TO ETHNOBOTANY**
Plants used for treating diseases, Ethovetrinary medicinal plants

BTG 401: **BIOTECHNOLOGY SEMINAR (1)**
Development of communication skills needed by professionals in the field of biotechnology though student oral presentations and facilitated.

BTG 402 **PROJECT SEMINAR**

BTG 403: **METHODS IN RECOMBINANT DNA TECHNOLOGY (4)**
Introduction to techniques and experimentation approaches used in DNA technology: Principles and techniques of Polymerase chain reaction, Southern, Northern and Western Blot methods of protean and DNA identifications. Methods of gene transfer. Principles, methodologies and applications of electrophoresis, chromatography, spectroscopy spectrophotometer, centrifugation and isotopic techniques. Ultracentrifugation, dialysis, optical microscopy. Review of modern analytical.

BTG 404: **INDUSTRIAL BIOTECHNOLOGY**
Microorganisms of Industrial importance and their roles, culture techniques and maintenance of selected strains, improvement of strains through mutation, gene amplification hybridization, protoplast fusion and transformation & DNA techniques and future impact. Basic fermentation design and operations. Single cell proteins, Bioinsecticides and Biofertlizers. Development and prospects of enzyme technology Biodegradation of Industrial materials. Industrial production and principles of processes organic acids, amino acid, antibiotics, vita mine.

BTG 405: **NUCLEOTIDE SEQUENCE ANALYSIS (3)**
Computer analysis of nucleotide sequences assembly; restriction analysis; gene location and identification; protein sequence analysis and structure prediction; database searching; sequence alignments; and phylogenetic analysis.

BTG 406 : **METABOLIC ENGINEERING**
Regulation of metabolism, induction, nutritional repression, feedback regulation metabolic control mechanisms; Regulatory mechanism of carbohydrates metabolism; Regulation of protein and amino acid synthesis; catabolite repression; Regulation of biosynthetic pathways in prokaryotes and eucaryotes feedback resistance mutation;

BTG 418: **BIOSAFETY (1)**
Definition and scope. Hierarchy of regulatory organs. Overview of safety issues and application in various products and services. Environmental risks associated with gene manipulation. Biohazards, Risk assessment and management in

BTG 407: **RESEARCH IN BIOTECHNOLOGY (6)**
Independent research findings undertaken by students into selected areas of biotechnology under the guidance of project supervision.

BTG 408: **BIOTECHNOLOGY OF ANIMAL REPRODUCTION**
The issue of food security, principle of animal breeding; marker assisted selection and breeding; artificial insemination, invitro fertilization, multiple relation embryo techniques for farm animals; genetic engineering of farm animals for better growth, monoclonal antibodies, recombinant DNA technology for development of diagnostics reagents for detection of animal diseases, animal vaccine production.

BTG 410: **COMPARATIVE VIROLOGY**
Biology of viruses and approaches to control through antiviral and genetic engineering. Genome organization, gene expression, replication movement and transmission across kingdom.

BTG 411: **PROCESS BIOTECHNOLOGY (3)**
Description of various types of vessels for cell cultivation. Bioreactor design and optimization. Agitation of bioreactors. Survey of the applications of biotechnology, emphasizing the pharmaceutical industry and the operation of fermentation systems. Case studies of down stream separation and purification protocols employed on an industrial scale.

BTG 412: **BIOTECHNOLOGY ROBOTICS**
Application and use of robotic equipment in the analysis of large number of samples; assay and protocol design; data collating, analysis and interpretation, applications in various life science industries.

BTG 416: **BIORESOURCES MANAGEMENT (3)**
Biological diversity, genetic diversity, specific diversity, species of local cereals, local legume species, local fruit tree species, genetic diversity expressed through large number of associations or combinations of genes in individuals of single species, wild local plants related to cultivated species and whose genetic diversity is crucial ingredient to coo-breeding or hybridization processes aimed at giving more vigour to the crop varieties that have been cultivated over so many years, loss of genetic variability of crops or genetic erosion, species disease resistance, utilization of plant and animal genetic resources, local germplasms, conservation of plant and animal genetic resources, the effects of destruction of natural environment on local plant and

animal genetic resources; the importance of conserving the biological heritage of plant and animal kingdoms, development of seed and gene banks, modes of operation of gene banks, germplasm collections of local crop species, gene banks and breeding, selection of resistant varieties, biotechnologically-based alternatives to live animal experiments; biotechnological protection of forest plantations and economic plants, germplam appropriation and privatization for crop improvement, patents and plant breeders rights, production of improved plants and animals.

BTG 415: **ANALYTICAL METHODS IN MICROBIOLOGY**
Hands on training in the use of analytical instrumentation in microbiological research and applications including biotransformatics and fermentations, biodegradation and identification of bacteria and fungi.

BTG 423: **PLANT GENETRANSFER (4)**
Principles and experimental techniques of non sexual gene transfer in plants.
Application of gene-transfer techniques in crop improvement and research in gene expression.

BTG 419 : **MARINE MICROBIOLOGY**
Examination of the roles of microbes in the oceans and their impact on oceanographic processes and biochemical cycles. Emphasis is on bacteria and their interactions with other Marine Organisms and the Marine environment. Laboratory exercises make use of modern techniques to study metabolic rates and community structure.

BTG 417: **PLANT MOLECULAR BIOLOGY**
Principles and experimental techniques of non sexual gene transfer in plants. Applications of gene-transfer techniques in crop improvement and research in gene expression.

BTG : **PLANT BREEDING:** Refer to Agriculture synopsis

BTG 420: **INTELLECTUAL PROPERTY AND BIOTHICS (1)**
Definition and scope, ethical issues, sperm bank designer babies, organ donation.
Property rights protection, patents, innovations and lineation and other legal instruments.

BTG 422: **BIOLOGY OF CANCER (3)**
A consideration of chemical viral and physical oncogenic agents; genetics and host factors; immunological response to neoplasia; chemotherapy.

BTG 417: **PLANT MOLECULAR BIOLOGY**
Fundamental and applied aspects of plant molecular biology; structure, expression and isolation of plant nuclear genes; molecular biology of plant development, plant organelles and plant-microbe interactions and plant biotechnology.

2.4 B.Sc. Botany Degree Programme

2.4.1 Philosophy, Aims and Objectives of the Degree Programme

The programme has been designed to provide a sound understanding of the concepts and methodologies of Botany in key areas that meet the needs of society. The main objectives of the programme are to broadly educate students for positions in the conservation and bio-diversity sectors, and to prepare them for graduate and professional studies in the plant sciences at the molecular level.

2.3.2 Admission and Graduation Requirement

The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, to form the core course with credit in three other relevant science courses Biology, Chemistry, Technical drawing Agricultural Science and Geography at the Senior Secondary School Certificate or its equivalent and atleast a pass in Physics. In addition, an acceptable pass in the University Matriculation Examination (UME) into 100-level is required.

Candidates with two A level passes (graded A-E) at the Advanced Level in one or more relevant subjects (Biology, Botany, Chemistry, Geography, Mathematics and Physics) may undertake the three – year degree programme into 200-level.

2.3.3 Learning Outcomes

All Bachelors honours degree student in Botany are expected to develop the following abilities and skills:

a. *Regime of Subject Knowledge*
   Cognitive abilities and skills relating to solution of problems in Botany
b. *Competencies and Skills*
   Practical skills relating to the conduct of Laboratory and Field work in Botany
c. *Behavioral Attitudes*
   General skills relating to non-subject specific competencies, communication, interpersonal, organization skills.

2.4.4 Attainment Levels

Graduates of Botany are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in Botany in relation to national and societal needs.

2.4.5 Resource Requirement for Teaching and Learning

a) Academic and non-academic staff. (See section 1.6)
b) Academic and Non-Academic Spaces (See section 1.6)
c) Academic and Administrative Equipment (See Appendix)
d) Library and Information Resources (See section 1.6)

2.4.6 **Course Contents and Descriptions**

YEAR I
100 LEVEL COURSES

Course Code	Course Title	Units
BIO 101	General Biology I	3
BIO 102	General Biology 2	3
BOT 101	Diversity of Plants	3
BOT 102	Flowering Plants, Forms and Function	2
CHM 101	General Chemistry I	3
CHM 102	General Chemistry II	3
MTH 101	General Mathematics I	3
MTH 102	General Mathematics II	3
PHS 101	General Physics I	3
PHS 101	General Physics II	3
LIB 101	Library Studies	1
GES 101	Use of English	2
PHS 105	General Physics Laboratory	1
CSC 101	Introduction to Computer Science	3
		36 Units

YEAR II
200 LEVEL

Course Code	Course Title	Units
BIO 201	Introductory Genetics	2
BIO 202	Introductory Ecology	2
BIO 203	General Physiology	2
BIO 204	Biological Techniques	2
BIO 205	Introductory Molecular Biology	3
BOT 202	Seedless Plants	2
BOT 203	Seed Plants	2
MIC 221	Introductory Microbiology	2
MIC 222	Introductory Microbiology II	2
STA 202	Statistics for Agriculture and Biological Science	2
GNS 201	Communication Skills	2
EPS 201	Entrepreneurship Studies	2
		25 Units

Other Electives to satisfy Minimum units
CHM 211 Organic Chemistry I
CHM 242 Organic Chemistry II
Fisheries and Zoology Courses.

YEAR I11
300 LEVEL COURSES

Course Code	Course Title	Units
BOT 301	Plant Taxonomy	3
BOT 302	Comparative Anatomy of Plant	3
BOT 303	Plant Physiology	3
BOT 304	Plant Ecology	3
BOT 305	Mycology	3
BOT 306	Plant Breeding	3
BOT 399	Restricted Electives	
	Aforestation	3
	Aquatic and Pollution Biology	3
	Horticulture	3
	Biotechnology	3
BOT 311	Medicinal Plant	3
BIO 312	Conservation and Biodiversity	3
BIO	Statistics	2
EPS 301	Entrepreneurship Studies I	2
		40

YEAR IV
400 LEVEL COURSES

Course Code	Course Title	Units
BOT 401	Seminar	1
BOT 402	Economic Botany	2
BOT 403	Nigerian vegetation	2
BOT 404	Soil Science	3
BOT 406	Plant pathology	3
BOT 407	Plant reproduction	3
BOT 408	Plant tissue culture	3
BOT 409	Plant Virology	3
BIO 413	Field Course/ Projects	4
BOT 414	Molecular Biology	3
BOT 415	Paleobotany and Paleontology	3
BOT 416	Plant Cytogenetics	3
		33

COURSE DESCRIPTION

BOTANY PROGRAMME

BOT 202 SEEDLESS PLANTS: (2 Units). (L 30 P0: T 0)
Morphology and reproduction of algae, bryophytes and pteridophytes including fossils.

BOT 203 SEED PLANTS: (2 Units) (L 30: P: TO)
Morphology and reproduction of seed plants.

BOT 301 PLANT TAXONOMY: (3 Units) (L 30: 0: T 0)
Taxonomy and its significance, principles and concepts in plant taxanomy. Construction and use of taxonomic keys. Experimental taxonomy with special emphasis on cyto-taxonomy and chemataxonomy. Sources of taxonomic data and Methods of Analysis.

BOT 302 COMPARATIVE ANATOMY OF PLANTS: (3 Units) (L 30: P0: T15)
Characteristics and classification of tissue and tissue systems; organisation of meristems, evolutiotion of vascular tissues, comparative mood anatomy. Anatomical adaptations to specia1ized habitats. Applied aspects of plant anatomy.

BOT 303 PLANT PHYSIOLOGY: (3 Units) (L 30: P0: T 15)
Plant water relation, Photosynthesis, Respiration, Growth and growth regulation, flowering dormancy, Seed germination, senescence; Physiological aspects of Crops yield. Pre -requisite -B10 203.

BOT 304 PLANT ECOLOGY: (Units) (L15: P 30: T 0)
Study of various plant communities and their ecological framework; Nigerian vegetation, desert and semi-desert plant productivity. Modern concepts in ecology.
Pre-requisite -BIO 202.

BOT 305 MYCOLOGY: (3 Units) (L 30: P0: T 15)
Structure, life cycles, Physiology and Classification of fungi. Fungi of economic importance. Metabolites of Fungi, Industrial uses of fungi, Fungi in Medicine.

BOT 306 PLANT BREEDING: (3 Units) (L 15: P 30: T 0)
The Objectives of plant breeding; origin and domestication of basis of breeding, self-pollinated and cross pollinated crops. Breeding methods, pure line breeding and mass selection, pedigree method, bulk population breedings, back cross breeding. Recurrent selection, beterosis, chromosome manipulation.

BOT 399 RESTRICTED ELECTIVES
Industrial field experience in anyone of the following: (a) Afforestation (3Units) (b) Applied Plant Anatomy (3 Units) (c) Aquatic and Pollution Biology (3 Units) (d) Horticulture (3 Units). Biotechnology (3 Units)

BOT 311: MEDICINAL PLANT: (3 Units)
Description identification and classification of medicinal plants. Preparation of Extracts from various organs of plants. Gathering of ethnomedical information. Collection and preservation of medicinal plant.

BOT 312: CONSERVATION AND BIODIVERSITY: (3 Units)
Plant breeding concepts and methods.

BOT 402 ECONOMIC BOTANY; (2 Units) (L30: P0: T15)
A study of the botany and cultivation of plant species with particular reference to Nigerian economic plants.

BOT 403 NIGERIAN VEGETATION: (2 Units) (L 30: P0: T 15)
A study of Nigerian forests, savannah grass lands and special emphasis on arid zones.

BOT 404 SOIL SCIENCES: (3 Units) (L 30: P0: T 15)
Classification and characteristics of soils. Chemical component and analysis of soils and plant tissue. Plant, soil water relationships.

BOT406 PLANT PATHOLOGY: (3 Units) (L30: P0: T 15)
Principles and concepts in plant pathology. The concept of disease, infection, pathogenesis, host-pathogen relationship and methods and theory of biological and chemotheraphy.
Pre-requisite -BOT 305.

BOT 407 PLANT REPRODUCTION: (3 Units) (L 30: P0: T 15)
Development trends of sexual and asexual reproductions.

BOT 408 PLANT TISSUE CULTURE: (3 Units) (L 15: P 30: T 0)
Meristem culture, organ cultivation, embryo culture. The role of plant hormones and vitamins. Techniques of plant tissue culture. Applications of plant tissue culture in plant breeding.

BOT 409 PLANT VIROLOGY: (3 Units) (L 45: P0: T 0)
General characteristics of plant bacterial viruses. Viral multiplication selected viral diseases in plants.
BOT 415: PALEOBOTANY AND PALEONTOLOGY: **(3 units)**

Morphology and Classification of Spurs and Pollen; their stratigraphic and pale environment applica tion. Study of fossils. Oil implications of Fossils

BOT 416: PLANT CYTOGENETICS ADVANCED ASPECTS OF CELL AND NUCLEAR DIVISIONS.

Morphology and behaviour of Chromosomes, Chromosomal Aberrations and Polyploidy importance of polyploidy, Population cytogenetics. Examples with reference to specific individuals.

2.5 B.Sc. Degree in Brewing Science and Technology

2.5.1 Philosophy, Aims and Objectives of the Degree Programme

The programme is designed to train students and equip them primarily for direct employment in Brewing Industries, although they may as well be employed in other allied and related industries such as malting, alcoholic liquor or soft drinks manufacturing industries and distilleries. Consequently, emphasis is placed on practical work and industrial training during the 5-year B. Sc programme. The programme also broadens the perspective of the students' vis-à-vis the problems of the brewing industry in a tropical country such as Nigeria and offers sufficient theoretical depth to enable talented graduates to undertake postgraduate research work in brewing biotechnology and related disciplines. In keeping with the basic philosophy of the university, the first two years are spent on introductory foundation courses that cover the broad spectrum of the pure sciences.

2.5.2 Admission and Graduation Requirement

The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, to form the core course with credit in three other relevant science courses Biology, Chemistry, Physics at the Senior Secondary School Certificate or its equivalent. In addition, an acceptable pass in the University Matriculation Examination (UME) into 100-level is required.

Candidates with two A level passes (graded A-E) at the Advanced Level in one or more relevant subjects (Biology, Botany, Chemistry, Geography, Mathematics and Physics) may undertake the three – year degree programme into 200-level.

2.5.3 Learning Outcomes

All Bachelors honours degree student in Brewing Science are expected to develop the following abilities and skills:

a. *Regime of Subject Knowledge*
Cognitive abilities and skills relating to solution of problems in Brewing Industry and other allied and related industries.

b. *Competencies and Skills*
Practical skills relating to the conduct of Laboratory and Industrial work in Brewing Industries

c. *Behavioral Attitudes*
General skills relating to non-subject specific competencies, communication, interpersonal, organization skills.

2.5.4 Attainment Levels

Graduates of Brewing Science are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in Brewing and other allied industries in relation to national and societal needs.

2.5.5 **Resource Requirement for Teaching and Learning**

a) Academic and non-academic staff. (See section 1.6)
b) Academic and Non-Academic Spaces (See section 1.6)
c) Academic and Administrative Equipment (See Appendix)
d) Library and Information Resources (See section 1.6)

2.5.6 **Course Contents and Descriptions**

YEAR I
100 LEVEL COURSES

Course Code	Course Title	Units
GST 111	Use of English	2
GST 112	The Nigerian People and Culture	2
GST 114	Social Science	2
MTH 111	General Maths 1	4
PHY 111	General Physics 1 (Mechanics)	3
PHY 112	General Physics Laboratory 1	1
CHM 111	General Chemistry 1	4
BIO 111	General Biology 1	4
GST 121	Use of English II	2
GST 122	Introduction to logic and Philosophy	2
MTH 121	General Maths II	4
PHY 121	General Physics II (Introduction to Electricity and Magnetism	3
PHY 122	General Physics/Lab II	1
CHM 121	General Chemistry II	4
BIO 121	General Biology II	4
TED 112	Engineering Drawing	2
		44 Units

YEAR II
200 LEVEL COURSES

Course Code	Course Title	Units
BST 221	Introduction to Brewing Science	3
BST 222	Engineer-in-Society	1
MTH 221	Mathematical Method II	3
PHY 222	Electric Circuits and Electronics	3
CHM 222	Organic Chemistry II	3
BCH 221	General Biochemistry II	3
MCB 221	General Microbiology II	3
		19 Units

YEAR III
300 LEVEL COURSES

Course Code	Course Title	Units
BST 311	Introduction to Food Engineering	3
BST 312	Raw Materials in Brewing	3
BST 313	Fundamentals in Food Processing	2
BST 314	Food Analysis	2
BCH 311	Metabolism of Carbohydrate and Lipids	3
BCH 312	Metabolism of Proteins and Nucleo Acids	3
GST 311	Application of Computer	2
MCB 311	Microbial Genetics	3
BST 321	Brewhouse Theory and Technology	3
BST 322	Fermentation	3
BST 323	Process Engineering I	3
BCH 321	Plant Biochemistry	2
BCH 323	Enzymology	3
STA 122	Statistics for Physical Sciences & Engineering Students	3
MCB 321	Industrial Microbiology	3
		41 Units

(Industrial Attachment – Long Vacation: Three Months)

YEAR IV
400 LEVEL COURSES

Course Code	Course Title	Units
BST 411	Quality Control I	3
BST 412	Bear Treatment & Packaging Technology	3
BST 413	Process Engineering II	3
BCH 412	Nutritional Biochemistry	3
BCH 413	Metabolic Regulations	2
BCH 417	Food Biochemistry	2
MCB 313	Microbial Physiology & Metabolism	3
BST 421	Industrial Attachment Ii (Six Months)	18
		36 Units

YEAR V
500 LEVEL COURSES

Course Code	Course Title	Units
BST 511	Quality Control II	3
BST 512	Brewery Calculations & Plant Design	2
BST 513	Wine-Making Technology	3
BST 514	Soft Drink-Making Technology	3
BST 515	Technical Writing and Presentation	1
MGT 316	Principles of Management	3
BST 520	Project	6
BST 521	Seminar (Research)	3
	Elective 1 (Free)	3
	Elective 11 (Restricted	3
		30 Units

*The Restricted Elective should be selected from the following
ACH 321 Environmental Chemistry 3
CSC 525 Post Harvest Physiology
and Storage Technology

COURSE DESCRIPTION

Course Description

15h (T): 45h (P)

BST 221 INTRODUCTION OT BREWING SCIENCE (2 Credit Hours)

Historical background of brewing process. Traditional brewing processes. Importance of beer. Beer production and world economy. Beer and health the metabolism of ethanol and its metabolic effects. Cereals in beer production.

Malting barely – selection, handling, storage stability and treatment. Modern brewing processes for beer, wines and potable spirits. Other uses of barley malt.

45h (T)

BST 222 ENGINEER-IN-SOCIETY (2 Credit Hours)

(i) Philosophy of Science
(ii) History of Engineering and Technology
(iii) Safety in Engineering and introduction to risk analysis
(iv) The role of engineer in Nation Building
(i) Invited lectures from professionals.

BST 311 INTRODUCTORY FOOD ENGINEERING (2 Credit Hours)

Units and dimensions, mass and energy balance. Fluid flow fluids in motion and flow patterns. Energy and momentum relationship. Flow of incompressible fluids in pipes and channels. Flow measurement. Heat transfer. Mass transfer. Liquid-solid separation (filtration, sedimentation). Evaporation. ("All topics using a unit operations approach, descriptive and problem solving methods to provide students with insight into the application of engineering concepts to the design of processes and equipment for food industry).

45h (T)

BST 312 RAW MATERIALS IN BREWING (3 Credit Hours)

Barley: Morphology of barley plant. The biochemistry of the grain. Nature of barley varieties. Classification of barley. The position of barley within the Graminae. Malting: Objectives of malting. Processes of malting – sleeping, gemination, kilning. Enzymatic reactions and biochemical changes occurring during malting. The technology of malt production.

TYPE OF MALT:

Brewing water: Composition, influence of solutes in water on brewing, treatment of brewing water. Adjuncts; selection, storage and handing especially, corn, rice, sorghum, sugars and syrups. Hops harvesting, storage, chemistry, products – extracts and pellets.

30h (T): 45 (P)

BST 313 FUNDAMENTALS IN FOOD PROCESSING (2 Credit Hours)

Basic methods of food processing and preservation: Processing – materials handing, sorting, cleaning, grading, size reduction, dehydration, freezing, separation, mixing, concentration, and fermentation. Preservation – chemical, dehydration, drying, salt curing/pickling, blanching, smoking, freezing, irradiation.

15 (t): 45 H (p)

BST 314 FOOD ANALYSIS (2 Credit Hours)

The principles and application of analytical methods such as photometry, colorimetry, gravimetry, refractometry. Physical and chemical analysis of water and other major food components – carbohyfrates, fats, proteins, minerals; analyses for food colours, additives, tracementals, contaminants.

15 (T): 45 (P)

BST 321 BREW-HOUSE THEORY AND TECHNOLOGY (3 Credit Hours)

Purpose of brew-house operation; storage, handling and preparation of materials. Schematic layout of brew-house equipment. Milling system: Different types and operations. Principles of size refuction. Crushing – capacity and measurement crist composition.

Mashing. Objectives of mashing. Biochemistry of process. Types of equipment, mashing system and time – temperature schedules. Wort separation – lauter tuns, filters and other methods. Wort boiling and hoping. Wort cooling. High gravity brewing. Brewhouse economy.

Pre-requisite BST 312 45h (t)

BST 322 FERMENTATION (3 Credit Hours)

Objectives in fermentation.

Yeast. Nature of yeast, Histology of the yeast cell. Yeast cultures pitching yeast. Yeast infections. Biochemistry of fermentation: Changes from wort to beer, glycolysis, fermentation by-products. Yeast physiology and growth in batch culture and continuous culture. Brewery fermentation main fermentation rooms and vessels. Control and regulation of fermentation. Secondary fermentation. Maturation/conditioning. Problem fermentation – beer types.

Pre-requisite MCB 221 30h (T) 45h(P)

BST 323 PROCESS ENGINEERING (3 Credit Hours)

FLUID FLOW: Flow of incompressible non-Newtonian fluids in pipes; shear rate and pressure drop. Velocity distribution for a power law fluid in laminar and turbulent flow in a pipe. Drying of solids. Humidification (psychrometry).

STEAM GENERATION: PV diagram showing saturation and super saturation points. Enthalpy, Entropy, Simple problems involving enthalpy and entropy. Steam as a gas obeying boyle's Law. Steam tables and their uses. Mollier chart and how they are used. Gas processes. Power cycles **REFRIGERATION**: Reversible carnot cycle. Curves showing enthalpy of ammonia, freon 12, 22, etc and their uses, coefficient of performance. Tonnage of refrigeration.

Simple problems on refrigeration. Types and qualities of refrigerant COMPRESSORS: Introduction to compressible fluids. Gas laws. Adiabatic and polytropic expansions. Gas constants, simple problems involving gas constants. Introduction to compressors. Single stage compressor. Problem solving.

Carbon dioxide: Introduction to cryogenic properties of CO2 Dryness fraction of CO2 accustics, electricity, instrumentation and control.

Pre-requisite BST 311 45h (T)

BST 411 QUALITY CONTROL I (3 Credit Hours)

Sampling Test: Physical, chemical, biochemical and microbiological evaluation of brewhouse raw materials..

Germination tests for barley. Methods of prediction of the quality of barley for malting.

Wort composition and quality control. Physical and chemical analyses of beer. Shelf-life evaluation. Significance and control of oxygen in cellar operations. Quality control of containers, crowns and labels. Organoleptic methods of beer analysis. Taste testing panel. Gushing in beer.

Pre-requisite BST 311 45h (T)

BST 412 BEER TREATMENT AND PACKAGING (3 Credit Hours)

Beer stabilization methods, clarification and filtration techniques. Exclusion of air. Chilling carbonating. Container filling and sealing equipment and their operating principles. Pasteurization and other methods of beer sterilization. Maintenance of equipment and corrective measures for variances in packaged product quality.

Pre-requisite BST 321 45H (H)

BST 413 PROCESS ENGINEERING II (3 Credit Hours)

FLUID FLOW pumps and **PUMPING**. System heads. Centrifugal pumps. Positive displacement pumps. Factors influencing pump selection pump installation, maintenance. Pump seals and packing. Valves. Mixing of liquids in tacks. Mixers and mixing small blade-high speed agitators. Large blade-low speed agitators. Dimensionless groups for mixing. Power curves. Scale-up of liquid mixing systems. The purging of stirred tanks. Fluid motion in the presence of solid particles. Relative motion between a fluid and a single particle. Relative motion between a fluid and a concentration of particles. Fluidization. Slurry transport. Material handling and size reduction. Material of construction.

STEAM GENERATION: Types of boilers. Operation of boiler plant and its component parts. Feed water analysis and treatment. Types and calorific values of boiler fuel. Simple problem on air-fuel ratio. Smoke test of boilers practically. Bumers – types of burners and their characteristics. Maintenance of boiler plant.

REFRIGERATION: Composition of refrigeration plant – compressors, condenser, expansion valve, evaporator. Types of condensers-air-cooled, water-cooled. Cooling tower and how they function. Types of evaporators and their evaporating systems. Ammonia controls – automatic values, etc. types of defrosting methods. Maintenance of the fridge plant.

COMPRESSORS: Types of compressors and their characteristics. Double stage compressors. Compressor driers. Intercoolers, after coolers. Maintenance of compressors. Working of pressure release values.

Pre-requisite BST 323 45h (T)

BST 511 QUALITY CONTROL II (3 Credit Hours)

Microbial contamination in breweries. Yeast flocculation, yeast speculation and determination of yeast cell concentration. Detection of wild yeasts and respiratory deficient mutants. Gram stain and KOH techniques. Detection and identification of bacteria. Control of sanitation and infestation in the brewery. Statistical quality control with emphasis on useful simple statistics for both laboratory and production personnel. Purification of water. Effluent treatment.

Pre-requisite BST 411 and 30h (T) 45h (P)
MCB 221

BST 512 BREWING CALCULATIONS AND PLANT DESIGN (2 Credit Hours)

Brewhouse calculations – grist weight, wort volume, extract yield, hoping rate, time and energy utilization. Brewery plant lay-out. Construction and economics of process design and optimization techniques. Optimum design of modern brewing plants.

30h (T)

BST 513 WINE – MAKING TECHNOLOGY (3 Credit Hours)

History of wine making. Raw materials: Grapes, fruits, honey and sugar. Vinification or must treatment, pressing. Alcoholic fermentation; natural (spontaneous) fermentation and yeast culture fermentation, biochemistry of process. Role of oxygen. Cooling systems. Flavour compounds of wine aromas associated with grape varieties. Post fermentation operations; ageing and mellowing. Microbial stabilization, malo-lactic fermentation, microbial spoilage, hot-bottling, addition of sorbic acid, sterile filtration and sterile bottling. Sulphour dioxide addition dangers and safeguards. Wine types, table wines, fruit wines, honey wines (mead), fortified wines and flavoured fortified wines. Indigenous wine-making technologies e.g palm-wine, cocoa-wine, burukutu.

45h (T)

BST 514 SOFT DRINK–MAKING TECHNOLOGY (3 Credit Hours)

History of soft drink development. Classification of soft drinks – carbonated and non-carbonated. Important properties. Sweeteners-sucrose, malt and maltose syrups; sweeteners from starch, lactose and lactitol, fructose; syrups, sorbitol, mannitol ad xylitol; proptein and peptide based sweeteners. Planning and layout of soft-drinks factories. The polyester/glass bottle. Labeling of soft drinks containers. CIP and associated technology. Postmix dispensing technology. And packaging.

54h (T)

BST 515 TECHNICAL WRITING AND PRESENTATION (1 Credit Hour)

Principles of effective communication. Professional use of English Language principles of technical writing. Oral presentation of technical ideas. 15h (T)

2.6. B.Sc. Degree in Chemistry

2.6.1 Philosophy, Aims and Objectives of the Degree Programme

Chemistry is the index of industrial development. The giant strides made by man in the understanding and exploitation of nature, synthesis of new materials essential to the enhancement of the quality of life, and the surge in and sustenance of economic and technological progress have benefited immensely from chemistry. A degree programme in chemistry should foster in the undergraduate an appreciation of the centrality of chemical science to human well-being, as well as its inevitable linkage to, and interactions with, other branches of science.

A degree programme in chemistry should therefore aim to:

- Stimulate in the students sustained interest and enthusiasm in chemistry and applications
- Build in students a culture of continuing enquiry
- Provide students with a broad and balanced base of chemical knowledge and practical skills
- Develop in students a range of skills applied in chemical and non-chemical areas, that can provide confidence for employment
- Provide students with a solid base of chemical knowledge and skills that are required for postgraduate studies and research, and
- Inculcate in students an appreciation of chemistry in all human endeavours.

2.6.2 Admission and Graduation Requirement

The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, Chemistry to form the core course with credit in Physics, and any other relevant science subjects at the Senior Secondary School Certificate or its equivalent. In addition, an acceptable pass in the University.

Candidates with two A level passes (graded A-E) at the Advanced Level in one or more relevant subjects (Biology, Botany, Chemistry, Geography, Mathematics and Physics) may undertake the three – year degree programme into 200-level.

2.6.3 Learning Outcomes

All Bachelors honours degree student in Brewing Science are expected to develop the following abilities and skills:

a. *Regime of Subject Knowledge*
Cognitive abilities and skills relating to solution of problems in Chemistry and other allied chemical industries.

b. *Competencies and Skills*
Practical skills relating to the conduct of Laboratory work in Chemical Industries.

c. *Behavioral Attitudes*

General skills relating to non-subject specific competencies, communication, interpersonal, organization skills.

2.6.4 Attainment Levels

Graduates of Chemistry are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in Chemistry and other allied industries in relation to national and societal needs.

2.6.5 Resource Requirement for Teaching and Learning

a) Academic and Non-Academic Spaces (See section 1.6)
b) Academic and Administrative Equipment (See Appendix)
c) Library and Information Resources (See section 1.6)

2.6.6 Course Contents and Descriptions

YEAR l

100 LEVEL COURSES

Course No.	Course Title	Units
GES 101	Use of English	2
MTH 101	General Mathematics I	3
MTH 102	General Mathematics II	3
PHY 101	General Physics I	3
PHY 102	General Physics II	3
BIO 101	General Biology I	3
BIO 102	General Biology II	3
CHM 101	General Chemistry I	3
CHM 102	General Chemistry II	3
CHM 107	Practical Chemistry I	1
CHM 108	Practical Chemistry II	1
BIO 107	Practical Biology I	1
BIO 108	Practical Biology II	1
PHY 105	Practical Physics I	1
PHY 108	Practical Physics II	1
LBS 101	Library Studies	1
CSC 101	Introduction to Computer Science	3
		36 Units

And any 2 Units of courses from:
Biology, Mathematics, Workshop Practice, Graphics, Statistics and Computer Science.

YEAR II
200 LEVEL COURSES
CORE COURSES

Course No.	Course Title	Units
CHM 210	Physical Chemistry II	2
CHM 211	Organic Chemistry II	2
CHM 212	Inorganic Chemistry II	2
CHM 213	Analytical Chemistry I	2
CHM 214	Structure and Bonding	2
PHY 201	Electromagnetism and Atomic Physics	3
PHY 202	Electronics	3
MTH 201	Mathematical Methods	3
MTH 205	Linear Algebra II	2
GES 201	Communication Skills	3
EPS 201	Entrepreneurship Studies I	2
		26 Units

And any 4 Units of courses to be selected from the following:

PHY 207	Thermal Physics, Waves and Optics	3
PHY 201	General Physics V (Elementary Modern Physics)	3
PHY 206	General Physics VI (Energy and Environment)	1
MTH 207	Real Analysis I	2
STA 203	Statistics for Physical Science and Engineering	4
BCH 201	General Biochemistry I	3
BCH 202	General Biochemistry II	3
BIO 201	Genetics I	2
BIO 202	Introductory Ecology	2
BIO 203	General Physiology	1
BIO 204	Biological Technique	1
CSC 203	Introductory to Computer Systems	3
		28 Units

YEAR III
300 LEVEL COURSES
CORE COURSES

Course No.	Course Title	Units.
CHM 301	Physical Chemistry III	2
CHM 302	Inorganic Chemistry III	3
CHM 303	Organic Chemistry III	3
CHM 304	Atomic and Molecular Structure and Symmetry	3
CHM 316	Applied Spectroscopy	2
		13 Units

A minimum of 17 Units from the following courses:

CHM	305	Petrochemistry	2
CHM	306	Organometallic Chemistry I	2
CHM	307	Carbohydrate Chemistry	1
CHM	308	Natural Products Chemistry I	1
CHM	309	Chemical Physics	1
CHM	310	Polymer Chemistry I	2
CHM	311	Colour Chemistry & Technology	3
CHM	312	Instrumental Methods of Analysis	3
CHM	313	Applied Surface and Colloid Chemistry	1
BCH	311	General Biochemical Methods	2
CHM	317	Industrial Raw Materials Resource Inventory	1
CHM	318	Industrial Chemical Process I	2
CHM	319	Environmental Chemistry	2
CHM	320	Industrial Chemical Technology I	2
CS	202	Computer Programming II	2
EPS	301	Entrepreneurial Studies II	2

Any 2 units courses from Management, German, French or Russian

YEAR 1V
400 LEVEL COURSES

All the courses in Part IV (Fourth Year) are assigned to subject groups. To ensure a balanced course the student must take, in addition to the courses in Group A, at least 4 Units from each of the remaining groups B, C, D, and E. This gives a minimum total of 23 Units. The remaining 7 units can be chosen freely from the groups B, C, D, and E and the electives.

Group A: COMPULSORY COURSES

Course No.	**Course Title**	**Units**
CHM 400	Seminar	1
CHM 401	Research Project	6
CHM 449	Industrial Training	3

Group B: Physical and Theoretical Chemistry

CHM 402	Theory of Molecular Spectroscopy	2
CHM 403	Quantum Chemistry	2
CHM 404	Group Theory and Symmetry	2
CHM 405	Statistical Mechanics	1
CHM 406	Reaction Kinetics	2
CHM 407	Electrochemistry	2
CHM 408	Statistical Thermodynamics	2
CHM 409	Radio-Nuclear Chemistry	2

Group C: Applied Chemistry Course

CHM 410	Analytical Chemistry II	2
CHM 411	Polymer Chemistry II	2
CHM 412	Colour Chemistry and Technology II	2
CHM 413	Industrial Chemical Technology II	2
CHM 415	Polymer Technology	2
CHM 417	Industrial Chemical Processes II	2
BCH 412	Industrial Biochemistry	3
BCH 413	Pharm. Biochemistry	2

Group D: Organic Chemistry Course

Course No	Course Title	Units
CHM 418	Photochemistry and Pericyclic Reactions	2
CHM 419	Organic Synthesis	2
CHM 420	Organometalic Chemistry II	2
CHM 421	Heterocyclic Chemistry	2
CHM 422	Physical Organic Chemistry	2
CHM 423	Natural Products Chemistry II	2

Group E: Inorganic Chemistry Course

Course No.	Course Title	Units
CHM 424	Co-ordination Chemistry	2
CHM 425	Non-aqueous Solvents	1
CHM 426	Chemistry of Lanthanides and Actinides	1

General Elective Courses

Material Science
Systems and Control Engineering
Management II
German, French or Russian

COURSE DESCRIPTION
Chemistry Programme

CHM 101 General Chemistry I: (3 Units) (L 45: P 45: T 15)

Atoms, molecules and chemical reaction; Chemical equations and stoichiometry, Atomic structure and periodicity; Modern electronic theory of atoms; Radioactivity; Chemical bonding; Properties of gases; Equilibria and Thermodynamics; Chemical Kinetics; Electrochemistry.

CHM 102 General Chemistry II: (3 Units) L 45: P 45: T 15]

Historical survey of the development and importance of Organic Chemistry; Nomenclature and classes of organic compounds; Homologous series; Functional groups; Isolation and Purification of organic compounds; Qualitative and quantitative organic chemistry; Stereochemistry; Determination of structure of organic compounds; Electronic theory in organic chemistry; Saturated hydrocarbons; Unsaturated hydrocarbons. Periodic table and Periodic Properties; Valence Forces; Structure of solids. The Chemistry of selected metals and non-metals. Qualitative analysis.

CHM 210 Physical Chemistry II: [2 Units] [L 15: P 30: T0]

Pre-requisite -CHM 101

Kinetic theory of gases; Behaviour of real gases; The law of thermodyamics; Entropy and free energy; Reactions and Phase equilibria; Reaction rates; Rate laws; mechanism and theories of elementary processes; photochemical reactions; Basic electrochemistry.

CHM 211 Organic Chemistry II: (2 Units) (L 15: P 30: T 0)

Factors affecting structure and physical properties of organic compounds; Factors availability of electrons; Stereochemistry. Methane, energy of activation and free radical substitution reactions in alkanes. Functional group chemistry. Electrophilic and Nucleophilic substitution reaction. Aromacity. Various organic reactions, e.g. addition free radical, elimination reactions, etc.

CHM 212 Inorganic Chemistry II: (2 Units) (L 15: P 30:T0):

Pre-requisite -CHM 102

Chemistry of First row transition metals. Introduction to co- ordination chemistry including elementary treatment of crystal field theory. Comparative Chemistry of the following elements: (a) Ga, In, TI, (b) Ge, Sn, Pb, (c) As, Sb, Bi (d) Se, Te, Po.

Elementary introduction to Organometalic Chemistry. Role of metals in biochemical Systems.

CHM 213 Analytical Chemistry I: (2 Units) (L 15: P 30: T0)

Pre-requisite -CHM 101 and 102

Theory of Errors; and statistical treatment of data: Theory of sampling. Chemical methods of analysis including volumetric, gravimetric and physiochemical methods, Optical methods of analysis; separation methods.

CHM 214 Structure and Bonding: (2 Units) (L 30: P 0: T 0) .

Pre-requisite -CHM 101 and 102
Idea of quantum states, orbitals, shape; and energy. Simple valence theory, electronrepulsion theory, atomic spectra. Methods of determining molecular shape, bound lengths and angles. The structure and chemistry of some representative main group element compounds.

CHM 301 Physical Chemistry III: (2 Units)(L 15: P 30: T 0).

Pre-requisite -CHM 210
A review of Gibbs Function. Chemical thermodynamics. Introduction to statistical thermodynamics. Ideal solutions. Non-Ideal solutions. Properties of electrolytes. Colligative Properties.

CHM 302 Inorganic Chemistry III: (3 Units) (L 30: P 15: T 0)
Pre-requisite -CHM 212
The Noble gases. Hydrogen. Electronic structure and general properties and comparative study of Group IA and group IIA elements. Chemistry of Boron; Carbon and Silicon; Nitrogen and Phosphorus; Oxygen and Sulphur. The Halogens. Transition elements. Separation of metals. Co-ordination Chemistry. Ligand and Crystal field theories. Introduction to Radiochemistry. Radioactivity and the periodic table.

CHM 303 Organic Chemistry III: (3Units) (L 30:P15:T 0)

Pre -requisite -CHM 211
Alcohols and their reactions. Ethers and Epoxides. Carboxylic acids and their derivatives. Aldehydes and Ketones. Carbanion I and β unsaturated compounds. Carbanion II. Amines; Aromatic and Alicyclic chemistry. Polyfunctional compounds. Heterocyclic Chemistry.

CHM 304 Atomic and Molecular Structure and Symmetry (3 Units) (L 45: P 0: T 0)
Pre-requisite -CHM 214
Schroedinger 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 distomic molecules. Simple pielectron theory, Huckel theory. Walsh rules. Rotational, Vibrational and Electronic Spectra. Applications for determining bond lengths and angles. Brief mention of other methods. Atomic spectra Russel Saunders Coupling, Orbital and spin angular momentum. Use of symmetry in Chemistry.

CHM 305 Petrochemistry: (2 Unit) (L 30: P0: T 0)

Petroleum in the contemporary energy scene. Nature, classification and composition of crude petroleum and natural gases. Distribution of petroleum and natural gases

resources (the global and Nigerian situations). Petroleum technology Survey of refinery products and process. Petrochemicals in industrial raw materials. Prospects for the petrochemical industry in Nigeria. Prospects for the petrochemical Industries in Nigeria & LNG.

CHM 306 Organometalic Chemistry I: (2 Unit) (L 30: P 0: T 0)
Pre-requisite -CHM 211
Classification of Organometallic compounds. Preparation, structure and reactions including abnormal behaviour of organometallic compound. Synthetic utility of organometallics. Generation and detection of free-radicals free Organometallic compounds.

CHM 307 Carbohydrate Chemistry: (1 Unit) (L 15: P 0: T 0)

Classification, structure and nomenclature. Sugars. General reaction, preparations and reaction mechanisms Configurations. Empimerization.

CHM 308 Natural Products Chemistry: (1 Unit) (L 15: P 0: T 0)

Terpenoids, carotenoids, steroids, alkaloids and Lipids.

CHM 309 Chemical Physics: (1 Unit) (L 15: P 0: T 0)

Theory of bonding in H_2^+ and H_2. Rotation and vibration of molecules. Heat capacities of crystals.

CHM 310 Polymer Chemistry 1: (2 Units) (L 15: P 15: T 0)

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

CHM 311: Colour Chemistry and Technology: (3 Units) (L 30: P 15:T 0)
Colour and constitution. Chemistry, properties of dyes and pigments. Classification of dyes and fibres. Dyeing mechanisms. Preparation and dyeing of natural and synthetic fibres. Colour fastness properties. Quality control procedures and the colouration industry. Paints, Inks-classification, Preparation and uses.

CHM 312: Instrumental Methods of Analysis: (3 Units) (L 30: P 15 T 0)
Spectroscopic techniques. Quantitative analysis. X-ray methods. Flurorescence methods. Nuclear Magnetic resonance and Electron spin resonance. Refractometry and Interferometry Polarimetry Polarography Calorimetry.

CHM 313: Applied Surface and Colloid Chemistry: (1 Unit) (L 15: P0:T0)

Some general principles relating to surfaces. Electrical potentials. Attractive forces. Solid gas interface and solid liquid interface. Definition of colloid and history of colloid development. Types of colloids. Polymers, Proteins, Gels, Association colloids, Detergency.

CHM 316: Applied Spectroscopy: (2 Units) (L 30: P 0: T0)

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

CHM 317; Industrial Raw Materials Resource Inventory: (1 Unit) (L15: P0:T0)

Survey of Nigeria's industries and their raw material requirements. Mineral chemistry. Fossils and their uses. Plant and animal products. Nuclear, Solar and hydrodynamic sources of energy. Potentials and applications of locally available raw materials as industrial feedstocks.

CHM 318: Industrial Chemical Processes I: (2 Units) (L 30: P 0: T0)

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

CHM 319: Environmental Chemistry: (2 Units) (L30:P0:T0)

Concepts of elementary cycles. Characteristics of the atmosphere. Sources, types and effects of environmental pollution. Waste water treatment. Composition of domestic/industrial wastes and waste management. Water chemistry and analysis. Chemical and Physical instrumentation in environmental Sciences. Introduction to Environmental Impact Assessment.

CHM 320 Industrial Chemical Technology I: (2 Units) [L30: P0: T0]
Heat transfer and Mass transfer processes. Unit operations. Chemical technology equipment.

CHM 402 Theory of Molecular Spectroscopy: (2 Units) (L 30: P 0: T0) Pre-requisite -CHM 301, 304, 316
Quantum theory of rotation and vibration. Theory of microwave, IR, Raman, UV, Visible and NMR spectroscopy. General introduction to electron spin resonance, Mossbauer effect, nuclear quadrupole resonance and other modern techniques.

CHM 403 Quantum Chemistry: (2 Units) (L 30:'P 0: T 0)

Pre-requisite -CHM 304
Postulates of Quantum mechanics; operators; angular momentum solution of the hydrogcn atom problem. Theory of atomic spectra. Self-consistent Field theory. Computational aspects. Pertubation and variation methods.

CHM 404 Group Theory and Symmetry: (2 Units) (L 30: P 0: T 0)
Review of molecular symmetry operations. Definition of groups. Molecular symmetry groups. Introduction to the mathematical structure of groups. Group representations. Detailed study of groups Cn, Dn, Coov and full rotation group. Applications. General symmetry applications. Symmetry of crystal lattices, Block orbitals for infinite system.

CHM 405 Statistical Mechanics: (1 Unit) (L 15: P 0: T 0)

Pre-requisite -CHM 301
Maxwell-Doltzmann statistics; calculation of thermodynamic properties; partition functions; heat capacities; entropy; equilibrium constants; use of spectroscopic datal transition state theory; quantum effects.

CHM 406 Reaction Kinetics: (2 Units) (L 30: P 0: T 0)

Pre-requisite -CHM 301
Review of first, second and third order rate equations. Rate constants and equilibrium constants. Collisien theory, transition state theory, reaction co-ordinates. Unimolecular reaction theory, bimolecular reaction mechanisms, chain reaction mechanisms; catalysis and heterogenous reactions. Photochemical reaction mechanisms.

CHM 407 Electrochemistry: (2 Units) (L 15: P 15: T 0)

Pre-requisite -CHM 301
Electrical double layer, potential at zero charge, polarizable and non-polarizable interface, mass transport, concentration polarization, Fick's Laws, Levic equation. Electrodics. Polargraphy. Corrosion – types and prevention.

CHM 408 Statistical Thermodynamics: (2 Units) (L30: T 0)

Microstates and randomness; esembles; probability and distribution functions; the Boltzmann distribution; statistical thermodynamics of gases; the calculation of thermodynamic equilibrium constant from partition function; statistical thermodynamics of monatomic solids; introduction to Fermi-Dirac and Dose-Einstein statistics.

CHM 409 Radiochemistry and Nuclear Chemistry (2 Units) (L 30; P 0: T0)

Pre-requisite -CHM 302
Natural radioactions, fusion, fission, decay processes, nature of radiation. Nuclear models, energetics of nuclear reaction. Principles and measurement of radioactivity. Applications of radioactivity. Radiation hazards.

CHM 410 Analytical Chemistry II: (2 Units) L 15: P 15: T 0)

Pre-requisite - CHM 301 –
Theory of Error Potentiometric and pH methods. Conducto-metric methods. Electroanalytical Methods Amperometric, Colometric methods of analysis. Coupled, methods of analysis, GC-MS. Sampling and Sample Pre-treatment. Radio-chemical methods, Chromatography.

CHM 411 Polymer Chemistry II: (2 Units) (L 15: P 15: T0)

Pre-requisite -CHM 310
Polymerisation mechanisms; detailed treatment of addition polymerisation. Stereospecific polymerisation. Copolymensation. Phase systems for polymerisation. Industrially important thermoplastic and thermosetting polymers: Polyurethanes. Rubber elasticity. Mechanical properties of polymers. Analysis and testing of polymers. Degradation of polymers.

CHM 412 Colour Chemistry and Technology II: (2 Units) (L 15: P 15: T0)

Pre-requisite -CHM 311
The chemistry and theory of dyeing. Chemistry and application of reactive dyes. Preparation and dyeing of man-made fibres. Dyeing machineries. Printing. Colouring matters for food, drugs and cosmetics. Dyes used in paper industry and colour photography.

CHM 413 Industrial Chemical Technology II: (2 Units) (L 30: P 0: T0) Pre-requisite -CHM 320
Hydrogen and carbon monoxide synthesis, gas, oxoprocess, water gas, source of hydrogen and its application. Industrial organic materials, Raw materials, Technical and economic principles of processes and product routes. Flow diagrams. Selected oils and fats, soaps and detergents, sugar, varnishes, plastics, woodpulp and paper. Environmental pollution.

CHM 415 Polymer Technology: (2 Units) (L 15: P 15: T0)

Pre-requisite -CHM 310 Co-requisite CHM 411
Large scale industrial polymerisation processes. Polymer Tech. Polymer processing, injection, extrusion, compression and transfer moulding of thermoplastics. Polymer additives. Polymeric surface coatings and adhesives.

CHM 417 Industrial Chemical Processes II: (2 Units) (L 30: P0: T0)

Pre-requisite -CHM 302
Chemical processing of minerals. Metallurgy and hydrometallurgical processes. Industrial electrochemistry. Manufacture of some heavy inorganic chemicals. Cement and binding materials. Inorganic fertilizers.

CHM 418 Photochemistry And Pericyclic Reaction: (2 Units) (L30: P0: T0)

Pre-requisite -CHM 303
Interaction of radiation with matter, electronic excitation, selection rules, deactivation routes, sensitisation, quanching, photofragmentation, oxidation, reduction, rearrangement, pericyclic reactions and molecular orbital symmetry.

CHM 419 Organic Synthesis: (2 Units) (L 15: P 15: T0)
Pre.requisite -CHM 303
Critical review of important reaction, reagents, methods including the mechanisms. Applications for synthesis of important and complex organic compounds.

CHM 420 Organometallic Chemistry II: (2 Units) (L 30: P 0: T0)

Pre-requisite -CHM 302 and 306
Introduction to Organometallic compounds of the transition elements. Classification of ligands electron rule, bonding, preparation of organic transition metal compounds. Reaction and structures of Organometallic compounds of transition elements. The organic chemistry of Ferrocene and related compounds. The role of organometallic compounds in some catalytic reaction.

CHM 421 Heterocyclic Chemistry: (2 Units) (L 30:P0: T0)

Pre-requisite -CHM 303
The Synthetic and mechanistic aspects of fused heterocyclic system -particularly Quinolines, Iso-quinolines, Benzofurans, Benzothiophenes, Indoles, Genzopyrylium salts, Coumarius and Chromones. Application of heterocyclic systems in drug synthesis.

CHM 422 Physical Organic Chemistry: (2 Units) (L 30: P0: T0)

Pre-requisite -CHM 303 and 308
Preparation and reactions of steremisomers, Stereoselectivity, Neighbouring group effects, and a few special topics in Physical organic Chemistry. Conformational Analysis.

CHM 423 Natural Products Chemistry II: (2 Units) (L 30: P0: T0)

Pre-requisite -CHM 303 and 308
Chemistry of terpenoids, steroids, and alkaloids, antibiotics, flavonoids. Prostaglandins and chlorophylls. Other natural products of pharmaceutical Importance. General methods of Isolation, separation, purification and structural

determination of the natural products. Classifications. Discussion of chemistry of important members; Biogeneses.

CHM 424 Co-Ordination Chemistry: (2 Units) (L 30: P 15: T0)

Pre-requisite -CHM 302
Definition, Recognition and Applications of Co-ordination compounds. Nomenclature, Co-ordination formula and Isomerism in complexes. Stereochemistry of complex molecules; Theories of structure and bonding. Physical methods of structural investigation. Magnetic properties. Absorption and Vibrational spectra. The spectrochemical series. The Nephelauxetic series and the John-Teller distortions. Stabilisation of unusual oxidation states by complex formation. Thermodynamic stability of complex compounds, the stability constant, the chelote effect. Preparation and reactions of complexes. Kinetics and Mechanisms.

CHM 425 Non-Aqueous Solvents: (1 Unit) (L 15: P0: T0)

Pre.requisite -CHM 302
Classification and General Characteristics, solute-solvent interaction. Protonic solvents. Oxyhalide solvents. Liquid halides. Divitrogen tetroxide, sulphur dioxide. Leveling effects, non-aqueous titrations.

CHM 426 Chemistry Of Lanthanides And Actinides: (1 Unit) (L 15: P 0: T0)

Pre-requisite -CHM 302
The elements and the position of the two series in the periodic table. Comparison of the two series. Lanthanides contractions

The electronic configuration and their sequences on oxidation states, size relationship, magnetic properties and colour. Chemical properties and structure of the elements and their compounds. Recovery and separation of the elements. Uses of Lanthanides and Actinides.

2.7 B.Sc. Computer Science Degree

2.7.1 Philosophy, Aims and Objectives of the Degree Programme

The purpose, aims and objective of bachelors honours degree programme in computer science should include:

- To create in students the awareness of and enthusiasm for computer science and its capabilities.
- To involve the students in an intellectually stimulating and satisfying experience of learning and studying
- To provide a broad and balanced foundation in computer science knowledge and practical skills.
- To develop in students through an education in computer science a range of transferable applicable skills of information technology to all aspects of human endeavours.
- To generate in students an appreciation of the importance of computer in an industrial, economic, technological and social context.
- To provide students with knowledge and skills base for further studies in computer science or multi-disciplinary studies involving computer science.

2.7.2 Admission and Graduation Requirement

The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, Physics to form the core subjects with credit in any other two relevant science subjects, at the Senior Secondary School Certificate or its equivalent. In addition, an acceptable pass in the University.

Candidates with two A level passes (graded A-E) at the Advanced Level in one or more relevant subjects (Chemistry, Mathematics and Physics) may undertake the three – year degree programme into 200-level.

2.7.3 Learning Outcomes

a) *Regime of Subject Knowledge*

Each institution providing degree programmes in Computer Science is free, within the context of university autonomy and academic freedom to decide on the content, nature and organization of its courses and modules. However, it is expected that all programmes will ensure that students are conversant with the core areas of computer science:

b. *Competencies and Skills*

Students are expected to develop a wide range of different abilities, dynamism and skills.

These may be divided into three categories, viz.

Cognitive Abilities and Skills
Practical Skills
General Skills

c. *Behaviourial Attitudes*

General skills relating to non-subject specific competencies, communication, interpersonal, organization skills.

2.7.4 **Attainment Levels**

Graduates of Cmputer Science are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in Computer Science, development of relevant ICT for national development and societal needs.

2.7.5 **Resource Requirement for Teaching and Learning**

a) Academic and Non-Academic Spaces (See section 1.6)
b) Academic and Administrative Equipment (See Appendix)
c) Library and Information Resources (See section 1.6)

2.7.6 **Course Cntents and Description**

YEAR I
100 LEVEL COURSES

Courses	**Title**	**Units**
CSC 101	Introduction to Computer Science	3
CSC 102	Introduction to Problem Solving	3
MAT 101	General Mathematics I	3
MAT 102	General Mathematics II	3
MAT 103	General Mathematics III	3
PHY 101	General Physics I	3
PHY 102	General Physics II	3
PHY 105	General Physics III	1
BIO 101	General Biology I	3
CHM 101	General Chemistry I	3
GES 101	Use of English	2
LIB 101	Library Skills	1
		31 Units

Electives
6 Units to be selected from Mathematics and Physics Courses.

YEAR II
200 LEVEL COURSES

Courses	**Title**	**Units**
CSC 201	Computer Programming I	3
CSC 202	Computer Programming II	3
CSC 218	Foundation of Sequential Program	3
CSC 204	Fundamentals of Data Structures	3
CSC 205	Operating Systems I	3
CSC 208	Discrete Structure	3
CSC 212	Computer Hardware	3
CSC 218	Foundations of Sequential Programme	3
MAT201	Mathematical Methods	3
PHS 201	Electronics	3
CSC 299	Industrial Training	3
EPS I	Entrepreneurship Studies I	2
GES 201	Communications Skills	2
		36 Units

Electives
8 Units to be selected from MATH 204, Linear Algebra I (3 units)
MATH 205, Linear Algebra II (3 units)
PHS 201 Modern Physics (3 units)
and Statistics courses

YEAR III
300 LEVEL COURSES

Courses	Title	Units
CSC 301	Structured Programming	3
CSC 302	Object-Oriented Programming	3
CSC 310	Algorithms and Complexity Analysis	3
CSC 305	Operating Systems II	3
CSC 314	Architecture and Organization I	3
CSC 315	Architecture and Organization II	3
CSC 304	Data Management I	3
CSC 316	Compiler Construction I	3
CSC 321	Systems Analysis and Design	3
CSC 332	Survey of Programming Language	4
CSC 333	Computational Science & Numerical Methods	3
CSC 308	Formal Methods and Software Development	3
CSC 399	Industrial Training II	3
EPS 301	Entrepreneurship Studies II	2
		42 Units

Electives

6 Units from	CSC 331 – Operations Research	-	3
	CSC 334 – Numerical Analysis	-	3
	CSC 335 - Statistical Computing	-	3
	CSC 306 – Theory of Computing	-	3

YEAR IV
400 LEVEL COURSES

Courses	Title	Units
CSC 403	Software Engineering	4
CSC 404	Data Management II	3
CSC 421	Net-Centric Computing	3
CSC 401	Organization of Programming Languages	3
CSC 411	Arficial Intelligence	3
CSC 441	Human Computer Interface	2
CSC 423	Computer Networks/Communications	3
CSC 499	Project	6
		27 Units

Electives

9 Units to be selected from	CSC 416	Compiler Construction II	3
	CSC 433	Computer Graphics and Visualisation	2
	CSC 482	Modeling and Simulation	3
	CSC 461	Information Technology Law	2
	CSC 435	Optimization Techniques	3
	CSC 406	Queuing Systems Performance Evaluation	3
	CSC 422	Project Management	3
	CSC 405	Special Topics in Software Engineering	3
	CSC 408	Computer System Performance Evaluation	
	CSC 432	Distributed Computing System	3
	CSC 452	Formal Models of Computaion	3
	CSC 492	Special Topics in Computer Science	3

COURSE DESCRIPTION

CSC 101: INTRODUCTION TO COMPUTER SCIENCE: (3 Units) (L 30: P: 45)

History of Computer Science and their generations. Computer Hardware; functional components Modern I/0 units

Software: Operating Systems, Application Packages

Program: Development; Flow charts and algorithms; Program Objects
BASIC or VISUAL BASIC Fundamentals.

CSC 102: INTRODUCTION TO PROBLEM SOLVING: (3 Units)

Problem solving strategies, Role of algorithm in problem solving process, implementations strategies, concepts and properties of algorithm.

CSC 201: COMPUTER PROGRAMMING I (3 Units) (L30: P45)

Introduction to problem solving methods and algorithm development, designing, coding, debugging and documenting programmes using techniques of a good programming language style, programming language and programming algorithm development. A widely used programming language should be used in teaching the above. E.g. FORTRAN 92

CSC 202: COMPUTER PROGRAMMING II (3 Units) (L30:P45)

Principles of good programming, structured programming concepts, Debugging and testing, string processing, internal searching and sorting, recursion. Use a programming language different from that in CSC 201. e.g. C-Language

CSC 204: FUNDAMENTALS OF DATA STRUCTURES: (3 Units)

Primitive types, Arrays, Records Strings and String processing, Data representation in memory, Stack and Heap allocation, Queues, TREES. Implementation Strategies for stack, queues, trees. Run time Storage management; Pointers and References, linked structures.

CSC 205 OPERATING SYSTEM I (3 Units)

Overview of O/S: Role & Purpose, Functionality Mechanisms to Support Client-server
models, hand-held devices, Design Issues influences of Security, networking, multimedia, Windows.

O/S Principles: Structuring methods Abstraction, processes and of recourses,
Concept of APIS Device organization interrupts.

CSC 208 DISCRETE STRUCTURE (3 Units) (L 45: P 0)

Basic Set Theory: Basic definitions, Relations, Equivalence Relations Partition, Ordered Sets. Boolean Algebra & Lattices, Logic, Graph theory: Directed and Undirected graphs, Graph Isomorphism, Basic Graph Theorems, Matrices; Integer and Real matrices, Boolean Matrices, Matrices med m, Path matrices. Adjacency Vectors/Matrices: Path adjacency matrix, Numerical & Boolean Adjacency matrices. Applications to counting, Discrete Probability Generating Functions,

CSC 212 COMPUTER HARDWARE: (3 Units) (L 45: P 0)
Computer circuits; diode arrays, PIAs etc, Integrated circuits fabrication process.Use of MSI, LSI and VLSI IC' hardware Design. Primary and Secondary memories; core memory, etc. Magnetic devices; disks, tapes, video disks etc. Peripheral devices; printers, CRT's, keyboards, character recognition. Operational amplifiers; Analog-to-digital and Digital-to-analog converter.
Analog computers.

CSC 218 FOUNDATIONS OF SEQUENTIAL PROGRAM: (3units) (L45: P0)
The relationships between H/L languages and the Computer Architecture that underlies their implementation: basic machine architecture, assembles specification and translation of P/L Block Structured Languages, parameter passing mechanisms.

CSC 299 INDUSTRIAL TRAINING I: (5 Units) (3 months)
Require 3 months of Industrial Training. Students experience will be documented and presented in a Seminar.

CSC 301 STRUCTURED PROGRAMMING: (3 Units)
Structured Programming elements, structured design principles, abstraction modularity, stepwise refinement, structured design techniques. Teaching of a structured programming language etc.

CSC 302 OBJECT-ORINTED PROGRAMMING: (3 Units)
Basic OOP Concepts: Classes, Objects, inheritance, polymorphism, Data Abstraction, Tools for developing, Compiling, interpreting and debugging, Java Programs, Java Syntax and data objects, operators. Central flow constructs, objects and classes programming, Arrays, methods. Exceptions, Applets and the Abstract, OLE, Persistence, Window Toolkit, Laboratory exercises in an OOP Language.

CSC 304 DATA MANAGEMENT I: (3 Units)
Information storage & retrieval, Information management applications, Information capture and representation, analysis & indexing, search, retrieval, information privacy; integrity, security; scalability, efficiency and effectiveness.

Introduction to database systems:

Components of database systems DBMS functions, Database architecture and data independence use of database query language.
Text:

CSC 305 OPERATING SYSTEM II: (3 Units)
Concurrency: States & State diagrams Structures, Dispatching and Context Switching; interrupts; Concurrent execution; Mutual exclusion problem and some solutions Deadlock; Models and mechanisms (Semaphones, monitors etc.)
Producer – Consumer Problems & Synchronization.
Multiprocessor issues.
Scheduling & Despatching
Memory Management: Overlays, Swapping and Partitions, Paging & Segmentations Placement & replacement policies, working sets and Trashing, Caching.

CSC 310 ALGORITHMS AND COMPLEXITY ANALYSIS: (3 Units)
Basic algorithmic analysis: Asymptotic analysis of Upper and average complexity bounds; standard Complexity Classes Time and space tradeoffs in algorithms analysis recursive algorithms.

Algorithmic Strategies:

Fundamental computing algorithms: Numerical algorithms, sequential and binary search algorithms; sorting algorithms, Binary Search tress, Hash tables, graphs & its representation.

CSC 314: COMPUTER ARCHITECTURE I AND ORGANIZATION I (3 Units) (L45: P0)
Fundamental building blocks, logic expressive immunization, sum of product forms. Register transfer notation, Physical considerations. Data representation, and number bases, Fixed and Floating point systems, representation memory systems organization and architecture.
Text:

CSC 315: COMPUTER ARCHITECTURE AND ORGANIZATION II
Memory system, general; characteristics of memory operation. (Technology-magnetic recording semi-conductor memory, coupled devices, magnetic bubble). Memory addressing, memory hierarchy, virtual memory control systems. Hardware control, micro programmed control, Asynchronous control, i/c control. Introduction to the methodology of faulty tolerant computing.

CSC 316: COMPILER CONSTRUCTION I: (3 Units)
Review of compilers assemblers and interpreters, structure and functional aspects of a typical compiler, syntax semantics and pragatics, functional relationship between lexical analysis, expression analysis and code generation. Internal form of course programme. Use of a standard compiler (FORTRAN<COBOL/PL) as a working vehicles. Error detection and recovery. Grammars and Languages: the parsing problem. The scanner.

CSC 321: SYSTEMS ANALYSIS AND DESIGN: (3 Units) (L 30: P 45)
System Concept; System Development Life Cycle
Analysis: Fact gathering Techniques, data flow diagrams, Process description data modeling.
System Design: Structure Charts, form designs, security, automated Tools for design.

CSC 333: COMPUTATIONAL SCIENCE AND NUMERICAL METHODS
Operations research, Numerical Computation, Graphical computation, Modeling and simulation, High performance computation

CSC 332: SURVEY OF PROGRAMMING LANGUAGES (4 Units) (L 45: P 45)
Overview of programming languages: History of programming languages, Brief survey of programming paradigms (Procedural languages, Object-oriented languages, Functional languages, Declarative – non-algorithmic languages, Scripting languages), the effects of scale on programming methodology; Language Description: Syntactic

Structure (Expression notations, abstract Syntax Tree, Lexical Syntax, Grammars for Expressions, Variants of Grammars), Language Semantics (Informal semantics, Overview of formal semantics, Denotation semantics, Axiomatic semantics, Operational semantics); Declarations and types: The concept of types, Declaration models (binding, visibility, scope, and lifetime), Overview of type-checking, Garbage collection; Abstraction mechanisms: Procedures, function, and iterations as abstraction mechanisms, Parameterization mechanisms (reference vs. value), Activation records and storage management, Type parameters and parameterized types, Modules in programming languages; Object oriented language paradigm; Functional and logic language paradigms.

CSC 399: INDUSTRIAL TRAINING II (5 Units) (3 months)
Student's Industrial work experience of 3 months duration. Students reports will be presented in a seminar.

CSC 401: ORGANIZATION OF PROGRAMMING LANGUAGES: (3 Units)
Language definition structure. Data types and structures, Review of basic data types, including lists and tress, control structure and data flow, Run-time consideration, interpretative languages, lexical analysis and parsing. Pre-requisite – CSC 201, 202, 304, 302.

CSC 403: SOFTWARE ENGINEERING: (4 Units)

Software Design:	Software architecture, Design Patterns, O. O. analysis & Design, Design for re-use.
Using APIS:	API programming Class browsers and Related tools, Component based computing.
Software tools and Environment:	Requirements analysis and design modeling Tools, Testing tools, Tool integration mech.

CSC 404: DATA MANAGEMENT II (3 Units) (L 30: P 45)

Rational Databases:	Mapping conceptual schema to relational Schema; Database Query
	Languages (SQL) Concept of Functional dependencies & Multi-
	Valued dependencies.
	Transaction processing; Distributed databases.
Text:	CJ Date.

CSC 405 : SPECIAL TOPICS IN SOFTWARE ENGINEERING (3 Units) (L30 : P 45)
Topics from process improvement ; software re-engineering configuration management ; Formal spécification, software cost – estimation, Software Architectue, Software patterns, Software Reuse and Open source development.

CSC 406 QUEUING SYSTEMS: (L 30: P0: T 0)
Introduction; Birth-death queuing systems; Markovian queues, the queue M/GI bounds, inequalities and approximations.

CSC 407 : SPECIAL TOPICS IN SOFTWARE ENGINEERING
(3 Units) (L 30: P 45)
Topics from process improvement; software re-engineering configuration management; Formal specification, software cost – estimation, Software Architecture, Software patterns, Software Reuse and Open source development.

CSC 408: COMPUTER SYSTEM PERFORMANCE EVALUATION
Measurement techniques, simulation techniques; techniques, workload characterization, performance evaluation in selection problems, performance evaluation in design problems, evaluation of programme performance.

CSC 411: ARTIFICIAL INTELLIGENCE: (3 Units)
Introduction to artificial intelligence, understanding natural languages, knowledge representation, expert systems, pattern recognition, the language LISP.

CSC 416: COMPILER CONSTRUCTION II (3 units) (L 45: P 0)
Grammars and languages, recognizers, Top-down and bottom-up language Run-time storage Organization, The use of display in run-time storage Organization. The use of display in run time storage allocation. LR grammars and analysers. Construction of LR table. Organisation of symbol tablets. Allocation of storage to run-time variables. Code generation. Optimisation/Translator with systems.

CSC 421: NET-CENTRIC COMPUTING (3 Units) (45: P 0)
Distributed Computing, Mobile & Wireless computing, Network Security; Client/Server Computing (using the web), Building Web Applications.

CSC 422: PROJECT MANAGEMENT (3 Units) (L 30: P 45)
Team Management, Project Scheduling, Software meansurement and estimation techniques, Risk analysis, Software quality assurance, Software Configuration Management, Project Management tools.

CSC 423:COMPUTER NETWORKS/COMMUNICATION (Units) (L 30: P 45)
Introduction, wares, Fourier analysis, measure of communication, channel characteristics, transmission media, noise and distortion, modulation and demodulation, multiplexing, TDM FDM and FCM Parallel and serial transmission (synchronous Vs analynchronous). Bus structures and loop systems, computer network Examples and design consideration, data switching principles broadcast techniques, network structure for packet switching, protocols, description of network e.g. ARPANET, etc.

CSC 432: DISTRIBUTED COMPUTING SYSTEMS (3 Units) (L 30: P 45)
Introduction: Definitions, Motivation; Communication Mechanisms: Communication Protocols, RPC, RMI, Stream Oriented Communication; Synchronization: Global State, Election, Distributed Mutual Exclusion, Distributed Transactions; Naming: Generic Schemes, DNS, Naming and Localization; Replication and Coherence: Consistency Models And Protocols; Fault Tolerance: Group Communication, Two- And Three-Phase Commit, Check pointing; Security: Access Control, Key Management, Cryptography; Distributed File Systems: NFS, Coda etc.

CSC 433: COMPUTER GRAPHICS AND VISUALIZATION (2 Units) (L30**: P 45)**

Hardware aspect, plotters microfilm, plotters display, graphic tablets, light pens, other graphical input aids Facsimile and its problems Refresh display refresh huggers, changing images, light pen interaction. Two and three dimensional transformation, perspective Clipping algorithms. Hidden line removal bolded surface removal. Warmock's method, shading, data reduction for graphical input. Introduction to had writing and character recognition. Curve synthesis and fitting. Contouring. Ring structures versus doubly linked lists. Elerarchical structures. Data structure: Organization for intersotive graphics.

CSC 441: HUMAN-COMPUTER INTERFACE (HCI) (2 Units) (L30: P0)

Foundations of HCI, Principles of GUI, GUI toolkits;
Human-centred software evaluation and development;
GUI design and programming.

CSC 452 FORMAL MODELS OF COMPUTATION (3 Units) (L 30: P 45)

Automata theory: Roles of models in computation Finite state Automata, Push-down Automata, Formal Grammars, Parsing, Relative powers of formal models. Basic computability: Turing machines, Universal Turing Machines, Church's thesis, solvability and Decidability.

CSC 482: COMPUTER SIMULATIONS (3 Units) (L 30: P 45)

Basic Definitions and Uses, Simulation Process, Some basic statistic Distributions Theory, Model and Simulation. Queues; Basic components, Kendal notation, Queuing rules, Little's Law, Queuing networks, Special/types of queues. Stochastic Processes; Discrete state and continuous state processes, Markov processes, Birth-Death Processes, Poisson Processes. Random Numbers; types of Random Number Exercises.

CSC 492: SPECIAL TOPICS IN COMPUTER SCIENCE (3Units) (L 30: P 45)

Special topics from any area of computer science considered relevant at given time. Topics are expected to change from year to year. Apart from seminars to be given by lecturers and guests, students are expected to do substantial readings on their own.

CSC 499: PROJECT (6 Units)

Students should embark on work that will lead to substantial software development under the supervision of a member of staff.

2.8 B.Sc. Environmental Management and Toxicology

2.8.1 Philosophy, Aims and Objectives of the Degree Programme

The philosophy of the programme is in the training of Personnel to the highest academic standard in the identification and resolution of environmental issues. The programme will provide skilled manpower, trained specifically for environmental surveillance, monitoring and management as against the present practice where these tasks were performed by people trained in Basic and Applied Sciences.

The programme is designed to provide the training needed for an understanding of the environment and to build upon this foundation by exploring in some depths, specific aspect such as resource depletion, recycling, re-use and the impact of Science and Technology on the environment.

2.8.2 Admission and Graduation Requirements

Admission into the programme may be through any of the following modes:

* **UME**: Candidates who have successfully completed the Senior Secondary School or its equivalent and obtained five credits in Mathematics, English Language, Chemistry and Biology or Agricultural Science, in not more than two sittings and candidates must also have at-least a pass in Physics.

* **Direct Entry**: Candidates who fulfils above requirements and who have obtained G.C.E Advanced Level, HSC or equivalent passes in Biology and Chemistry. may be admitted at the 200 level of the programme.

* **Special Admission**: A candidate who fulfils normal admission requirements and in addition holds an ND or HND certificate (minimum upper credit) in Health Technology, Agriculture and other related fields, can be considered for admission into the programme at the appropriate level.

Transfer Cases: Candidates wishing to transfer from one programme to Environmental Management and Toxicology for some good reason(s) may be considered for absorption at the appropriate level. Any deficiencies in their background should be rectified by taking appropriate courses.

To qualify for the award of the degree of Bachelor of Environmental Management and Toxicology, a student:

(a) Must have spent minimum of 3,4 or 5 years on the programme depending on the year of entry.

(b) Must have passed all the University Compulsory courses.

(c) Must have passed all department and College Core courses and required elective.

(d) Should not have spent more than two years in excess of the prescribed minimum periods for the award of the degree.

(e) Should not have less than a CGPA of 1.0 at the end of the programme.

2.8.3 **Learning Outcomes**

a) *Regime of Subject Knowledge*

The degree will provide students with the knowledge and understanding required by today's Environmental Scientists, with career opportunities in Environmental Management, Environmental Toxicology, Research, Consultancy, Policy and Environmental Protection.

b) *Competencies and Skills*

The degree programme emphasis the importance of integrating Biology, Ecology, Chemistry, Physics, Geography etc, in other to understand the Science of human impact on the environment, and how these need to be applied within the context of social, legal and political frameworks to resolve some of the major environmental issues facing the world.

c) *Behavioural Attitude*

Graduates of Environmental Management are governed by their code of professional conduct of the professional body.
These attributes relate to:

The ability to discharge professional obligations to members of the public
Display of professional integrity
Competence with General Ethics
Compliance with the Regulation of Society
Participation in Professional Environmental Management

2.8.4 **Attainment Levels**

Graduates of Environmental Management and Toxicology are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in the environment relating to pollution, degradation and waste management.

2.8.5 **Resource Requirement for Teaching and Learning**

a) Academic and non-Academic Staff (See section 1.6)
b) Academic and Non-Academic Spaces (See section 1.6)
c) Academic and Administrative Equipment (See Appendix)
d) Library and Information Resources (See section 1.6)

2.8.6 **Course Contents and Descriptions**

100 LEVEL

FIRST SEMESTER

COURSE CODES	COURSE TITLES	U	L	T	P
BIO 101	Introductory Biology 1	2	2	-	-
BIO 103	Introductory Physiology 1	2	2	-	-
BIO 191	Biology Practical 1	1	-	-	1
CHM 101	Introductory Physical Chemistry	3	2	1	-
CHM 191	Practical Chemistry 1	1	-	-	1
MTS 105	Algebra Trig. for Biological Sciences	3	2	1	-
PHS 105	General Physics 1	3	2	1	-
PHS 191	Physics Laboratory 1	1	-	-	1
GNS 101	Use of English	2	2	-	-
GNS 103	Introduction to Social Problems	2	2	-	-
	TOTAL	20	14	3	3

SECOND SEMESTER

COURSE CODES	COURSE TITLES	U	L	T	P
AEM 102	Principles of Economics	2	2	-	-
BIO 102	Introductory Biology II	2	2	-	-
BIO 192	Biology Practical II	1	-	-	1
CHM 102	Introductory Organic Chemistry	2	2	-	-
CHM 104	Introductory Inorganic Chemistry	2	2	-	-
CHM 192	Practical Chemistry II	1	-	-	1
MTS 106	Calculus for Biological Sciences	3	2	1	-
PHS 106	General Physics II	3	2	1	-
PHS 192	Physics Laboratory II	1	-	-	1
GNS 102	Introduction to Nigerian History	1	1	-	-
	TOTAL	18	13	2	3

200 LEVEL

FIRST SEMESTER

COURSE CODES	COURSE TITLES	U	L	T	P
BIO 201	General Ecology	2	2	-	1
BCH 201	General Biochemistry	3	2	-	-
CHM 211	Basic Inorganic Chemistry I	2	1	-	1
CHM 221	Basic Organic Chemistry I	2	2	-	-
CHM 231	Basic Physical Chemistry I	2	2	-	-
CHM 291	Experimental Chemistry I	1	-	-	1
CSC 201	Computer Programming 1	3	2	-	1
EMT 201	Introduction to Environmental Sciences I	2	2	-	-
GNS 201	Literature in English	2	2	-	-
	TOTAL	19	15	-	4

SECOND SEMESTER

COURSE CODES	COURSE TITLES	U	L	T	P
BIO 206	General Physiology	2	1	-	1
CHM 212	Basic Inorganic Chemistry II	2	2	-	-
CHM 222	Basic Organic Chemistry II	2	2	-	-
CHM 232	Basic Physical Chemistry II	2	2	-	-
CHM 292	Experimental Chemistry II	1	-	-	1
EMT 202	Methods in Environmental Analysis I	3	3	-	-
GNS 202	Elements of Politics and Government	1	1	-	-
GNS 204	Logic and History of Science	2	2	-	-
	ELECTIVES	2	2	-	-
	TOTAL	17	15	-	2

ELECTIVES

COURSE CODES	COURSE TITLES	U	L	T	P
BCH 202	General Biochemistry II	3	2	-	1
WMA 202	Introductory Climatology and Biogeography	3	2	-	1
WMA 204	Elements of Hydrology	2	2	-	-
FIS 310	Oceanography	2	1	-	1

300 LEVEL

FIRST SEMESTER

COURSE CODES	COURSE TITLES	U	L	T	P
EMT 301	Principles of Natural Resources Management	2	2	-	-
EMT 303	Methods in Environmental Analysis II	2	2	-	-
EMT 307	Environmental Pollution Studies	2	1	-	1
EMT 309	Environmental Geosciences I	3	2	-	1
FWM 315	Remote Sensing and Mapping Techniques	3	2	-	1
FST 305	General Microbiology	3	2	-	1
STS 201	Elementary Statistics for Non-Majors	3	2	-	1
	ELECTIVES	2	2	-	-
	TOTAL	20	15	-	5

ELECTIVES

COURSE CODES	COURSE TITLES	U	L	T	P
EMT 305	Metals and the Environment	2	2	-	-
MCB 211	Introductory Biotechnology	2	2	-	-
BCH 307	Metabolism of Nucleic Acids	2	2	-	-
WMA 307	Water Resources of Nigeria	2	2	-	-
WMA 309	Agrometeorology I	3	2	-	1

SECOND SEMESTER

COURSE CODES	COURSE TITLES	U	L	T	P
EMT 300	Environment Ecosystem and Management	2	1	-	1
EMT 304	Hazardous Substance Management	2	2	-	-
EMT 306	Environment Impact Assessment	3	2	-	1
EMT 312	Entrepreneurial Studies I	2	2	-	-
PHS 364	Energy and Environment	1	1	-	-
SOS 312	Soil Chemistry and Soil Micro-Biology	3	2	-	1
EMT 320	Air Analysis	1	-	-	1
	Electives	5	5	-	-
	TOTAL	19	15	-	4

ELECTIVES

COURSE CODES	COURSE TITLES	U	L	T	P
EMT 308	Environmental Aspects of Pesticides and other Toxicants Usage	3	2	-	1
EMT 322	Landscape Studies and Planning	3	2	-	1
BCH 310	Introductory Toxicology	2	2	-	-
MCB 302	Microbial Genetics and Molecular Biology	3	2	-	1
FWM 304	Aerial and Ground Survey	3	2	-	1
FWM 306	Widelife and Ecology and Management	3	2	-	1

400 LEVEL (Environmental Management Option)

FIRST SEMESTER

COURSE CODES	COURSE TITLES	U	L	T	P
EMT 401	Environmental Monitoring System and Techniques	3	2	-	1
EMT 403	Environmental Aspect of Farming System	3	2	-	1
EMT 405	Environmental Education and Awareness	2	2	-	-
EMT 409	Soil Analysis	1	-	-	1
EMT 411	Water Analysis	1	-	-	1
EMT 415	Entrepreneurial Studies II	2	2	-	-
EMT 421	Rural and Urban Regional Planning	2	2	-	-
EMT 423	Human Environment	2	2	-	-
EMT 425	Environmental Auditing	2	2	-	-
	Electives	2	2	-	-
	TOTAL	20	16	-	4

ELECTIVES

COURSE CODES	COURSE TITLES	U	L	T	P
EMT 417	Scientific Writing and Presentation in Environmental Science	2	2	-	-
EMT 427	Geographic Information System (GIS)	2	2	-	-
EMT 429	Integrated Resources Management	3	2	-	1

400 LEVEL (Environmental Toxicology Option)

FIRST SEMESTER

COURSE CODES	COURSE TITLES	U	L	T	P
EMT 401	Environmental Monitoring System and Techniques	3	2	-	1
EMT 403	Environmental Aspect of Farming System	3	2	-	1
EMT 405	Environmental Education and Awareness	2	2	-	-
EMT 407	Principles of Toxicology I	3	2	-	1
EMT 409	Soil Analysis	1	-	-	1
EMT 411	Water Analysis	1	-	-	1
EMT 413	Experimental Pesticide Chemistry and Residue Analysis	1	-	-	1
EMT 415	Entrepreneurial Studies II	2	2	-	-
MCB 405	Environmental Microbiology	3	2	-	1
	Electives	2	2	-	-
	TOTAL	21	14	-	7

ELECTIVES

COURSE CODES	COURSE TITLES	U	L	T	P
EMT 417	Scientific Writing and Presentation in Environmental Science	2	2	-	-
MCB 406	Petroleum Microbiology	3	2	-	1
EMT 427	Geographic Information System (GIS)	2	2	-	-

SECOND SEMESTER

COURSE CODE	COURSE TITLES	U	L	T	P
EMT 499	Industrial Attachment	16	-	-	16

500 LEVEL (Environmental Management Option)

FIRST SEMESTER

COURSE CODES	COURSE TITLES	U	L	T	P
EMT 501	Environmental Law	2	2	-	-
EMT 507	Seminar	2	-	2	-
EMT 511	Ecological Disasters and Control	3	2	-	1
EMT 513	Environmental Biotechnology	2	2	-	-
EMT 521	Environment and Poverty	3	2	-	1
EMT 523	Environmental Health and Safety Management	3	2	-	1
	Elective	2	2	-	-
	TOTAL	17	12	2	3

ELECTIVES

COURSE CODES	COURSE TITLES	U	L	T	P
FRM 505	Forestry and Wildlife Policy, Law and Administration	2	2	-	-
WMA 401	Principles of Soil and Water Preservation	2	2	-	-
WMA 509	Water Quality Assessment	3	2	-	1

SECOND SEMESTER

COURSE CODES	COURSE TITLES	U	L	T	P
EMT 504	Waste Management	3	2	-	1
EMT 506	Human Settlement and Development	3	2	-	1
EMT 510	Conservation of Biology Diversity	3	3	-	-
EMT 512	Petroleum and Environment	2	2	-	-
EMT 599	Project	4	-	-	4
	Electives	3	3	-	-
	TOTAL	18	12	-	6

ELECTIVES

COURSE CODES	COURSE TITLES	U	L	T	P
EMT 520	Tourism and Recreation	3	3	-	-
EMT 522	Environment and Community Health	3	3	-	-

500 LEVEL (Environmental Toxicology Option)

FIRST SEMESTER

COURSE CODES	COURSE TITLES	U	L	T	P
EMT 501	Environmental Law	2	2	-	-
EMT 503	Principles of Toxicology II	2	2	-	-
EMT 505	Principles of Analysis of Toxicants	3	2	-	1
EMT 507	Seminar	2	-	2	-
EMT 509	Structural Elucidation of Organic Pollutant	3	2	-	1
EMT 513	Environmental Biotechnology	2	2	-	-
EMT 515	Radionuclides in the Environment	2	2	-	-
	Elective	2	2	-	-
	TOTAL	18	14	2	2

ELECTIVES

COURSE CODES	COURSE TITLES	U	L	T	P
EMT 523	Environmental Health and Safety Management	3	2	-	1
EMT 511	Ecological Disasters and Control	3	2	-	1
WMA 401	Principles of Soil and Water Conservation	2	2	-	-

SECOND SEMESTER

COURSE CODES	COURSE TITLES	U	L	T	P
EMT 504	Waste Management	3	2	-	1
EMT 512	Petroleum and Environment	2	2	-	-
EMT 514	Miscellaneous Techniques in Environmental Analysis	2	2	-	-
EMT 516	Separation Techniques in Environmental Analysis	2	2	-	-
EMT 518	Methods in Environmental Analysis III	2	2	-	-
EMT 599	Project	4	-	-	4
	Electives	3	3	-	-
	TOTAL	18	16	-	5

ELECTIVES

COURSE CODES	COURSE TITLES	U	L	T	P
EMT 506	Human Settlement and Development	3	2	-	1
EMT 510	Conservation of Biological Diversity	3	3	-	-
EMT 520	Tourism and Recreation	3	3	-	-
EMT 522	Environment and Community Health	3	3	-	-

COURSE DESCRIPTIONS

EMT 202: METHODS IN ENVIRONMENTAL ANALYSIS I (3 UNITS)

Review of Fundamental Concepts. Sampling techniques, statistical treatment, analytical data, accuracy, precision, errors, student's 'T' function, rejection of outliers. Gravimetric analysis: Types precipitate/crystal formation, contamination and appropriate handling precipitates/crystals, co-precipation, precipation from homogenous solution. Titrimetric analysis: Acid-base redox, complexometric, precipation non-aqeous titrations, indicators. Colorimetry: Spectrophotometric reagents, elementary visible spectro photometry: spectrophotometric titrations.

EMT 300: ENVIRONMENT, ECOSYSTEMS AND MAN (2 UNITS)

Population, community, ecosystem, environment and environmental factors. Study of communities and ecosystem, abundance, density, yield, cover, frequency. The ecology of niche, niche, overlap competition coexistency , resource shift. Habitats: The primary terrestrial and aquatic habitats which affect man. Alteration imposed on the habitats by man. Integration of ecology and environment into development planning. Ecological management. Ecodevelopment and integrated development. Environmental planning principles – inter-disciplinary not multidisciplinary, holistic, comprehensive, participative coordinated, integrated and continuous planning.

EMT 301: PRINCIPLES OF NATURAL RESOURCES MANAGEMENT (2 UNITS)

Natural resources types and origin, environment, resource and development; rational use of resources and concept of sustainable development. Management of forests, grazing, lands, soils, foods, minerals, etc. Community resource development, population and pressure on resource utilization, administration and management of natural resource in Nigeria. Resource economics and management. Environmental conservation – Protection of nature and conservation of species. Conservation of agricultural landscape. Case studies concerned with concepts of balanced approach to natural resources management. Development of planning and management principles of natural resources and ecosystem subject to increasing development processes.

EMT 304: HAZARDOUS SUBSTANCES MANAGEMENT (3 UNITS)

The nature, origin and classification of hazardous toxic substances; Characteristics of wastes and hazardous substance,. Identification of hazardous substances. Sources and pathways of hazardous substances. Disposal methods and technology of hazardous substance. Geological environmental factors affecting choice of disposal site; contamination of water bearing strata; soil, plants, food webs and bio-concentration. Analysis of hazardous and toxic substances. Regulations and law governing the sale, importation, transportation, storage and disposal of hazardous and toxic substances.

EMT 305: METAL AND THE ENVIRONMENT (2 UNITS)

ORIGIN OF METALS. Classification of metals., Utilisation of metals in industries. Sources of metal pollution; geological weathering, industrial discharge, metals fabricating and furnishing, leaching of metals from garbage, agricultural waste products. Effect of metals on the environment sediment, waste, air and food. Adverse effect of heaby metals – poisoning effects of Ph. Cd. Zn and Hg. Other

effects e.g. neurologic, and renal effects. Analysis of metals in environmental samples.

EMT 308: ENVIRONMENTAL ASPECTS OF PESTICIDE AND OTHER TOXICANTS USE (CM) (3 UNITS)

Movement and absorption of pesticides in soil. Factors affecting mobility of pesticides and other toxicants in the soil. Soil Herbicide interaction and herbicide efficacy. Famigant action and systematic activity. Pesticide conversion mechanisms in the environment. Enzymic and non-enzymic conversion, degradation of pesticides and other toxicants in soil, water, plants and in animals. Pesticides in food chains. Detection/determination and management of toxic wastes in the environment, sanitary fundamentals of pesticide application, safely measures in storage, dispensing, transportation and use of pesticides; disposal of pesticide containers and wastes ecological and environmental health effects. Environmental criteria standards, regulations on pesticidal hoe. Case studies of global disasters of misuse and abuse of pesticides.

EMT 401: ENVIRONMENTAL MONITORING SYSTEMS AND TECHNIQUES (3 UNITS)

Definition, general principles of environmental monitoring. Organisation of monitoring programmes for site and resource specific strategies. Classification of monitoring techniques and use (physical, chemical, biological radioactive) global sources, sinks and transport (mass balance) of both mand-made and natural atmospheric trace components, Ocean-atmosphere interactions, reversible effect of human activities on the global environment e.g. green house effect, climate change, depletion of stratosphere ozone layer, acid rain. Air pollution meteorology, chemistry and biology. Atmosphere dispersion models. Elements of air pollution control. Sampling and air monitoring techniques. Mechanism of pollutant interaction with soil and vegetation. General principles of biotesting, aquatic toxicity, types, bio, assays, data analysis and interpretation.

EMT 403: ENVIRONMENTAL ASPECTS OF FARMING SYSTEMS (3 UNITS)

- Farm systems and farming systems.
- The relevance of the farm-system approach
- Classification of farming systems
- Difficulties of farming systems
- Problems and peculiarities of shifting cultication
- Characteristics and problems of permanent upland cultivation
- Irrigation farming
- Enviromental and health implication of irrigation
- Perrenial crop farming
- Ranching
- Institutional and environmental requirements of site related systems.

EMT 405: ENVIRONMENTAL EDUCATION AND AWARENESS (2 UNITS)

Population and environment (responsible use). Role of educational intervention in environmental action. Methods of dissemination of environmental information; case studies of information to various target groups. Methods of public opinion assessment. Social theory for environmental psychology, ecological, psychology theory of participation, social response to environmental-pollution, environmental damage and compensation.

EMT 407: PRINCIPLES OF TOXICOLOGY 1 (3 UNITS)

History of toxicology, Biochemistry cellular and molecular toxicology. Biotoxins, carcinogenesis, tertratogenesis and mutagenesis/genetic toxiology, biotransformation of toxicants. Systematic toxicology, toxic responses of blood, liver, kidnery, respiratory systems, central nervous systems, skin, reproductive system, eye and the immune systems.

Practicals: Demonstration to topical application contract tests, systemic activity of pesticides. Acetycholinesterases inhibition in insects in VICO and in VITRO. Inhibition of egg hatch in nematodes and chitindeposition in insects.

Resistance tests in insects. Probit analysis. Effect of gamma irradiation on insect development studies. Effect of morphogenic agents on larval and pupa development in insects. Autoradiographic studies. Bioassay of resistant/susceptible strains of insects, audiovisuals. Pre-requisite BCM 201.

EMT 411: WATER ANALYSIS (1 UNIT)

Sampling and analysis of water for various biological and physico-chemical water quality parameters: PH, hardness, alkalinity, chlolride, phosphate, nature, ammonia, sulphate, sulphide, sulphite, fecal bacteria, etc. Determination of dissolved oxygen (D.O), chemical oxygen demand (COD), biochemical (BOD) dissolved and suspended solids, conductivity, turbidity, temperature, saturation index, sodium adsorption rationg, etc.,
Pre-requisite ERM 302.

EMT 413: **EXPERIMENTAL PESTICIDE CHEMISTRY AND RESIDUE ANALYSIS (1UNIT)**

Sampling, planning the sampling programme, sample containers, collection of various environmental samples –water solid sediments, vegetation, blood, milk, fish, investebrates birds, mammals, air etc.

Sample Preservation

Extraction and clean-up methods, instrumentation for pesticide analysis, use of gas chromatograph for determination of pesticide residues, Analytical quality assurance; recovery and precision studies. Pesticide formulation analysis. Experimental designs and field/green houses trials on effect of pesticide on (a) growth and yield of crops (b) control of pests and diseases. (c) insect resistance probit analysis. Screening of Nigerian herbs for pesticidal activities. Isolation and characterisation of active ingredients in Nigerian herbs. Maintenance, tgrouble shooting and calibration of instruments.

EMT 501: ENVIRONMENTAL LAW (2 UNITS)

Basic concept of environmental standard criteria and regulation. Federal environmental laws organisation of environment protection. States edict and regulation on the environment, plant and animal quarantine. Regulations and enforcement mechanisms, violations and sanctions. Comparative study of environmental laws in some advance countries. e.g. USA, Canada, Thiland, etc. International Laws and conventions.

Pre-requisite EMT 407

EMT 503: PRINCIPLES OF TOXICOLOGY II (2 UNITS)

Sources, fate and effects of different toxicants in the environment; pesticides, metals, radiation and radioactive materials, plan and animal toxins, polyhalogenated compounds, hazardous wastes, dusts, asbestos, plastics. Factors that influence toxicity, route of administration, chemical and biological factors. Environmental toxicology, food additives and contaminants, atmospheric, aquatic and soil pollutants. Clinical toxicology, cosmetics and drugs, occupational toxicology and health. Autoradiography. Toxicity testing. Future of toxicology in the developing countries i.e. regulatory and legal requirements.

EMT 504: WASTE MANAGEMENT (3 UNITS)

Types, nature and characteristics of toxicants, sampling of air, soil, water and other ecological materials particularly using a staplex sampler at different flow rates and other modern methods. Sample preservation and preparation techniques. Samples collection techniques of air, soil, water, food, blood etc. Analytical methods for toxicants. Instrumental neutron.

Activation analysis. Atomic absorption spectrophotometer UV/Visible spectrophotometer. Gas chromatograph hybrid methods e.g. GC/Mass spectrometer. Auto-analyzer chemical separation methods. Gas analyzers. Quality assurance of analytical data statistical treatment of data. Interpretation of data.

EMT 505: PRINCIPLES OF ANALYSIS OF TOXICANTS (3 UNITS)

Types and forms of wastes. Sources of waste. Methods of solid, liquid and gaseous wastes management technology including wastes recycling and utilization. Institutional arrangements for waste management. Environmental health effects of waste management. Economics of wastes management, wastes management strategies. Case studies.

EMT 506: HUMAN SETTLEMENT AND DEVELOPMENT (3 UNITS)

- Human settlements, size and density
- Factors influencing location, landscape designs, parks and reserves
- Rural, urban land use and environmental quality
- Culture and environment: patterns, health and safety
- Environmental ethics
- Impact of human settlement and development on the environment
- Case studies: examples of significant human settlements and developments projects and their environmental impacts.

EMT 507: SEMINAR (2 UNITS)
The purpose of this course is to familiarize the students with effective use of the library, preparation of project reports, papers for journal publication and journal reviews. Students will be given essays on topics of general interest from widespread areas of environmental management.

EMT 509: STRUCTURAL ELUCIDATION OF ORGANIC POLLUTANTS
Structural elucidation of organic pollutants, basic instrumentation and techniques. Applications of ur, ir, n, m, r, and m, s in chemical analysis and structural elucidation of organic pollutants.

EMT 511: ECOLOGICAL DISASTERS AND CONTROL (3 UNITS)
Ecological consequences of mismanagement of natural resources. Principles and practice of greebelt establishment in arid coastal areas. Origin causes of erosion. Erosion forecasting surface water management. Soil hydrology. Soil water movement. Drainage, leaching and water disposal. Economics and benefits of erosion control. Mechanics of erosion. Types and forms of erosion. Evapo-transportation. Erosion/food control measures, engineering and administrative measures.

EMT 512: PETROLEUM AND ENVIRONMENT
Origin and composition of crude oil, composition of refund oils; extent, sources fate and effects of oil in the environment.

Characteristic of biogenic and petrogenic hydrocarbons control of oil pollution. Oil pollution monitoring , sampling, sample containers, extraction, clean-up, identification and quantitation, oil tagging. Use of bio-indicators in oil pollution monitoring. Biomarkers.

EMT 514: MISCELLANEOUS TECHNIQUES IN ENVIRONMENTAL ANALYSIS (2 UNITS)
Miscellaneous advanced techniques in environmental analysis X-ray methods, neutron activation and radiochemical methods, enzymatic and kinetic methods, automated and process analyzers.

EMT 599: PROJECT (CR) (4 UNITS)
Investigation of an environmental research problem.

CHM 101: INTRODUCTORY PHYSICAL CHEMISTRY (3 UNITS)

Atoms, molecules and structures. Electronic configuration. Periodicity and building up of the periodic table. Periodicity and building up of the periodic table. Chemical reactions, chemical equiations and stoichiometry. Bonding and intermolecular forces. Kinetic theory of matter, derivation and calculation of all the laws involved. Theremochemistry and simple calculation based on Hess's law. Rate of reaction. Chemical equilibrium Oxidation – Reduction reaction. Chemical Kinetics, equilibra and released simple calculation. Important application of equilibra like, Solutbility. Solubility of ianic solids. Electrochemistry and workings of various cells Corrosion.

CHM 102: INTRODUCTORY ORGANIC CHEMISTRY (2 UNITS)
Tetravalency of carbon, structure, molecular composition and variety of carbon compounds. Functional group classes of carbon compounds. Functional group classes of carbon compounds. The chemistry of Alkenes and petroleum including ozonolysis, alkynes, benzene; alcohol including Phenols, others aldehyde, ketones, acids, amines and derivatives of these. Structure of simple sugars, starch and cellulose, peptides and protein. Synthetic polymers from various classes of compounds. Mechanisms of reactions discussed in all cases and used of compounds.

CHM 104: INTRODUCTORY INORGANIC CHEMISTRY (2 UNTIS)
Hybridization and shapes of simple molecules including carbon compounds. Extraction of the metals. Comparative Chemistry of group IA (alkali metals). IIA (alkaline earth metals) and IVA (carbon group) elements. Introduction to transition metal chemistry and nuclear chemistry. Acids, bases and salts.

CHM 211: BASIC INORGANIC CHEMISTRY I (2 UNITS)
Wave mechanical treatment of atomic structure, Periodicity and periodic table. Chemical bonding. Bonding theories; Valency bond theory molecular orbital theories. Inorganic Stereochemistry, Nomenclature of Inorganic compounds. Chemistry of group IIIA, (boron group), VA (Nitrogen group), noble gas. Introduction to first row transition metal chemistry.

CHM 222: BASIC ORGANIC CHEMISTRY II (3 UNITS)
PRE-REQUISITE – CHM 102
Methane, energy of activation and free radical substitution reaction in alkanes. Stereochemistry: Relative and absolute configurations. Racemization and resolution of racemic mixtures. Welden inversion, Geometrical isomerism, determination of configuration of geometrical isomers. Stereochemistry of amines and oximes.

Conformational analysis. Function Group Chemistry. Comparative study of functional groups. Alicyclic and aromatic hydrocarbons. Halogeno-hydrocarbons alcohols, phenols: Carbonyl compounds, acids and their derivatives, nitro, amino, and sulphur compounds. Organic Reaction: Electrophylic and nucleophilic substitution reactions. Aromaticity. Various organic reactions e.g. addition free radical elimination reactions.

CHM 231: BASIC PHYSICAL CHEMISTRY I (2 UNITS)
The kinetic theory of gases. Molecular velocities and their distribution. Heat capacity and the equipartition of energy. First law of thermodynamics, kirchoffs

equations, second law, computation of entropy for simple systems, free energy and spontaneity of reactions. Equilibrium constant. Vant Holf isochore, chemical potentials and definitions. Third law of thermodynamics and its applications. Partition. Law and phase equilibria.

BCH 201: GENERAL BIOCHEMISTRY (3 UNITS)

Principles of the chemical basis of life. The molecular basis of cellular structure – polysaccharides, lipids, proteins, nucleic acids. The cellular basis of life. Buffers, Acidity and alkalinity, pH and pKa values and their effects on cellular activities. Chemistry of carbonhydrates, lipids, amino acides and proteins, nucleic acids and nucleaoproteins. Enzymes and co-enzymes. Vitamins, (Pre-requisites: BIO 101, 102, CHM 101, 102, 104).

MCB 405: ENVIRONMENT MICROBIOLOGY (3 UNITS)

The microbial environment. Concepts in environmental microbiology. Microbial populations and community dynamics. Mirco-organisms in their natural environments. The terrestrial environment – the nature, chemical activities and methods of investigation of soil microflora, nitrogen fixation. The acquatic environment the microbiology of water supplies, water treatment water supply and public health – sewage and sewage disposal in the hot climates. Biodegradation of materials. The role of microbes in prospecting, recovery and degradation of petroleum products. Aero Biology, sources, importance and control of airborne micro-organisms.

BIO 201: GENERAL ECOLOGY (2 UNITS)

Aims and scope of ecology. Basic units of ecology (Population, community and ecosystem): Biotic and abiotic components of an ecosystem. Production in ecosystems. Energy flow and nutrient cycling. Dynamics of population and communities.

BIO 206: GENERAL PHYSIOLOGY (2 UNITS)

Metabolism and energy production. Circulatory system of animals. Homeostasis. Nervous and hormonal control of systems. Excretion and osmoregulation. A survey of the fundamental principles of plant physiology including photosynthesis respiration, cell-water relationship, mineral nutrition, nutrient uptake and deficiency, symptoms.

FWM 306: WILDLIFE ECOLOGY AND MANAGEMENT (3 UNITS)

Organisation of Wildlife Resources. Wildlife in relation to their environment. Factors affecting distribution and abundance of wildlife. Wildlife population characteristic of mortality, movement, lifecycles, food and food habits. Wildlife capture techniques: objectives traps and consideration for design: immobilization by drugs. Handy, care and feeding of captured animals field exercises of different capture methods.

FRM 505: FOREST AND WILDLIFE POLICY, LAW AND ADMINISTRATION (2 UNITS)

Forest, wildlife and related natural resources, policies, planning effective use of forest resources, structure of wildlife administration, problems of conserving forest and endangered species. Nigeria law in natural resources management. Administration

and wildlife conservation for economic and recreation uses, problems of wildlife conservation in Nigeria.

MTS 105: ALGEBRA AND TRIGONOMETRY FOR BIOLOGICAL SCIENCES (3 UNITS)

INTRODUCTION:. Use of Mathematics in Agriculture. **Elementary Set Theory**: Set notations. Set operations. Algebra of sets. Venn diagram. Applications. **Operations with Real Numbers:** Indices and Logarithms. Surds. Use of Logarithms in Agricultural Sciences. Remainder and Factor theorems. Partial Fractions. **Equations and Inequalities:** Linear and Quadratic inequalities. Theory of quadratic equations. Cubic Equations. Equations reducible to Quadratic type. **Sequences and Series:** Arithmetic and Geometric Progression. Arithmetic mean and Geometric mean. Arithemetic series. Geometric series. N^{th} term of a series. Binomial theorem. The General term. Binomial series. **Matrix Algebra:** Matrices. Algebra of Matrices. Determinant of a Matrix. Properties. Inverse of a matrix. Solution of Linear system of Equations. **Elementary Trigonometry:** Degree and Radian Measures. Pythagorean Identities. Trigonometric functions of any Angle. Graphs, Inverse trigonometric functions. Compound Angles. Solution of trigonometric Equations.

MTS 106: CACULUS FOR BIOLOGICAL SCIENCES (3 UNITS)

Functions IN Agriculture. Domain and Range of a function. Grap[hs of Elementary functions. One-to-one and Onto Functions. Composite function. Applications to Agricultural Sciences. **Limits and Constinuity:** Limits. Algebra of Limits. Continuity and discontinuity of functions Removable discontinuity. **Differentiation:** Geometrical meaning of derivatives. Algebra of differentiable functions. Implicity differentiation. Logarithmic differentiation. Higher derivatives etc. Applications of derivatives: Errors and Approximations. Minima and Maxima. Curve sketching etc. Applications to Agricultural Sciences. **Integration** as Inverse of Differentiation. Indefinite and Definite Integrals. Properties. Mehtos of Integration. Applications as area under a curve. Surface Areas and volumes of solides of Integration. Applications as area under a curve. Surface Areas and volumes of solids revolution etc. **Co-ordinate Geometry:** Slope and midpoint of a line. Equations of a straight line. Parallel and perpendicular lines. Equations of a circle, Parabola, Ellipse and hyperbola. Tangents and Normal

STS 201: ELEMENTARY STATISTICS (FOR NON-MAJORS) (3 UNITS)

Fundamental statistics concepts: probability theory and random variables: elementary probability distributions: binomial, poison and normal: regression and correlation analysis, estimation, point estimation, confidence intervals for means and variances; statistical tests and hypotheses in biological and agricultural experimentations: analysis of variance: control chart for within and between batch variabilities: Industrial experimentation, experimental errors, experimental design-fixed and random effects for both completely randomized and randomized blocks, lating and lattice square, factorial and split-plot designs. Some non parametric tests.

CSC 201: COMPUTER PROGRAMMING (3 UNITS)

History of computers; general structure of a computer system, types, classification and characteristics of a computer: computer systems and environmental conditions. Internal representation of data: character representation, concept of data, record file,

basic models of files processing and their advantages, problem solving: flow charts, algorithms, symbolic names, subscripts, expressions and control statements, computer structures and machine language, introduction to computer programming with special emphasis on BASIC and FORTRAN programming languages: computer applications.

PHS 105: GENERAL PHYSICS I NON MAJORS (3 UNITS)
Linear motion, motion in a circle and Simple Harmonic Motion. Gravitation, Statics and hydrostatics, elasticity, friction, viscosity and surface tension. Heat, temperature, thermometers. Expansion of solids, liquid and gases. The gas laws, change of state, kinetic theory of matter. Heat transfer.

PHS 106: GENERAL PHYSICS II FOR NON MAJORS (3 UNITS)
Waves and resonance. Propagation of light at plane and curved surfaces. The human eye and optical instruments. Radioactivity and useful effects of radiation. Current and static electricity, introductory magnetism and alternating currents. Introductory atomic physics and electronics.

PHY 191/192: PHYSICS LABORATORY I/II (1 UNIT EACH)
Selected experiments relating to the theoretical course PHS 101/102. The experiments should illustrate basic techniques, observations, quantitative measurement, graphical representation, analysis and deductions from the data and error analysis. They must also acquaint students with a cross-section of basic measuring instruments.

PHS 364: ENERGY AND ENVIRONMENT (1 UNIT)
Energy and power, demand, principles and outlook: The cost of transformation of energy. Thermal pollution, electrical energy from fossil fuels. Hydroelectric power generation. Cost, capacity, storage, reserves, efficiency and environmental effects of these. Electrical energy from nuclear reactors. Prospects for the future through the promise (and problems) of breeder reactors, fusion power, solar power, geothermal, tidal and wind power etc.

SOS 312: SOIL CHEMISTRY AND MICROBIOLOGY
Introduction to soil chemistry. Historical perspective. Chemical composition of soils, soil colloids: inorganic and organic colloids. Silicate mineral chemistry. Cation and anion exchange phenomena and base saturation. Flocualtion and dispersion. Soil reaction (active and reserve acidity, alkalinity buffering capacity, soil acidity and liming, lime requirements and management consideration). Soil organisms, perspective on the biosphere (energy and nutrient cycles). classification systems. Distribution in soils, growth requirements and functions of representative groups of microfauna and macrofauna, microflora and macroflora. Association between microbe and plants, soil organic matter. Importance of soil organic matter in humid tropical soils, general decomposition process. Humification, organic matter maintenance. The dynamics of N.P and S pools.

FIS 310: OCEANOGRAPHY (2 UNITS)
Study of the temperature and chemistry of sea water. Biological activities and their distribution. Salinity, chlorinity, currents, tides, waves, sound and radiation in the sea, conductivity, diffusion, viscosity and dynamics of sea water distribution and

behaviour of plankton. Brackish water condition and fauna. Interrelationship and physiological adaptations of marine organisms.

AMW 202: INTRODUCTION CLIMATOLOGY AND BIOGEOGRAPHY (3 UNITS)

Basic definitions and explanations in climatology and biogeography. Climatological problems and investigation methods – relationship with meteorology, bio-geography and hydrology, climatology data processing methods; basic factors of climate formation, influence of relief on climate and plants. Geographical distribution of slimates elements, plants and animals, climate and soil. The concept of adaptation in plants and animals. Classification of climate and biogeography of the earth.

AMW 204: ELEMENTS OF HYDROLOGY (2 UNITS)

Definition, scope and application of hydrology. The concept of hydrological cycle and drainage basin characteristics: precipitation-forms, types and measurements. Factors affecting interception, evaporation, evapotranspiration, surface run-off and subsurface flow. Determination and analysis of infiltration, percolation, permeability aquifers and groundwater movement.

AMW 307: WATER RESOURCES OF NIGERIA (2 UNITS)

Rainfall-pattern, spread and quantity. Daily, monthly and yearly rainfall in different regions of the country. Rivers in Nigeria – main rivers and their flows, average flow, maximum and minimum flow, annual yield. Rivers Niger, Benue, Ogun Kaduna, Sokoto, Rima, Hadejia, Jamare, Gurara etc. Lakes and reservoirs-natural land artificial lakes, Reservoirs above dam-Kainji and Jebba. Tiga dams and Reservoirs etc. Reservoirs behind small and medium earth dams different states in Nigeria. Tidal and saline waters in the coastal areas. Groundwaters – in Boreholes and Tubewells. Use of water-irrigation for agriculture, water supply and waste water engineering, navigation, hydropower generation, environmental sanitation, industrial use, etc. Agencies – Federal Ministry of Agriculture and Water Resources. Water Corporations. Department of Waterways and Navigation, River Basin Development Authorities, Research Institute, Universities.

AMW 308: SYNOPTIC METEOROLOGY (2 UNITS)

General information on synoptic meteorology methods of long and short range weather forecasts. Basic synoptic codes-prospects of using meteorological satellite data – elements of worlds weather watch: compilation and analysis of weather charts. Analysis of the fields of meteorological elements. Air masses – their classification and properties: Atmospheric forms, cyclone activity. Macro-synoptic processes and long-range weather forecast; laws of general atmospheric circulation: Peculiarities of circulation in various areas of the globe.

2.9 B.Sc. Geology Degree Programme

2.9.1 Philosophy, Aims and Objectives of the Degree Programme

The main aims and objectives of the degree programme in geology should be:

a. To instill in students a sense of enthusiasm for geology, an appreciation of its application and relevance in the solution of different societal developmental problems, and to involve them in an intellectually stimulating and satisfying experience of learning and studying.

b. To provide students with a broad and balanced foundation of geological knowledge and practical skills.

c. To develop in students the ability to apply their geological knowledge and skills to the solution of theoretical and practical problems in geology.

d. To develop in students, a range of transferable skills and attitudes that are of value in geological and non-geological employment.

e. To provide students with a knowledge and skills base from which they can proceed to further in specialized areas of geology or multi-disciplinary areas involving geology

f. To generate in students an appreciation of the importance of geology in an industrial, economic, environmental, technological and social development.

2.9.2 Admission and Graduation Requirement

The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, Physics and Chemistry to form the core subjects with credit in any other one relevant science subject, at the Senior Secondary School Certificate or its equivalent. In addition, an acceptable pass in the University.

Candidates with two A level passes (graded A-E) at the Advanced Level in one or more relevant subjects (Chemistry, Mathematics and Physics) may undertake the three – year degree programme into 200-level.

2.9.3 LEARNING OUTCOMES

a *Regime of Subject Knowledge*

Each university providing bachelors honours degree programme in geology is free, within the context of academic freedom and university autonomy, to decide on the content, nature and organization of its courses and modules. Therefore, geology degree programmes offered by individual universities may differ in particular characteristics and depth of treatment of individual aspects. Inspite of this, it is expected that all geology programmes will ensure that students become conversant with the following main aspects of geology.

a. Major aspects of geological terminology, nomenclature, conventions, units and a sound understanding of the fundamental concepts in geology.

b. The major groups of rocks and their characteristic features

c. Earth history and the concept of time in geology

d. Physical geology and the practical identification of common rockforming minerals and fossils.

e. Crystallography, mineralogy and the principles and procedures of identifying minerals using the polarizing microscope.

f. Principles and techniques of field geology and the interpretation of topographic and geologic maps.

g. Systematic paleontology covering the morphology, evolution, identification of major animal phyla including their stratigraphic and paleoecologic distributions.

h. The morphology and classification of pollens and spores and their applications in stratigraphic and paleoenvironmental studies

i. The characteristics of igneous and metamorphic rocks and the geological processes which gave rise to them.

j. The characteristic features of sedimentary rocks including their structure and composition and the recognition of sedimentary environments from the rock records.

k. The principles and concepts of stratigraphy and their application in sedimentary basin analysis.

l. The principles and processes of formation of mineral deposits and techniques for their evaluation.

m. Petroleum geology and the nature of source and reservoir rocks and hydrocarbon traps and evaluation of petroleum potential of a sedimentary basin.

n. Applications of the physical and chemical properties of rocks in the design of exploration techniques in the search for groundwater, mineral deposits, hydrocarbon and engineering foundation studies.

o. An appreciation of the value of fieldwork in geology, which is practicalised by field training programmes and skills acquisition through industrial attachment.

p. Awareness of major issues currently at the frontiers of geological research and development.

b. *Competencies and Skills*

At the bachelors honours level, geology students are expected to develop a wide range of different abilities and skills. These are divided into three broad categories as follows:

Geology – related cognitive abilities and skills

Geology – related practical skills

c. *Behaviourial Attitudes*

Transferable skills that may be developed in the context of geology but are of a general nature and applicable in non-geology contexts.

These main abilities and skills are detailed below.

2.9.4 **Attainment Levels**

Graduates of Geology are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in the exploration and exploitation of natural earth resources and also be able to carry out research in Geo-Sciences.

1.9.5 **Resource Requirement for Teaching and Learning**

a) Academic and non-Academic Staff (See section 1.6)
b) Academic and Non-Academic Spaces (See section 1.6)
c) Academic and Administrative Equipment (See Appendix)
d) Library and Information Resources (See section 1.6)

2.9.6 **Course Contents and Descriptions**

YEAR I
100 LEVEL COURSES

Courses		Title	Units
GES	102	Culture and Civilization	3
GEY	101	Introduction to Geology I	2
GEY	102	Introduction to Geology II	2
CHM	101	General Chemistry 1	3
CHM	102	General Chemistry II	3
PHS	102	General Physics I	3
PHS	102	General Physics II	3
MTH	101	General Mathematics	3
CSC	101	Introduction to Computer Science	3
STA	101	Statistical Inference	4
STA	131	Statistical Computing I	2
GES	101	Use of English	2
LIB	101	Lib Studies	2
			35 Units

YEAR II
200 LEVEL COURSES

Courses		Title	Units
GEY	201	Physical Geology	2
GEY	202	Crystallography and Systematic Mineralogy	3
GEY	203	Introduction to Petrology	3
GEY	204	Mineral Resources	2
GEY	205	Invertebrate Paleontology	3
GEY	206	Igneous and Metamorphic Petrology	2
GEY	207	Elementary Surveying	2
GEY	208	Mineral Resources and Environmental Geology	2
GEY	209	Introduction to Surveying	3
GEY	210	Geological Map Interpretation and Field Mapping	3
GES	103	Government, Society and Economy	3
GES	105	Land Use, Agriculture and Animal Husbandry	3
CHM	212	Basic Inorganic Chemistry	2
CHM	213	Introductory Analytical Chemistry	3
CHM	210	Physical Chemistry	
MTH	202	Ordinary Differential Equation	4
PHS	201	Classical Physics I	4
STA	202	General Applied Statistics I	2
ICH	227	Chemical Raw Materials I	3
GES	201	Communication Skills	2
EPS	201	Entrepreneurship Studies I	2
			53 Units

YEAR III
300 LEVEL COURSES

Courses	Title	Units
GEY 301	Geochronology and Precambrian Geology	2
GEY 302	Quarternary and Environmental Geology	2
GEY 303	Optical and Determinative Mineralogy	2
GEY 304	Igneous and Metamorphic Petrology	3
GEY 305	Sedimentary Depositional Environments and basins of Africa	2
GEY 306	Marine Geology	3
GEY 307	Introduction to Applied Geophysics	2
GEY 308	Principles of Geophysies	2
GEY 310	Mapping & Industrial Technics in Geology	2
GEY 312	Photogeology and Remote Sensing	2
GEY 313	Structural Geology	3
TPE 345	Drilling I	2
CSC 201	Computer Programming	1
		27 Units

YEAR IV
400 LEVEL COURSES

Courses	Title	Units
GEY 401	Advance Mineralogy	2
GEY 402	Igneous Petrology	2
GEY 403	Metamorphic Petrology	2
GEY 404	Economic Geology	3
GEY 405	Applied Geochemistry and Isotope	2
GEY 406	Micropaleontology and Palaeocology	3
GEY 407	Advanced Sedimentary Petrology	2
GEY 408	Petroleum Geology	3
GEY 409	Applied Geophysics	3
GEY 410	Engineering Geology	2
GEY 411	Hydrogeology	2
GEY 412	Advanced Global Tectonics and Structures	2
GEY 413	Field Geology of Nigeria	2
GEY 414	Seminar in Geology	2
GEY 415	Project in Geology	6
		38 Units

Course Description

GEY 101 INTRODUCTION TO GEOLOGY I (2 Units) (L.30: P 45)
Elements of Physical geology and physiographic features of the Earth. Classification properties and description of major minerals, rocks type and occurrence of economic minerals. History of the Earth and Universe.

GEY 102 INTRODUCTION TO GEOLOGY II (2 Units) (L. 30: P 45)
Theory of evolution of organism. Distribution and Classification of major fossil groups and their occurrence and uses. Principle of historical geology, and stratigraphy.

GEY 201 PHYSICAL GEOLOGY: (2 Units)
Planet Earth: its composition from core to crust. Minerals; rocks and weathering. Surface processes and landforms, major earth structures. Practical identification of common rockforming minerals and rocks; interpretation of topographic and simple geologic maps.

GEY 202 CRYSTALLOGRAPHY AND SYSTEMATIC MINERALOGY (3 Units) (L.30: P 45)
The main morphological properties classification and mode of occurrence of rock forming minerals. Crystal system and identification
.

GEY 203 INTRODUCTION TO PETROLOGY (2 Units) (L.30: P 45)
The principal igneous, sedimentary and metamorphic rocks. Their characteristics features and microscopic textures and their identification.

GEY 204 MINERAL RESOURCES (2 Units) (L.30: P 45)
Elementary geology, distribution and Utilization of economic minerals and energy resources

GEY 205 INVERTEBRATE PALAEONTOLOGY (3 Units) (L.15: P 45)
Major invertebrate fossil groups, their classification, ecology. Stratigraphic distribution and evolutionary trends. Origin of the atmosphere, Hydrosphere and biosphere.

GEY 206 IGNEOUS AND METAMORPHIC PETROLOGY: (2 Units)
Origin, occurrence, geologic setting and systematic description of igneous rocks. Metamorphism and description of metamorphic rocks, metamorphic minerals and textures of metamorphic rocks.

GEY 207 ELEMENTARY SURVEYING: (2 Units)
Surveying instruments and their uses e.g. the chain, Steel measuring tape, ranging poles, land chain arrows dumpy levels, theodolity, Planimeters. Linear surveying, levelling area measurements, volume of earthwork, curve ranging and techeometry, Harometric heighting.

GEY 208 MINERAL RESOURCES AND ENVIRONMENTAL GEOLOGY: (2 Units)
Metallic and non-metallic mineral resources - their composition, distribution and utilization. Fossil fuels; surface and underground water hydrology. Pollution and its sources, hazards, and control. Prediction and control of geologic hazards.

GEY 209 INTRODUCTION TO SURVEYING (3 Units) (L.15: P 90)
Introduction to surveying instruments and method. Methodologies and techniques linears and areal surveying, and geological and mining evaluation.

GEY 210 GEOLOGICAL MAP INTERPRETATION AND FIELD MAPPING (3 Units) (L.15: P 90)
Practical – recording of geological features and base maps. Field techniques. Interpretation and simple geological maps.

GEY 301 GEOCHRONOLOGY AND PRECAMBRIAN GEOLOGY OF AFRICA: 2 Unit (L.30: P 0)
Geology and evolution of Precambrian domains and rocks, with special reference to Africa. Radiometric age determination

GEY 302 QUATERNARY AND ENVIRONMENTAL GEOLOGY: 2 Units (L.30: P 0)
Nature, distribution and economic significance of superficial deposits, environmental monitoring and controls.

GEY 303 OPTICAL AND DETERMINATIVE MINERALOGY: 2 Units (L.15: P 45)
Principles of optics and crystallography, optical properties of the common rock forming minerals.

GEY 304 IGNEOUS AND METAMORPHIC PETROLOGY: 3 Units (L.30: P 45)
Character and Origin of igneous and metamorphic rocks. Crystallization of magma and igneous suites. Control of metamorphism and facies concepts. Microscopic textures of igneous and metamorphic rocks.

GEY 305 SEDIMENTARY DEPOSITIONAL ENVIRONMENTS AND BASINS OF AFRICA: 2 Units (L.30: P 0)
Physical, Chemical and Biological influence on marine and continental depositional environments and their sedimentation patterns. Analysis of the African sedimentary basins.

GEY 306 MARINE GEOLOGY: 2 Units (L.30: P 0)
Character of Oceans and continental margins. Basic oceanography and resources of the seas.

GEY 307 INTRODUCTION TO APPLIED GEOPHYSICS: 2 Units (L.15: P 45)
Physical properties of rocks and materials, and their measurements. Application of geology to engineering and water problems.

GEY 308 PRINCIPLES OF GEOPHYSICS: 2 Units (L.30:P 0)
Introduction to seismic, gravity and magnetic methods techniques of acquisition and interpretation of geophysical data.

GEY 310 MAPPING AND INDUSTRIAL TECHNIQUES IN GEOLOGY: 2 Units (L.0:P 90)
Field study of specific areas and production of geological maps and reports. Industrial exposure in earth sciences.

GEY 312 PHOTOGEOLOGY AND REMOTE SENSING: 2 Units (15) (45)
Techniques of photogrametry, study, and interpretation of aerial photographs and satellite imageries, applications to mineral resources, and environmental evaluation. Dynamics of rocks, stress-strain relationships, faults, folds, ring dykes, introduction to Acrustal teconics, study and interpretation of geological maps.
HL = 30, Hp = 45, U = 3, S = 1st, P = GEY 284

GEY 313 STRUCTURAL GEOLOGY
Stress amd strain deformation, major deformational structures of the earth, problems concerning geological maps, structures stereographic projection in Structural Geology Structural Mapping Practice.

GEY 401 ADVANCED MINERALOGY: 2 Units (L.15: P 45)
Optical and X-ray properties and structures of minerals. Systematic mineralogy including crystal chemistry

GEY 402 IGNEOUS PETROLOGY: 2 Units (L.15: P 45)
Igneous rocks = origin and differentiation of magmas, magmatic provinces and relation to crystal chemisty.

GEY 403 METAMORPHIC PETROLOGY: 2 Units (L.15: P 45)
Metamorphic facies and isograde, contact and regional metamorphic zones. High and low, pressure metamorphic belts and distribution in time and space.

GEY 404 ECONOMIC GEOLOGY: 3 Units (L.30: P 45)
Principles and processes of formation of mineral deposits. Prospecting, exploration, mine development and mineral treatment. Ore reserve calculation and mineral economics.

GEY 405 APPLIED GEOCHEMISTRY AND ISOTOPES: 2 Units (L.30: P 0)
Controls and element distribution in relation to petrogenesis, and ore genesis. Mineral exploration, environmental monitoring and its implication to Health.

GEY 406 MICROPALAEONTOLOGY AND PALAEOECOLOGY: 3 Units (L.30: P 45)
Distribution GEY 384n, classification and stratigraphical application of major groups of microfossils; palaeoecologic interpretations and models.
.

GEY 407ADVANCED SEDIMENTARY PETROLOGY: 2 Units (L.15: P 45)
Provenance of sediments, types, diagnosis and sedimentation processes, qualitative and statistical analysis of textural and compositional parameters and reconstruction of sedimentary environment.

GEY 408 PETROLEUM GEOLOGY: 2 Units (L.30:P 0)
Origin, occurrence and distribution of hydrocarbon deposits and fields.

GEY 409 APPLIED GEOPHYSICS: 3 Units (L 30) (P 45)
Fundamentals of seismic, gravity, magnetics and electrical methods, emphasizing the interpretation of geophysical data related to applied geology.

GEY 410 ENGINEERING GEOLOGY: 2 Units (L.30: P 0)
Application of geology to engineering problems in roads, bridge and dam construction.

GEY 411 HYDROGEOLOGY: 2 Units (L.30: P 0)
Geology, nature, origin and occurrence of groundwater, regional groundwater resource evaluation.

GEY 412 ADVANCED GLOBAL TECTONICS AND STRUCTURES: 2 Units (L. 30: P 0)
Study of the major structures of the Earth, continental separation, plate tectonics, and patterns of crystal evolution in specific region.

GEY 413 FIELD GEOLOGY OF NIGERIA: 2 Units (L.0: P 90)
Field study through excursion to major geological features and type localities within the basement complex and sedimentary domain of Nigeria.

GEY 414 SEMINAR IN GEOLOGY
Literature search write-up, and presentation on a topic in Geology.

GEY 415 PROJECT IN GEOLOGY: 6 Units (L.0: P 270)
Geology investigation and independent research involving field, laboratory and library studies.

2.10 B.Sc. Degree in Applied Geophysics

Although the minimum duration for the B.Sc. degree in Applied Geophysics is Four(4) years, there is a provision for an option of a Five-year programme.

2.10.1 Philosophy, Aims and Objectives of the Degree Programmes

The programme is intended to provide a mission-oriented geoscience knowledge and expertise to all the students that go through the programme and equip them with the necessary skills to have adequate knowledge of the composition of the Earth's subsurface and be able to fully exploit the earth's natural resources for national development.

The programme also aims at bringing together the ingredients necessary for a well-paid career as required in the mineral/oil industry and engineering/groundwater-related areas of the national economy and in the relevant government establishments. Opportunities for the attainment of academic excellence through effective teaching and research in all aspects of Applied Geophysics are also provided.

The specific objectives of the Department are among others, to:

i. Impact basic and fundamental knowledge in all areas of Applied Geophysics.

ii. Provide the necessary training and exposure in all aspects of Applied Geophysics that is in the forefront of development such as in hydrocarbon and groundwater exploration, environmental pollution, Dam site Roads and other Civil Engineering construction site investigations.

iii. Provide opportunity for a better appreciation of fields with the use of integrated Applied Geophysics at maximizing growth and technological development in all aspects of explorations.

iv. Develop the necessary manpower needed for industrial, technological, research, and academic development of the country in all aspects of Applied Geophysics.

v. Provide effective teaching, research and practical oriented/field work programme that is required in all the fields of applied Geophysics.

vi. Offer the opportunities for the full development of Applied Geophysics to meet the ever growing challenges as is applicable in the industry, private sector and government services, for the overall growth and development of the country and mankind in general.

2.10.2 Admission and Graduation Requirement

The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, Physics and Chemistry to form the core subjects with credit in any other one relevant science subject, at the Senior Secondary School Certificate or its equivalent. In addition, an acceptable pass in the University Matriculation Exams is required.

Candidates with two A level passes (graded A-E) at the Advanced Level in one or more relevant subjects (Chemistry, Mathematics and Physics) may undertake the three – year degree programme into 200-level.

2.10.3 **Learning Outcomes**

a *Regime of Subject Knowledge*

The range of knowledgeto be covered is the various areas of exploration, processing and interpretation methods in order to equip the students with the knowledge of the earth in general and the available natural earth resources of Nigeria in particular.

b. *Competencies and Skills*

At the bachelors honours level, geophysics students are expected to develop a wide range of different abilities and skills. These are divided into three broad categories as follows:
Geophysics – related cognitive abilities and skills
Geophysics – related practical skills

c. *Behaviourial Attitudes*
Transferable skills that may be developed in geophysics graduates are in addition to contain skills of a general nature and applicable in general problem solving of human development.

2.10.4 **Attainment Levels**

Graduates of Geophysics are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in the exploration and exploitation of natural earth resources and also be able to carry out research in Geo-Sciences.

2.10.5 **Resource Requirement for Teaching and Learning**

a) Academic and non-Academic Staff (See section 1.6)
b) Academic and Non-Academic Spaces (See section 1.6)
c) Academic and Administrative Equipment (See Appendix)
d) Library and Information Resources (See section 1.6)

2.10.6 **Course Contents and Descriptions**

YEAR I
100 LEVEL COURSES

Course Code	Course Title	Units
CHM 101	General Chemistry I	3
PHY 101	General Physics I	3
MTH 101	General Mathematics I	3
GLG 101	General Geology	3
PHY 107	General Physics Lab. I	1
CHM 107	General Chemistry Lab I	1
GST 101	Use of English	2
LIB 103	Library	2
CSC 101	Introduction to Computer Science	2
CHM 102	General Chemistry II	3
PHY 102	General Physics II	3
MTH 102	General Mathematics II	3
PHY 108	General Physics Lab. II	1
CHM 108	General Chemistry Lab II	1
GST 102	Use of English II	2
		33 Units

YEAR II
200 LEVEL COURSES

Course Code	Course Title	Units
MTH 201	Mathematical Method I	3
MTH 209	Differential Equation	3
PHY 201	Elementary Modern Physics	3
PHY 205	Thermal Physics	3
GLG 201	Physical Geology	3
MTH 201	Computer Programming I	3
GLG 206	Geological Map Interpretation	2
PHY 204	Waves and Optics	3
MTH 242	Computer Programming II	3
GPH 202	Introduction to Earth Physics	2
GPH 220	Geomathematics	2
PHY 202	Electric. Circuit & Electronics	3
PHY 209	Introduction to Space Science	2
PHY 208	Physics Lab. III	2
GST 201	Communication Skill	2
EPS 201	Entrepreneurship Studies I	2
		41 Units

YEAR III
300 LEVEL COURSES

Course Code	Course Title	Units
GST 301	Sedimentology	3
EPS 301	Entrepreneurial Skills I	2
PHY 303	Electromagnetism	3
GPH 307	Magnetic Prospecting Methods	2
GLG 313	Introductory Field Mapping	1
GPH 309	Gravity Prospecting Methods	3
GPH 305	Geophysical field method & Instrumental Analysis	2
MNE 301	Engineering Survey	2
EPS 312	Entrepreneurial Skills II	2
GLG 304	Stratigraphy	2
GPH 308	Seismic Refraction Prospecting	3
MTH 122	Statistics & Numerical Analysis for Phy. Sciences & Engineering	4
GPH 312	Electrical & Electromagnetic Methods	2
GLG 312	Structural Geology	3
MET 204	Introduction to the Atmospheric Physics	2
EPS 301	Entrepreneurship Studies II	2
GPH 311	Principles of Geophysics	2
GPH 320	Independent Field Work	3
		43 Units

YEAR IV
400 LEVEL COURSES

Course Code	Course Title	Units
PHY 309	Energy & Environmental Studies	2
GLG 408	Petroleum Geology	3
GPH 411	Seismic Reflection Prosp. Methods	3
GPH 413	Radiometrics & Well logging	3
GLG 413	Field Geology of Nigeria	3
GPH 401	Project	3
GPH 402A	Industrial Training (site Work Supervision)	4
GPH 402B	Industrial Training (University supervision)	2
GPH 402C	Industrial Training (Report)	4
GPH 405	Engineering Geophysics	2
GPH 404	Geophysical Data Processing	3
GPH 406	Project	3
GPH 408	Geophysical Seminar	2
GLG 312	Photogeology and Remote Sensing	3
GPH 409	Radiometrics and Well Logging Methods	3
		43 Units

For the Five-year Option :

YEAR V
500 LEVEL COURSES

Course Code	Course Title	Units
GPH 505	Geophysical Time series Analysis	3
GPH 513	Borehole Geophysics	3
GPH 401	Engineering Geology	3
GPH 509	Environmental Geophysics	3
	Elective*	3
GPH 508	Geophysical Seminar	2
GPH 510	Geophysics and Geothermal Energy	3
GPH 516	Radiometric Prospecting Methods	2
GPH 518	Electromagnetic Prospecting Method	3
GPH 504	Groundwater Geophysics	3
GPH 506	Special Topics & Case Histories	1
GPH 520B	Thesis Project	3
		32 Units

Optional Electives

EEE 341	Electrical Circuit Theory 1	3
GLG 405	Economic Geology	3
PHY 315	Intr. Solid State Elec.	3

Course Description

GPH 202: INTRODUCTION TO EARTH PHYSICS (2 Units)
The Earth's History. The Earth's interior. Seismicity and earthquake zones. The nature of the gravity field of the earth. The measurement of gravity and the figure of the earth. The Earth's magnetic field. Rock magnetism, Polar wandering and the continental drift. Heat flow and geothermometry.
Pre-requisite: IMC 201

GPH 220. GEOMATHEMATICS (3 Units)
Differential and integral calculus. Types of functions. Vector analysis, magnetic and Gravity potential theory representation. Matrix algebra, solution of Laplace equations and spherical harmonic analysis. Fourier analysis. Statistical regression analysis, curve fitting techniques and analysis of errors. Bessel equation and Lagendre polynomials. Solution of Matrix equations.
Pre-requisite: IMC 201.

GPH 305: GEOPHYSICAL FIELD METHODS AND INSTRUMENTAL ANALYSIS (2 Units).
Study of the essential elements of geophysical data acquisition systems. Seismic surveys using explosive or surface sources. Signal amplification, multiplexed, etc. methods in Electrical prospecting. Elements of currents and voltage measurement circuitries. Field surveys using gravimeters in Electromagnetic prospecting. Field procedures for the different EM methods. Geophysical Logging Instruments and methods. Instrument circuitry in Induced Polarization Prospecting Methods.
Pre-requisite: AGP 306, 307, 308 and 309.

GPH 307: MAGNETIC PROSPECTING METHODS (3 Units)
Introduction: Potentials: Fundamentals of magnetic dipole interactions with applications to simple mass distributions**,** Gauss Theorem. The filed equation. Instrumentation and field procedures. Reduction of magnetic data. Anomaly separation and interpretation. Air-borne and sea-borne magnetic surveys. Data acquisition and Interpretation. Applications of magnetic methods in mineral exploration and geologic mapping.
Pre-requisite: PHY 202, AGP 202 & IMC 203.
Concurrent registration with IMC 301 and PHY 303.

GPH 308: SESMIC REFRATION PROSPECTING METHODS (3 Units)
Geophysics and Mineral Exploration activity. Seismic exploration: Wave types: direct, refracted and reflected wave paths. Curved ray theory and applications. Refraction for the N-layer horizontal case. Numerical solution for a refraction profile over a single dipping interface. Field techniques, processing and interpretation of modern seismic refraction sections, static correction charts.
Pre-requisites: Same as with AGP 307.

GPH 309: GRAVITY PROSPECTING METHOD (3 Units)
Introduction: Potential; Theory of attraction and potential with applications to simple mass distributions. Theorems of Green and Gauss. The field equations, Green's formulae and Equivalent surface layers, Instruments and Date acquisition, Gravity,

data reduction, regional, residual anomaly separation. Interpretation of gravity anomalies, death and total mass estimates applications of gravity method in mineral exploration, groundwater and geologic mapping.
Pre-requisites: AGP 202; Concurrent registration with IMC 301

***GPH 311: PRINCIPLES OF GEOPHYSICS (2Units)**
Gravity and magnetic methods. Data acquisition and interpretation, spontaneous potential and electrical resistively methods, concepts of electrical potential, current density and conductivity of rocks, potentials distribution in a homogeneous earth and apparent resistively; Elect-interpretation.
*For Geology and Engineering Students only.

GPH 312: ELECTRICAL PROSPECTING METHODS (3 Units)
An introduction to the fundamentals, instrumentation, field procedure, computations, interpretation and application of electrical exploration methods. Laboratory work will scale and mathematical models coupled with fieldwork in areas of known geology.
Pre-requisites IMC 202 and PHY 201, 303.

GPH 320: INDEPENDENT FIELD WORK FOR GEOPHYSICS (3 Units)
An independent geological and geophysical filed studies exercise lasting 4-6 weeks during the long vacation at the end of the third year. A report on this exercise may be written and submitted at the beginning of the second Semester of the fourth year.

GPH 405: ENGINEERING GEOPHYSICS (3 Units)
Shallow geophysical techniques for evaluation of engineering parameters; elastic co-efficient, geologic structured, groundwater, seismic hazards and regulatory criteria.
Pre-requisites: 308, 312.

GPH 409: Radiometrics and Well Logging Methods
Fundamental principle of radioactivity, nuclear, radioactive decay processes, radioactivity of rocks and minerals. Instrumentation, and data interpretation. Case histories.Concepts of the logging techniques. Electrical logging methods. Resistively, self-potential, induced Polarization, E, Dipmeter, etc. Porosity logs-sonics, gamma ray, density, neutron logs, etc…Others-susceptibility, caliper, thermal, gravimetry logs. Instruments, data acquisition and interpretation of logs, application of geophysical logs in oil and ground water exploration.

GPH 411: SEISMIC REFLECTION PROSPECTING METHODS (3 Units)
The place of Geophysics in Oil Exploration, propagation of seismic waves. Analytical treatment of elementary seismic reflection problems. Field techniques. Processing and interpretation of modern seismic reflection sections, NMO charts.
Pre-requisites: GPH 308

GPH 504: GROUNDWATER GEOPHYSICS (3 Units)
Applications of geophysical methods in groundwater exploration. Aquifer determination in basement complex and sedimentary areas. Mapping of geological structure useful to groundwater investigation. Determination of aquifer characteristics. Relevant geophysical techniques and field procedures. Borehole location strategy. Case histories.
Pre-requisites: Final year standing in Applied Geophysics or consent of department.

GPH 505: GEOPHYSICAL TIME SERIES ANALYSIS (3 Units)
Review of Fourier transform, convolution auto correction, impulse response; 2-transom, sampling theory, filter design, particular attention to geophysical application for each topic. Extensive use of the computer.
Pre-requisites: IMC 202, 301, and 242.

GPH 506: SPECIAL TOPICS AND CASE HISTORIES (1 Unit)
Topics are selected to illustrate recent advances and developments in Applied Geophysics in any of the following areas: Modeling, time series analysis and filters. Integrated geophysical methods in oil and ore prospecting. Choice of methods in a geophysical survey. Composite surveys in regional structural mapping, oil prospecting and searching for ores. Examples of combined geophysical programmes and case histories.

GPH 508: GEOPHYSICAL SEMINAR (2 Units)
Presentation by class members of materials drawn from personal investigation or of materials selected from geophysical literature.

GPH 509: ENVIRONMENTAL GEOPHYSICS (3 Units)
Applications of geophysical techniques in environmental pollution studies, saline water intrusion and mapping, determination of groundwater quality, chemical pollution at industrial sites and delineation of chemical plumes, oil spillage, pollution and its mapping.
Pre-requisite: Final-year standing in Applied Geophysics and consent of department.

GPH: 510: GEOPHYSICS AND GEOTHERMAL ENERGY (3 Units)
Origin and nature of heat flow from the earth. Factors that control economic aspects of geothermal energy. Descriptions of known fields. Application of heat flow measurement, Electrical surveys, seismicity studies and other exploration tools for the search and evaluation of geothermal energy. Field Trips.
Pre-requisite: GPH 312 and PHY 205.

GPH 513: BOREHOLE GEOPHYSICS (3 Units)
Concepts of the logging techniques. Electrical logging methods. Resistively, self-potential, induced Polarization, E, Dipmeter, etc. Porosity logs-sonics, gamma ray, density, neutron logs, etc…Others-susceptibility, caliper, thermal, gravimetry logs. Instruments, data acquisition and interpretation of logs, application of geophysical logs in oil and ground water exploration.
Pre-requisites: Consent of the Department:

GPH 516: Radiometric Prospecting Methods (3 Units)
Fundamental principle of radioactivity, nuclear, radioactive decay processes, radioactivity of rocks and minerals. Instrumentation, and data interpretation. Case histories.
Pre-requisite: PHY 204.

GPH 518: ELECTROMAGNETIC PROSPECTING METHODS (3 Units)
Classification of electromagnetic methods. Amplitude and phase anomalies, compensator method. Turam method. Moving source and receiver methods.

Magneto telluric methods. Applications of electromagnetic methods in mineral and groundwater exploration.
Pre-requisites: PHY 303, 304.

GPH 520: STUDENT'S PROJECT (6 Units)
An independent research project chosen according to student's and interest and supervised by staff, during the final year. The subject matter must be related to any aspect of applied geophysics – oil, groundwater, mineral exploration, or engineering site investigation.
Pre-requisites Final-year standing.

1.11 B.Sc. Industrial Chemistry Degree Programme

1.11.1 Philosophy, Aims and Objectives of the Degree Programme

Industrial Chemistry is the index of industrial development everywhere in the world. The frontiers of chemistry are very large, ranging from one extreme of natural products to those synthesized by man. 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 undergraduate Programme is designed to encompass an appreciation of the centrality of chemical sciences in the entire undergraduate curricula. It is also planned to arouse entrepreneurial spirits needed for self-employment and economic emancipation. The specific 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 aptitudes.

(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 the 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 viz, food, environmental, textiles, polymer etc.

1.11.2 Admission and Graduation Requirement

The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, Chemistry to form the core course with credit in Physics, and any other relevant science subjects at the Senior Secondary School Certificate or its equivalent. In addition, an acceptable pass in the University.

Candidates with two A level passes (graded A-E) at the Advanced Level in one or more relevant subjects (Biology, Botany, Chemistry, Geography, Mathematics and Physics) may undertake the three – year degree programme into 200-level.

2.11.3 **Learning Outcomes**

All Bachelors honours degree student in Industrial Chemistry are expected to develop the following abilities and skills:

a. *Regime of Subject Knowledge*
Cognitive abilities and skills relating to solution of problems in Industrial Chemistry and other allied chemical industries.

b. *Competencies and Skills*
Practical skills relating to the conduct of Laboratory work in Chemical Industries.

c. *Behavioral Attitudes*
General skills relating to non-subject specific competencies, communication, interpersonal, organization skills.

1.11.4 **Attainment Levels**

Graduates of Industrial Chemistry are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in Industrial Chemistry and other allied industries in relation to national and societal needs.

1.11.5 **Resource Requirement for Teaching and Learning**

a) Academic and Non-Academic Staff (See Section 1.6)
b) Academic and Non-Academic Spaces (See Section 1.6)
c) Academic and Administrative Equipment (See Appendix)
d) Library and Information Resources (See section 1.6)

2.11.6 **Course Contents and Descriptions**

YEAR I
100 LEVEL COURSES

Course No.	Course Title	Units
CHM 101	General Chemistry I	3
CHM 107	Practical Chemistry I	1
MTH 101	General Mathematics I	3
PHY 101	General Physics I	3
PHY 107	Practical Physics I	1
BIO 101	Introductory Biology I	3
BIO 107	Practical Biology I	1
GES 101	Use of English Language I	2
CSC 101	Library Science	2
LIB 101	Library Studies	1
CHM 102	Foundation Chemistry II	3
CHM 108	Practical Chemistry II	1
MTH 102	General Mathematics II	3
PHY 102	General Physics II	3
PHY 108	Practical Physics II	1
BIO 102	Introductory Biology II	3
BIO 108	Practical Biology II	1
		35 Units

YEAR II
200 LEVEL COURSES

Course No.	Course Title	Units
CHM 201	Introductory Chemistry	4
CHM 241	Physical Chemistry I	4
PHY 222	Heat and Thermodynamics	3
CSC 201	Introductory Computer Science	3
STA 271	Statistics and Elementary Probability.	4
EPS 201	Entrepreneurial Studies I	2
GST 201	Communication Skill	2
CHM 221	Inorganic Chemistry I	3
CHM 231	Organic Chemistry I	3
CHM 232	Spectroscopy	3
CHM 242	Physical Chemistry II	3
PHY 242	Atomic Physics I	3
GST 202	African History & Culture	2
CHM 233	Biochemistry	3
CHM 234	Biophysical Chemistry	2
		44 Units

YEAR III
300 LEVEL COURSES

Course No.	Course Title	Units
CHM 301	Chemical Literature	1
CHM 311	Analytical Chemistry I	3
CHM 321	Inorganic Chemistry II	3
CHM 331	Organic Chemistry II	3
CHM 351	Process Science I	3
CHM 353	Macromolecular Chemistry I	3
CHM 355	Introductory Material Science	2
EPS 301	Entrepreneurial Studies II	2
CHM 322	Inorganic Chemistry III	3
CHM 332	Organic Chemistry III	3
CHM 342	Electrochemistry	2
CHM 352	Process Science II	3
CHM 354	Management and Chemical Industry I	2
CHM 356	Colour and Textile Chemistry	3
CHM 358	Management and Chemical Industry II	2
CHM 357	Petroleum Chemistry	3
CHM 359	Glass Blowing Practical	1
		42 Units

YEAR IV
400 LEVEL COURSES

7th and 8th Semester

Industrial Attachment for 9 months.

Maximum **8 Credit Units**

YEAR V
500 LEVEL COURSES

Course No.	Course Title	Units
CHM 511	Instrumental Analytical Methods	3
CHM 522	Structure & Coordination Chemistry	3
CHM 532	Physical Organic chemistry	3
CHM 551	Chemistry of Industrial Processes	3
CHM 556	Macromolecular Chemistry II	3
CHM 561	Research Project I	3
CHM 533	Organic Synthesis	3
CHM 543	Reaction Kinetics	3
CHM 554	Environmental Chemistry	3
CHM 561	Research Project II	3
CHM 571	Seminar in Chemistry	2
		32 Units

Elective Courses (one only)

Course No.	Course Title	Units
CHM 521	Nuclear & Radiation Chemistry	3
CHM 531	Medicinal Chemistry	3
CHM 553	Chemical Processes Technology	3
CHM 557	Polymer Technology	3
CHM 535	Natural Product Chemistry	3
CHM 540	Photochemistry	3
CHM 542	X-ray Crystallography	3
CHM 555	Mineral Processing	3
		24 Units

Optional Courses (one only)

Course No.	Course Title	Units
CHM 534	Organometallic Chemistry	3
CHM 541	Solid State Chemistry	3
CHM 536	Food Chemistry	3
CHM 501	Special Laboratory Methods	3
CHM 537	Agrochem & Chemotherapeutic Agents	3
CHM 544	Chemical Physics	3
CHM 552	Geochemistry	3
		21 Units

Course Description

CHM 101 FOUNDATION CHEMISTRY I 2+1+0 (3 Credits)

Physical Qualities and Units: The physical qualities understood as consisting of numerical magnitude and unit. International system of units: Base units, mass length, time, current, amount of substance. Other units expressed as products or quotients of base units.

Relative Masses of Atoms and Molecules: Relative atomic, isotopic, molecular and formula masses. The mole concepts and the Avogadro constant. Determination of relative masses. Calculation of empirical and molecular formulae. Chemical stoichiometry.

Atomic and Nuclear Basis: Evidence for atomic constituents: Electrons, protons and neutrons – their relative charges and masses. The nucleus, atomic number, mass isotopes and mass spectra. The electronic structure of the atom. Radioactivity; x-ray radiation and detection. Nuclear transformation and binding energy. Nuclear reaction and stability. Applications of radionuclides, electromagnetic radiation, wavelength and frequency. Radiation as energy, the plank relation, regions of electromagnetic spectrum absorption and emission of radiation. Wave particle dualism and the de Broglie equation treated symbolically. Heisenberg uncertainty principle. Energy levels in atomic hydrogen and their quantum numbers. Ionization energy. The size, shape and orientation of atomic orbitals. Radical and polar diagrams and the effect of nuclear charge. Electron and nuclear spin-the sterm- Gerlach experiment. Many electron atoms, electron configuration and pauli principle. Hund's rule.

Chemical Bonding: Dependence of properties of solids, liquids and gases on type of chemical bonding. Electrovalent bond between ions. Covalent bonds. The shape of simple molecules including CO_2 (linear), CH_4 (tetrahedral), NH_3 (pyramidal), HO (non-liner), SO (trigonal), SF, (octahedral). Metallic bonds. Intermolecular bonds. Hydrogen bonding and its influence on properties.

CHM 102 FOUNDTION CHEMISTRY II 2+1+0 (3 CREDITS)

Gases, Liquids and Solids.

Derivation of ideal gas equation leading to Boyle's Law and Avogadro's Hypothesis. The Avogadro constant. A simplified treatment (e.g. particle in a box). The assumption for ideal behavior and their limitation for real gases at high pressure and low temperature. Boltzmann distribution and molecule speed. Boltzmann constant. Liquids: the kinetic concept of the liquid state and simple kinetic-molecular description of melting, vapourization and vapor pressure saturated and unsaturated vapors. Phase equilibria: Phase rule, equilibria involving one, two and three components. Solids: Lattice structure and spacing. NaCl as ionic lattice. Cu as a cubic close-packed metal lattice. Graphite and Diamond – their properties as macromolecular structures. Lattice energy and forces between the particles in atomic molecular and ionic lattice.

Electrolysis: The factors affecting the mass of substance liberated during electrolysis. Relationship between faraday and the Avogadro constant and the charge of the electron.

Equilibria: Chemical equilibria: Reversible, reactions and dynamic equilibrium, factors effecting chemical equilibria: Le Chatelier's principle. Equilibrium constraints: their definition and calculation in terms of concentrations. Effect of temperature of equilibrium constants. Ionic equilibria: Bronsted-lowry theory of acids and bases. Strong and weak acids in terms of conductivity. Strong and weak electrolytes. Degree of dissociation. The ionic product of water Kw. PH and calculation, pH indicators; choice of indicators, Buffer solutions.

Chemical Kinetics: Simple rate equations; order of reactions; rate constants. Rate = K(A) reactions, simple calculations on half life. Quantitative effects of temperature on rate constants. Catalysis.

Thermo-chemistry and Chemical Energetics: Standard enthalpy changes of reaction, formation, combustion and neutralization: Hess Law. Lattice energy for simple ionic crystals. A treatment of the Born-Haber cycle is not required.

CHM 201 INTRODUCTORY CHEMISTRY 3+1+3 (4 CREDITS)

General Inorganic Chemistry: Periodicity of Physical Properties: The variation in physical properties with atomic number across the 2nd and 3rd periods (lithium to neon, sodium to argon). Variation in first ionization energies, atomic radii, melting points and explanation in terms of structure and bonding in elements. The relevance of ionization energy and electronic configuration.

Group II elements: Reactive metals similar to each other with only gradual changes as their atomic numbers increases – the elements magnesium, calcium, strontium and barium. The uncreative nitrogen. Group VII elements – a group of unreactive non-metals. An introduction to the chemistry of some d-block (transition) elements-chromium, manganese, iron, nickel and copper. Crystal field theory and the chemistry of complex ions.

Elementary and general comparison of elements of the 2nd and 3rd transition series with the elements of the first series, study of the following elements and their important compounds: (Zr, Hf), (Nb, Ta), (Mg, W), (Te, Re), (The platinum metals), and (Ag, Au).

Introductory Analytical Chemistry: Introduction to theory of sampling and errors: statistical treatment of data; chemical methods of analysis including volumetric, gravimetric and other physio-chemical methods. Fundamental laws and theories. Chromatography: Practical experience. Thin layer, paper and column chromatography. The use of Rf values.

General Organic Chemistry: General introductory nomenclature of alkanes, alkenes alkynes. The shape of ethane, ethane, acetylene and benzene molecules. Structural isomerism in aliphatic and aromatic compounds. Cis-trans isomerism in alkenes. The nature of C-H, C-Br, C=C and C=O bonds in terms of electron density distribution. General preparations of alkanes alkenes and alkynes; they types of reactions –

addition, substitution and elimination. Free radical reactions of alkanes. Alkenes characterized by electrophilic addition and electrophilic substitution for arenas. Halogen derivatives, Hydroxyl compounds; carboxyl compounds, carboxylic acids and Hydroxyl compounds; carboxyl compounds, carboxylic acids and derivatives, amines – their structure and derivatives preparations and quantitative and qualitative tests.

CHM 221 INORGANIC CHEMISTRY I 2+0+3 (3 Credit)
Pre-requisite: CHM 201
Solid state structures of simple AB and AB_2 type compounds of the s, p and d block elements. Periodicity of the elements illustrated by a study of their simple compounds, the hydride acids and halides. The solution properties of the compounds including solvation, solute/solvent interaction and redox reactions.

CHM 231 ORGANIC CHEMISTRY I 2+0+3 (3 Credits)
Pre-requisites: CHM 201
Molecular Structure and Isomerism: Empirical and molecular formulae. Molecular constitution and constitutional isomerism. Molecular configuration and configurationally isomerism. Molecular conformation and conformational isomerism. Influence of molecular structure on physical properties.

Mechanism and Reactivity: Modes of bond formation and fission. Types of reagent. Types of reactions. Electronic and steric effects. Kinetic and thermodynamic control of reaction. Elementary concepts of acidity and basicity.

Chemistry of hydrocarbons: Nomenclature, structure, physical properties, reactions and industrial importance of typical alkanes and Cycloalkanes, alkenes and cycloalkene, alkynes and cycloalkynes. Practical work will illustrate physical properties and reactions of representative hydrocarbons.

CHM 232 SPECTROSCOPY 2+0+3 (3 Credits)
Pre-requisites: (CHM 101 &CHM 102
Existence of characteristic energy levels; Bohr-Einstein frequency relationship selection rules; characteristic spectra; factors determining relative intensities; Boltzmann distribution effects of temperatures; characteristic line width; absorption and emission spectra and their determination; absolute intensity; Beer-Lambert Law.

Survey: Spectral transactions and their main uses.

Vibrational Spectrosocopy: Harmonic oscillators and the effects of anharmonicity; normal modes of vibration criteria for infra-red activity; Raman activity; group frequencies.

Ultra-violet and Visible Specroscopy: Types of transitions; consideration of intensities d/d transitions; aromatic systems; Woodward rules.

Resonance Spectroscopy: Resonance condition, chemical shifts; intensities; coupling constants.

Mass Spectrometry: Generation of positive ions; characteristic fragmentation patterns; isotope effects.

Practical Work:
Example are as follows: determination of meaningful aspectra (sample preparation and instrumental parameters); determination of simple n.m.r. and mass spectra; investigation of carbonyl stretching frequencies; study of the effects of conjugation in the ultra-violet region; Lambert Law as applied to mixture; determination of pKa of methyl red; the investigation of an unknown compound using the integrated approach.

CHM 233 BIOCHEMISTRY 2+0+3 (3 Credits)
Pre-requisite: CHM 231
Amino acids as units of protein structure; the peptide bond; primary, secondary, tertiary and quaternary levels of structure and the forces maintaining them. The biologically active state of proteins; protein denaturation. Enzymes as proteins and as biological catalysts; the active centre; enzymes binding and catalysis: enzyme specificity.
Michealis – Menten treatment for one – substrate reaction, including inhibition and the use of graphical directed and enzyme – catalyzed reactions. Dissimilation and biosynthesis. Glyxolysis as an example of a metabolic pathway, its reactions, enzymes and yield of ATP.
Advantages and disadvantages of in vitro experiments with tissue/cell rupture and homogenization; the isolation of organelles. The purification of proteins with emphasis on enzymes. Elementary theory and practice of solubility methods and methods and methods based on chromatographic, electrophoric centrifugation and bio-affinity techniques.

CHM 234 BIOPHYSICAL CHEMISTRY 1+0+3 (2 Credits)
Pre-requisite: CHM 233
Introduction:
The anatomy and physiology of the human body.

Excitable Tissue:
Anatomy of the nervous system, smooth and voluntary muscles. Introduction to autonomic pharmacology. The endocrine glands – its function and roles. Components of blood and coagulation. Ventilation. The gastrointestinal system. Excretory organs and their functions. Homeostasis, urine formation, acid-base balance, role in the maintenance of blood volume and pressure. Introduction on pharmacology. Origins and classification of drugs administration to drug receptor theories, dose response curves antagonism, principles of drug metabolism and excretion. Drug screening, bioassay, drug toxicity.

CHM 241 PHYSICAL CHEMISTRY I 2+0 +3 (3 Credits)
Pre-requisite: CHM 201
Energetics: Bond dissociation energies. Energy cycles, including the Born Haber cycle, applied to both covalent and ionic bonds. Limited accuracy of dissociation energies. Heats of formation and their determinations. Laws of thermodynamics. The concept of reversibility. The possibility of endothermic processes, and the concept of entropy –with calculations based on the simple models. Standard entropy values,. Free

energy as a criterion for chemical reaction and equilibrium. Kinetic and thermodynamic control. Derivation of the isotherm.

Chemical Kinetics: Factors affecting the rates of chemical reactions. Rate laws. Order of reaction and molecularity of elementary processes. Relationship of order to mechanism. Rate equation for zero, first and second order reactions. Half lives. Experimental investigation of reaction rates. Sampling and physical methods of following reactions. Determination or order. Effect of temperature on reaction rate. The Arrhenius equation. Presentation of collision and transition state theories. Catalysis, simultaneous reactions, opposing, consecutive, side and chain reactions. Methods for studying fast reactions.

CHM 242 PHYSICAL CHEMISTRY II 2 +0+3 (3 Credits)
Pre-requisite: CHM 201
Ions in Solutions: Bronsted and generalized acid-based concepts; application to aqueous and non aqueous solvents. Equilibria; strengths of acids bases, pH hydrolysis of salts, buffer actions, acid base indicators, titrations, Concepts of activity, Debye Huckel theory. Conductance measurements. Interactions in electrolyte solutions.

Surface Chemistry: Interfacial relationships. Criteria for spreading monomolecular films on water. Adsorption form solution, at gas – solid interface; adsorption isotherms. Classification of colloidal systems. Preparation and properties of lyophilic and lyophobic sols. Ideal solids, glasses and polymers. Colloidal systems, surface energies, wetting, adhesion and contact angles. Insoluble surface films. Micelle formation, Lyophobic and lyophilic properties.

CHM 301 CHEMICAL LITERATURE 1+0+0 (1 Credit)
Use of Internet in literature searching; chemical literature; the scientific journal; Synthetic reaction Search, Structural and Sub structural Searches; the patent Literature; Outline searching.

CHM 311 ANALYTICAL CHEMISTRY 2+0+3 (3 Credits)
Pre-requisite: CHM 201
Processes in analytical Chemistry: Safety in the Laboratory. Sources and nature of errors. Standardization of units, Volumetric analysis. Gravimetric analysis. Qualitative inorganic analysis. Sampling techniques. Principles of solvent extraction. Introduction to separation methods.

CHM 321 INORGANIC CHEMISTRY II 2+0+3 (3 Credits)
Pre-requisite: CHM 221
Chemistry of s-and p-block elements: Relations between electronic structure, size and reactions of compounds. Chemistry of d- and f- block elements: Detection, nomenclature and isomerism of complex compounds. Crystal field theory, d-d spectra detection, nomenclature and isomerism of complex compounds. Crystal field theory, d-spectra, molecular orbital and valence bond theories. Comparative study of the chemistry of the transition elements and their compounds Lanthanides and actinides.

CHM 322 INORGANIC CHEMISTRY III 2+0+3 (3 Credits)
Pre-requisite: CHM 321
Compounds having metal-carbon bonds: sigma – and pi bonded compounds. Their structure, properties and uses. Energy considerations applied to extraction of elements and thermal stability of compounds in aqueous and non-aqueous solvents. Inorganic reactions in solution: Types of reaction, Types of reaction, effects of solvent. Oxidation-reduction and substitution reactions. Kinetics of fast reactions, methods of study of SN^1, SN and ion-pair mechanisms.

CHM 331 ORGANIC CHEMISTRY II 2+0+3 (3 Credits)
Pre-requisite: CHM 231
Review of General organic chemistry, aromatic chemistry: preparation and reactions of benzene derivatives. Electrophilic and nucleophilic substitution in the benzene ring. Carbonyl chemistry and synthetic applications. Stereochemistry: Stereochemistry of organic compounds and optical isomerism of compounds with one or more asymmetric centres. Concepts of chirality and absolute configuration. The synthesis of alicyclic compounds and their stereochemistry. Introduction to mechanistic organic chemistry.

CHM 332 ORGANIC CHEMISTRY III 2+0+3 (3 Credits)
Pre-requisite: CHM 331
Heterocyclic Chemistry: The chemistry of five – and six – membered ring. Heterocyclic compounds containing nitrogen, oxygen and sulphur. Fused heterocycles. Substitution reactions in monocyclic/heterocylic compounds and the benzol – derivatives. Brief treatment of heterocylcic compounds containing more than one hetero-atom. Reactive intermediates: formation and reactions of arynes, carbenes, nitrenes and free radicals. Photochemical generation of reactive species and its use in organic synthesis. Polyfunctional molecules: The interaction of functional groups within a molecules, synthesis and reaction of animoacid. Formation of peptide bond; recemization. Chemistry of hydroxy-acids, hydroxy-ketones and hydroxy-aldehydes. Lactone and lactan formation. Properties of bicarbonyl compounds.

CHM 342 ELECTROCHEMISTRY 1+0+3 (2 Credits)
Pre-requisite: CHM 241 & CHM 242
Chemical Equilibria: Ionic equilibria, Conductance, theory and measurement, interpretation of data for strong and weak electrolytes, Conductance and transport processes. Thermodynamics and galvanic cells. Standard electrode potentials. Practical electrode. Molecular forces in solids and liquids: Dipole moments. Interaction potentials and . forces. Reversible galvanic cells, measurement of e.m.f. Electrode potentials and the electrochemical series. Standard state and the Nernst equation. Applications of e.m.f. measurements (excluding thermodynamic relationships). Potentiometric titration including measurement of pH. Redox reactions. The electrical double layer and its applications.

CHM 351 PROCESS SCIENCE I 2 + 0 + 3 (3 Credits)
Pre-requisite: CHM 201:
Commercial process, problems of scale and cost. Process flow sheet and stiochiometry. 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, bath fractional and continous t\fractional distillation; number of stages; effects of operating variables.

CHM 352 PROCESS SCIENCE II 2 + 0 + 3 (3 Credits)
Pre-requisite: CHM 351:
Mass transfer processes; single phase and interphase, 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 film and liquid film rate determining steps. Solid-liquid separation by filtration and sedimentation. Stoichiometry for systems involving recycles.

CHM 353 MACROMOLECULAR CHEMISTRY I 2 + 0 + 3 (3 Credits)
Pre-requisite: CHM 201:
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.

CHM 354 MANAGEMENT AND CHEMICAL INDUSTRY I 2 + 0 + 0 (2 Credits)
Management Process and Methods: The nature of management and the role with the chemical industry: management theory. Managerial association and specialization. Line and staff structure: functions and relationship. The manager role. Organization structure and management structure. Authority and organization. Corporate policy and organizational constraints on management process. The decision process, managerial techniques 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.

CHM 355 INTRODUCTORY MATERIAL SCIENCE 2+0+0+ (2 Credits)
Pre-requisite: CHM 221
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 an inelastic regions, mechanical, thermal and electrical properties of materials.

Crystal growth and imperfections (defects). Material transformation-deformation, strengthening, electroplating and corrosion.

CHM 356 COLOUR AND TEXTILE CHEMISTRY 2+0+1+ (3 Credits)
Pre-requisite: CHM 353.
Classification of dyes and textile fibres. Natural Regenerated and Synthetic fibers. Physical and Structural Properties of fibers. Preparatory processes: Singeing, desizing, scouring, bleaching, mercerization and optical brightening. Color and constitution. Theory of dyeing. Dyeing preparation, structure, and application of dyes. After treatments and quality control: Colour fastness.

CHM 357 PETROCHEMISTRY 2+0+3 (3 Credits)
Pre-requisite: CHM 231 & CHM 242
Nature, classification and composition of crude petroleum. Characteristic and scope of petroleum industry. Physical and chemical outlay of refinery operations. Oil refining. Crude oils and separation processes. Steam reforming and major reforming reactions. Catalytic cracking and desulfurization. Petrochemicals and the production.

CHM 358 MANAGEMENT AND CHEMICAL INDUSTRY II 2+0+0 (2 Credits)
Pre-requisite: CHM 354
An introduction to the anatomy of management; Industrial Relation; Public Relations; Industrial Psychology; Organizational Design: Management of Personnel; An introduction to the production functions; planning for productivity; General Problem solving processes and creative thinking; Analytical methods of investigation.

CHM 359 GLASSBLOWING PRACTICAL 0+0+3 (1 Credit)
Properties of glass in general use. Manufacturers symbol 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 simple butt joining bulb blowing and bending, rounding off end of tube, taper drawing and reaming, ring seal and side grinding and polishing.

CHM 450 INDUSTRIAL ATTACHMENT (9 MONTHS) 0+0+0 (8 Credits)
Pre-requisite: Students must have passed all required curses up to the end of 6th semester and carry over load must be below 15 units.

All candidates enrolled in the B. Sc or B. Tech. Industrial Chemistry Programme and who have successfully completed all specified required courses for this degree option are required to proceed on industrial attachment normally during their 7th & 8th semesters of residence. The minimum duration of industrial attachment is nine months. All students enrolled in this course would be required to submits a report and give presentation at the end of their period of attachment. The grading will normally be based on the reports, seminars and assessment of the industry base supervisor.

CHM 501 SPECIAL LABORATORY METHODS 1+0+6 (3 Credits)
Pre-requisite: CHM 231
Selected advanced chemistry laboratory exercises to enhance students knowledge and manipulative skills in modern laboratory techniques and methods – viz. Ozonolysis, hydrogenation, hydroboration – oxidation, functional groups protection and de-

protection, high vacuum distillation and other separation methods. Advanced qualitative organic and inorganic analysis.

CHM 511 INSTRUMENTAL ANALYTICAL METHODS 2+0+3 (3 Credits)
Pre-requisite: CHM 351 & CHM 311
Radiochemical methods; fluorescence and phosphorescence; Electroanalytical methods; voltametry; spectroscopy; Theory and practices of gas chromatography; Thermal methods of analysis; High performance liquid chromatography; Automated analytical methods; Enzymatic methods.

CHM 521 NUCLEAR AND RADIATION CHEMISTRY 3+0+0 (Credits)
Revision of proton-neutron nucleus, neutron excess, shell model and nuclear spin. Alpha, megatron, position, electron capture, gamma and internal conversion decay modes of the properties of particles produced – annihilation, range, shielding etc. Health effects, permissible dose level, risk estimates, kinetics of decay, half life and decay curve. Detection systems, solid and liquid scintillation counting. Quenching and channels ratio correction. Natural radioactivity. Induced radioactivity – mass and energy balance including recoil. Binding energy. Fission and fusion. Reactor types classified by fuel, moderator coolant. Introduction to activation analysis. The use of isotopes in reaction mechanism and analysis.

CHM 522 STRUCTURE AND COORDINATION CHEMISTRY 2+0+0 (3 Credits)
Pre-requisite: CHM 221 & CHM 322
Nomenclature, coordination number. Isomerism and stability of complex compounds. Theories of structures i.e. valence bond theory, crystal field theory, molecular orbital and ligand field theories and their relations to bonding in coordination compounds. Kinetics and mechanism of complex formation. Electronic spectra of transition metal complexes as well as their magnetic properties. Preparations, reactions and structure of complexes with – acceptor ligands such as CN, CO and NO. Applications of infrared and nmr spectroscopy to problems of coordination chemistry. Introduction to non-aqueous solvent systems; classification of solvents. Solute-solvent interactions.

CHM 531 MEDICINAL CHEMISTRY 2+0+3 (3 Credits)
Pre-requisite: CHM 233 and CHM 234
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 micosomal enzymes system. Drug-receptor interactions. Bioassay of drugs, pharmacokinetics, the importance of plasma levels of a drug. Drug discovery, design and development. Drug Action: Neurohumoral transmission: Neuromuscular and ganglionic blockade sympathominetics; adrenaline receptors; adrenergic neuron antagonists. Autocoids; Histamine; Serotomin; polypeptides; prostaglandins and related substances; antiallergic, antinflamatory and antipyretic agents. Generally-acting drugs. Opiates, receptors and antagonists; Dopamine receptors and antipsychotic drugs; antidepressants; anti-anxiety drugs. Selective toxicity; The basis of selective toxicity. Survey of host defence mechanisms and the use of chemotherapy. The bacterial cell membrane, effect on its permeability – role of antifungals. Folic acid and the role of antimetabolities. Drug resistance, protein synthesis and its interference. Protozoology – parasites, life cycle of material parasite – other example 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 .

CHM 532 PHYSICAL ORGANIC CHEMISTRY 2+0+3 (3 Credits)
Pre-requisite: CHM 331 & CHM 332
Stepwise and concerted reaction mechanism. Kinetic studies, non-kinetic studies, Nucleophilic displacement reactions. The mechanisms of SN^1, SN^2, SN^1 processes. The effects of structure, enviroment, nature of the nucleophile, solvation factors, added salt etc on the course and rates of reactions, stereochemical concepts. Ester hydrolysis – unimolecular and bimolecular processes. Linear free energy relationships. The Hammet equation; determination of constituent and reaction constants; significance and use of the signs and symbols to + 6m/P+0+6+m/o application to evaluation of mechanistic pathways. Review of reaction intermediates viz. benzyne, carbenes, nitrenes, carbonium ions. Orbital symmetry in Pericyclic reactions. Electrocyclic reactions. Sigmatropic rearrangements. Woodward Hoffman Rule. Huckel Rule and aromaticity.

CHM 533 ORGANIC SYNTHESIS 2+0+3 (3 Credits)
Pre-requisite: CHM 331 & CHM 332
Reduction methods. Catalytic hydrogenation. Reduction with boron and aluminum hydrides and their analogues and derivatives. Metal reductions. Selective reduction in polyfunctional compounds. Oxidation methods. Epoxidation, hydration and Hydroxylation of alkenes, oxidative cleavage of glycol. Peroxyacids and coupling and relevance to biosynthesis survey of synthetic applications of Organometallic Organoboranes. Hydroboration oxidation to ketones. Carboxylation reactions and protonolysis phosphorus halides and their applications. Enamines: synthesis and applications. Formation of polycyclic compounds. Aldol type reactivity and reaction of minimum salts with nucleophile. Synthesis of complex molecules. Pericyclic reactions. Methodology for the construction synthetic routes.

CHM 534 ORGANOMETALLIC CHEMISTRY 2+0+3 (3 Credits)
Pre-requisites: CHM 231, CHM 331 & CHM 332
Classification of donor-bonding types. Substitution in square planar compounds. Physical measurements and their interpretation. Preparation and reaction of model compounds. Catalytic systems. Oxidation, reduction, hydroformulation, polymerization.

CHM 535 NATURAL PRODUCTS 2+0+3 (3 Credits)
Pre-requisite: CHM 231.CHM 331 & CHM 332
Organic natural products, including terpenes, steroids, alkaloids vitamins, antibiotics: synthesis, degradation and biological functions. Pheromone – a review. Conformational effects and interactions in polyfunctional molecules.

CHM 536 FOOD CHEMISTRY 2+0+3 (3 Credits)
Pre-requisite: CHM 231 & CHM 233
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 standards.

CHM 537 AGROCHEMICAL & CHEMOTHERAPEUTIC AGENTS 2+0+3 (3 Credits)
Pre-requisite: CHM 331 & CHM 332
Pesticides, fungicides, and insect sex attractants. Survey of modern approaches to pest and fungal growth control. Naturally occurring pesticides – retenoids, pyrethroids. 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.

Chemotherapeutic Agents: General antibiotic types. Their mode of activity. The tetracyclines or B-lactam antibiotics will be discussed with regard to source, synthetic routes, synthetic analogues, biosynthesis and mode of action. Prostaglandins. Biosynthesis of prostanoic acid, derivatives of E.F.A. and B series of prostaglanding. Synthetic approaches. Cyclophexane analogues.

CHM 540 PHOTOCHEMISTRY 2+0+3 (3 Credit)
Pre-requisite: CHM 331 & CHM 242
Energy levels. Absorption and emission of light. Interaction of radiation with matter. Spin conservation rules. Electronic excitation: Excitation of atoms in the phase, excitation of diatomic molecules, polyatomic molecules, complex polyatomic molecules and other complexes. Selection rules, deactivation routes, energy transfer, simple reactions of stable singlet and triplet states. Reactions of species produced photochemical. Reactions of species produced photochemically. Sensitization and quenching. Conventional photolysis procedure. Flash photolysis. Photosynthesis, Chemiluminescence, vision and the photographic process

CHM 541 SOLID STATE CHEMISTRY 2+0+3 (3 Credits)
Pre-requisite: CHM 242 & 322
Band structure of solids. Electrical, optical and magnetic properties of defects solids. Atom movement and diffusion processes. Surcaces of solids. Reactions of solids, types, kinetic characteristics and parameters. Gas-solid and solid-solid reactions. Application to pigments, semi-conductors and catalysis. Corrosion: Mechanism factors and method of monitoring, prevention and control or corrosion in petroleum and chemical industries. Introduction to stress corrosion concepts.

CHM 542 X-RAY CRYSTALLOGRAPHY 2+0+3 (3 Credits)
The nature of the crystalline state. Principles and uses of x-ray diffraction from single crystals, powders, and polycrystalline materials. X-ray fluorescence spectrometry – principles and industrial applications. Electron probe. Microanalysis. Electro diffraction and the electro microscope. Neutron diffraction.

CHM 543 REACTION KINETICS 2+0+3 (3 Credits)
Second and third order rate equations – review. Rate constant and equilibrium constants – derivation state theory, reaction coordinates, unimolecular reactions theory, bimolecular reaction mechanism; chain reaction mechanisms. Photochemical and electrochemical reactions; complex reaction systems; concurrent, consecutive and chain reactions. Catalysis and heterogenous reactions.

CHM 544 CHEMICAL PHYSICS 3+0+0 (3 Credits)
Pre-requisite: PHY 321, MTH 281 & CHM 242
Theory of bonding in H_2^+ and H_2: Molecular Hamiltonian, exact solution for H_2, Linear combination of atomic orbitals method, valence bond theory, comparison of valence bond and molecular orbital theory, resonance. Coulomb and exchange integrals, evaluation of total energy. Rotation and Vibration of molecules: Rigid rotor, harmonic oscillator, morse potential, inharmonic oscillator, fundamental overtone for harmonic and inharmonic oscillators.
Heat capacities of crystals: Monatomic crystals, Einstein's model, Einstein's characteristic temperatures, Debye theory of crystals and heat capacity, complicated crystal structures.

CHM 545 GROUP THEORY AND SYMMETRY 2+0+3 (3 Credits)
Pre-requisite: CHM 443
A review of molecular symmetry operations; definition of groups; molecular symmetry groups, revision of linear algebra. Group representations; character tables, irreducible representations, point groups, and full rotation group. Applications; hybrid orbitals, symmetry orbitals; ligand field theory, normal mode of vibrations, selection rules and electronic spectra – General symmetry applications; dipole moments optical activity; Woodward – Hoffman rules. Symmetry of crystal lattice.

CHM 551 CHEMISTRY OF INDUSTRIAL PROCESSES 2+0+3 (3 Credits)
Pre-requisite: CHM 351 & CHM 352
Overview of chemical processes and products with emphasis 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, Fluorine, Coal/Oil etc.

CHM 552 GEOCHEMISTRY 2+0+3 (3 Credits)
Elements and its abundance. Geochemical classification of elements. Some aspects of isotope geochemistry. Introductory mineralogy and mode of occurrence of selected ores with reference to Nigeria. Physical and chemical analysis of ore. Some aspects of organic geochemistry mineral processing: practice of crushing. Sizing and concentration of mine products. Introduction to water. Chemistry.

CHM 553 CHEMICAL PROCESS TECHNOLOGY 2+0+3(3Credits)
Pre-requisite: CHM 352
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. Multicomponent vapor-liquid equilibria, bubble points and dew points; key components partial material balances.

The approximate design of Multicomponent distillation columns. Minimum reflux ration, minimum number of theoretical stages; feed point location. Rigorous

simulation procedure; multicomponent 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 feeback and adaptive control. Primary elements, final elements. Nature of offset; one, two and three term algorithms. Response to disturbances. Controller optimization. Control of systems with non-linear response characteristics. Direct digital control. Programmed control regimes.

CHM 554 ENVIRONMENTAL CHEMISTRY 2+0+3 (3 Credits)
The water cycle. Heavy metal and pesticides as pollutants. Mutagenic and other effects of pollutants. Recovery of water by sewage treatment etc. Modern and unusual methods of pollution analysis. Biodegradable macromolecules including detergents. Polymers, biodegradable and photodegradable, and polymer additives photochemical aspects.

CHM 555 MINERAL PROCESSING 2+0+3 (3 Credits)
Physical processing of minerals and their classification. Mineral concentration. Liquid-solid separation and aggregation. Chemical processing of minerals – unit operations, hydrometallurgical processes. Halogen processes and metallurgy; high temperature processes and metallurgical thermochemistry

CHM 556 MACROMOLECULAR CHEMISTRY II 2+0+3 (3 Credits)
Pre-requisite: CHM 353
Polymerization processes; mechanism and kinetics of free radical, ionic and stereo-specific polymerization. Additions of polymerization in bulk, solution, suspension and emulsion. Ring opening polycondensation processes. Gelation Theory. Copolymerization: Addition copolymerization, reactivity ratios, the copolymer-equation. Prediction of reactivity ratios. 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, super-cooling. Inorganic macromolecules; condensed oxyanion structures, silicates; silicon. Solution properties of macromolecules: Thermodynamics of polymers solutions. Morphology, Crystallinity and Orientation

CHM 557 POLYMER TECHNOLOGY 2+0+3 (Credits)
Polymer characterization, criteria for polymer solubility, chain conformation, thermodynamics and phase equilibrium. Molecular weight size and distribution: Rheology of polymers: Mechanical properties and viscoelasticity, structure property relationships. Polymer types: thermosetting elastomers, plasticizers, resins and extrusion, spinning, vulcanization and reinforcement. Blow and injection moulding. Casting, testing and quality control: Chemical analysis. Birefringence measurement physical testing.

CHM 561 RESEARCH PROJECT 0+2+6 (3 Credits)
A selection of topics will be organized and made available to students at the beginning of the 9^{th} semester. The project topics may involve research in the laboratory, library search or an industrially based topic discovered during the period of attachment. If laboratory work is not involved, the topic will be centered on a particular aspect of the main subject discipline in a wider context e.g industrial, social,

economical, political historical and philosophical. Each student will be supervised by one member of the academic staff. The results of the project are to be presented in a typed bound dissertation which will be orally examined at the end of the 10th semester by the external examiner, one academic staff as internal examiner, the supervisor and the Head of Department. A final grade would be determined after consultation among the panelists. The external may moderate the overall grade accordingly.

CHM 571 SEMINAR IN CHEMISTRY 2+0+0 (2 Credits)
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 tonnages. 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) **Writing Research Proposals:** Methodology and Process
*Topics may be chosen from any three of the above in addition to (8) above, during the 10th semester.

1.12 **B.Sc. Mathematics Degree Programme**

2.12.1 **Philosophy, Aims and Objectives of the Degree Programme**

To instill in students a sense of enthusiasm *for* mathematics, an appreciation of its application in different areas and to involve them in an intellectually stimulating and satisfying experience of learning and studying.
To provide students a broad and balanced foundation in mathematics knowledge and practical skills in statistics and computer science.
To develop in students the ability to apply their mathematics knowledge and skills to the solution of theoretical and practical problems in mathematics
To develop in students, through an education in mathematics, a range of transferable skills of value in mathematical related and non-mathematical related employment.
To provide students with knowledge and skills base from which they can proceed to further studies in specialized areas of mathematics or multi-disciplinary areas involving mathematics.
To generate in students an appreciation of the importance of mathematics in an industrial, economic, environmental and social context.

2.12.2 **Admission and Graduation Requirement**

The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, Physics to form the core subjects with credit in any other two relevant science subjects at the Senior Secondary School Certificate or its equivalent. In addition, an acceptable pass in the University.

Candidates with two A level passes (graded A-E) at the Advanced Level in one or more relevant subjects (Mathematics, Further Mathematics ,Physics and Chemistry) may undertake the three – year degree programme into 200-level.

1.12.1 **Learning Outcomes**

a) Regime of Subject Knowledge

All bachelors honours level,Mathematics graduates are expected to develop cognitive abilities and skills relating to intellectual tasks including problem solving in mathematics

b) *Competencies and Skills*

They should be able to demonstrate practical skills relating to the solution of mathematical problems and its applications.

c) *Behaviourial Attitudes*

They should be able to demonstrate general skills relating to non-subject specific competencies, computer literacy, communication skills, interpersonal skills, organization skills, IT skills and life-long learning skills.

1.12.2 **Attainment Levels**

Graduates of Mathematics are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in Mathematics and other related areas in relation to national and societal needs.

1.12.3 **Resource Requirement for Teaching and Learning**

a) Academic and Non-Academic Staff (See Section 1.6)
b) Academic and Non-Academic Spaces (See Section 1.6)
c) Academic and Administrative Equipment (See Appendix)
d) Library and Information Resources (See section 1.6)

1.12.4 **Course Contents and Descriptions**

YEAR 1
100 LEVEL COURSES

MTH 101	Elementary Mathematics I	3
MTH 102	Elementary Mathematics II	3
MTH 103	Elementary Mathematics III	3
PHY 101	General Physics I	3
PHY 102	General Physics II	3
PHY 103	General Physics III	4
CHM 101	General Chemistry I	3
BIO 101	General Biology I	3
GST 101	Use of English	2
CSC 101	Introduction to Computer Science	3
LIB 101	Library Studies	1
		31 Units

A minimum of 12 Units chosen from courses in year 1 Physics, Chemistry, Biology, Economics, Computer Science.

YEAR II

200 LEVEL COURSES

Course No.	**Course Title**	**Units**
MTH 201	Mathematical Methods I	3
MTH 202	Elementary Differential equations I	3
MTH 203	Sets Logic and Algebra I	3
MTH 204	Linear Algebra I	2
MTH 205	Linear Algebra II	2
MTH 207	Real Analysis I	3
CSC 201	Computer Programming I	4
MTH 209	Introduction to numerical analysis	3
STA 211	Probability II	4
GST 201	Communication Skills	2
EPS 201	Entrepreneurship Studies I	2
MTH 210	Vector Analysis	2
		33 Units

YEAR III

300 LEVEL COURSES

Course No.	Course Title	Units
MTH 300	Abstract Algebra I	3
MTH 301	Metric Space Topology	3
MTH 302	Ordinary Differential Equations II	3
MTH 303	Vector and Tensor Analysis	3
MTH 304	Complex Analysis I	3
MTH 305	Complex Analysis II	3
MTH 306	Abstract Algebra II	3
MTH 307	Real Analysis II	3
MTH 308	Introduction to Mathematical Modeling	3
MTH 310	Mathematical Methods II	3
EPS 301	Entrepreneurship Studies II	2
		32 Units

A minimum of 8 units from the list below-

MTH 309	Discreet Mathematics	4
STA 311	Probability III	4
STA 321	Distribution Theory III	2
ST A 331	Statistical Inference III	
MTH 312	Optimization Theory	4
MTH 313	Geometry	4
MTH 314	Analytical Dynamics	3
MTH 315	Dynamics of a rigid body	3
MTH 316	Introduction to operations Research	3
MTH 317	Differential Geometry	3
MTH 319	Numerical Analysis I	3

Electives should be selected from Year III courses in Physics, Computer Science, Economics and Accounting.

YEAR IV

400 LEVEL COURSES

Course No.	Course Title	Units
MTH 401	Theory of Ordinary Differential Equations	3
MTH 402	Theory of Partial Differential Equations	3
MTH 403	Functional Analysis	3
MTH 404	Project	6
MTH 405	General Topology	3
MTH 406	Lebesgue Measure and Integration	3
		21 Units

Electives: A minimum of 9 units from:

MTH 407	Mathematical Methods III	3
MTH 408	Quantum Mechanics I	3
MTH 409	General Relativity	3
MTH 410	Electromagnetism	3
MTH 411	Analytical Dynamics II	3
MTH 412	Field Theory	3
MTH 413	Fluid Dynamics	3
MTH 414	Elasticity	3
MTH 415	Systems Theory	3
MTH 416	Measure Theory	3
MTH 417	Numerical Analysis II	

Course Description

MTH 101 ELEMENTARY MATHEMATIC I: (3 Units) L30: P0: T0)
(ALGEBRA AND TRIGONOMETRY)
Elementary set theory, subsets, union, intersection, complements, venn diagrams. Real numbers; integers, rational and irrational numbers, mathematic I, induction real sequences and series, theory of quadratic equations, binomial theorem. Complex numbers; algebra of complex numbers; the Argand Diagram. Re Moivre's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formalae.

MTH 102 ELEMENTARY MATHEMATICS II: (3 Units) (L30: P0: T 15)
Calculus: Function of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation. Extreme curve sketching; Integration as an inverse of differentiation. Methods of integration, Definite integrals. Application to areas, volumes.

MTH 103 ELEMENTARY MATHEMATICS III: (3 Units) (L30: P 0: T 15)
(Vectors, geometry and dynamics)
Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, Scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional co-ordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Elementary Mathematics IV. Impact of two smooth sphere, and of a sphere on a smooth sphere.
Pre-requisite -MTH 101

MTH 201 MATHEMATICAL METHODS 1: (3 Units) (L30: P 0: T 1)
Real-valued functions of a real variable. Review of differentiation and integration and their applications. Mean value theorem. Taylor series. Real-valued functions of two or three variables. Partial derivatives chain rule, extrema, languages multipliers.

Increments, differentials and linear approximations. Evaluation of line, integrals. Multiple integrals.
Pre-requisite -MTH 103.

MTH 202 ELEMENTARY DIFFERENTIAL EQUATIONS: (3 Units) (L30: P 0: T15)
(Equations 1): Pre-requisite -MTH 103
Derivation of differential equations from primitive, geometry, physics etc. order and degree of differential equation. Techniques for solving first and second order linear and non-linear equations. Solutions of systems of first order linear equations. Finite linear difference equations. Application to geometry and physics.

MTH 203 SETS, LOGIC AND ALGEBRA i: (3 Units) (L30: P 0: T 15)
Pre-requisite -MTH 101
Introduction to the language and concepts of modern Mathematics. Topics include; Basic set theory:mappings, relations, equivalence and other relations, cartesian products. Binary logic, methods of proof. Binary operations. Algebraic structures, semigroups, rings, integral domains fields. Homeomaphics. Number systems; properties of integers, rationals, real and complex numbers.

MTH 204 LINEAR ALGEBRA I: (2 Units) (L15 P 0: T 15)
Pre-requisite -MTH 101,102
Co-requisite -MTH 203
Vector space over the real field. Subspaces, linear independence, basis and dimension. Linear transformations and their representation by matrices - range, null space, rank. Singular and non-singular transformation and matrices. Algebra of matrices.

MTH 205 LINEAR ALGEBRA II: (2 Units) (L15: P0: T 15)
Pre-requisite MTH 101, 102. Co-requisite MTH 203, 204.
Systems of linear equation change of basis, equivalence and similarity. Eigenvalues and eigenvectors. Minimum and characteristic polynomials of a linear transformation (Matrix). Caley -Hamilton theorem. Bilinear and quadratic forms, orthogonal diagonalisation. Canonical forms.

MTH 207 REAL ANALYSIS I: (3 Units) (L30 P 0: T 15)
Pre-requisite -MTH 101, 103
Bounds of real numbers, convergence of sequence of numbers. Monolone sequences, the theorem of nested Intervals. Cauchy sequences, tests for convergence of series. Absolute and conditional convergence of series and rearrangements. Completeness of reals and incompleteness of rationals. Continuity/and differentiability of functions R….) R. Rolles's and mean value theorems for differentiable functions Taylor series.

MTH 209 INTRODUCTION TO NUMERICAL ANALYSIS: (3 Units) (L.30 P0: T 15)
Pre-requisite -MTH 101, 103
Solution of algebraic and transcedental equations. Curve fitting. Error analysis. Interpolation and approximation. Zeros or non- linear equations ‘to one variable’. Systems of linear equations. Numerical differentiation and integratial equations. Initial value problems for ordinary differential equation.

MTH210,VECTOR ANALYSIS
Elementary Vector Algebra, Vector and Tripplre vector Products (more application solution of vector equation, plain curves and space curves. Geometrical equation of lines and planes. Linear independence of vectors; components of vectors, direction cosines; position vector and scaler products; senent frenent formulae; differential definition of gradients, divergent and simple multiplication)

MTH 300 ABSTRACT ALGEBRA I: (3 Units) (L30: P0: T 15)
Pre-requisite -MTH 101, 203
Group: definition, examples including permutation grounds. Subgroups, cosets. Legranges theorem and applications. Cyclic, groups. Rings: definition examples including Z, Zn, rings of polynomials and matrices. Integral domains, fields. Polynomial rings, factorization. Euclidean algorithm for polynomials H.C.F. and L.C.M. of polynomials.

MTH 301 METRIC SPACE TOPOLOGY: (3 Units) (L30: P 0: T 15)
Sets, matrics, and examples. Open spheres (or balls). Open sets and neighbourhoods. Closed sets. Interior, exterior, frontier, limit points and closure of a set. Dense subsets and separable space. Convergence in metric space homeomorphisms. Continuity and compactness, connectedness. Pre-requisite -MTH 202.

MTH 302 ORDINARY DIFFERENTIAL EQUATIONS II: (3Units)
[L30: P 0: T 0 15] Pre-requisite.- MTH 202.
Ordinary differential equations: linear dependence, wronskian, reduction order, variation of parameters, series solution about ordinary and regular points. Special functions: Gamma, Beta, Bessel, lengendre, Hyper geometric. Laplace transform and applications to initial value problems

MTH 303 VECTOR AND TENSOR ANALYSIS: (3 Units) (L30: P0: T 15]
Pre-requisite -MTH 201, 204
Vector algebra. Vector, dot and cross Products. Equating of curves and surfaces. Vector differentiation and applications. Gradient, divergence and curl. Vector integrate, line surface and volume integrals Greens Stoke's and divergence theorems. Tensor products of vector spaces. Tensor algebra. Symmetry. Gartesian tensers.

MTH 304 COMPLEX ANALYSIS: (3 Units) (L30: P 0: T 15)
Pre-requisite -MTH 203, 207
Functions of a complex variable. Limits and continuity of functions of a complex variable. Derivating the Cauchy-Riemann equations. Analytic functions. Bilinear transformations, conformal mappling Contour integrals. Cauchy's theorems and its main consequences, Convergence of sequences and series of functions of a complex variable. Power series. Taylor series.

MTH 305 COMPLEX ANALYSIS II (3Units) (L30: P 0: T 15)
Pre-requisite -MTH 203, 207
Co-requisite -MTH 307
Laurent expansions. Isolated singularities and residues. Residue theorem Calculus of residue, and application to evaluation of integrals and to summato of series. Maximum Modulus principle. Argument principle. Rouche's theorem. The

fundamental theorem of algebra. Principle of analytic continuation. Multiple valued functions and Riemann surfaces.

MTH 306. ABSTRACT ALGEBRA II: (3 Units) (L30: P0: T 15)
Pre-requisite -MTH 203, 206
Normal subgroups and quotient groups. Monomorphic isomorphism theorems. Cayley's theorems. Direct products. Groups of sma1l order. Group acting on sets. Sylow theorems. Ideal and quotient rings. P.I.D. 8, U.F.D 'S euclides rings. Irreducibility; Field extensions, degree of an extension, minmum polynomial. Algebraic and transcendental extensions. Straight edged and compass constructions.

MTH 307 REAL ANALYSIS II: (3 Units) (L30: P0: T 15)
Pre-requisite -MTH 207
Riemann integral of functions R…..)R, continous monopositive functions. Functions of bounded variation. The Riemann Strieltjes integral. Pointvise and uniform convergence of sequences and series of functions R….)R. Effects on limits (sums) when the functions are continuous differentiable or Riemann integrable power series.

MTH 308 INTRODUCTION TO MATHEMATICAL MODELLING: (3 Units)
Pre-requisite -MTH 201, 202, 204 (L 30: P 0: T 15)
Co-requisite -MTH 302, 303
Methodology of model building; Identification, formulation and solution of problems, cause-effect diagrams Equation types. Algebraic, ordinary differential, partial differential, difference, integral and functional equations. Application of mathematical models to pluprical, biological, social and behavioural sciences.

MTH 309 DISCREET MATHEMATICS: (4 Units) (L45:P0:T15)
Groups and subgroups; Group Anioms, Permutation Group, Cosets, Graphys; Directed and un-directed graphs, subgraphs, cycles, connectivity, Application (flow Charts) and state transition graphs; lattics and Boolean Algebra, Finite fields: Minipoly- nomials. Irreducible polynomials, poly-nomial roots, Application (error-correcting codes, sequences generators). MTH -201, 202, 308.

MTH 310 MATHEMATICAL METHODS II (L30: P.O. T 15)
Sturm – Liouville problem. Orthogonol polynomios and functions. Fourier series and integrals. Partial differential equations: general and particular solutions. Linear equations with constant coefficients, first and second order equations, solutions of the heat, wave and laplace equations by the method of separation of variables. Eigen function expansions. Methods of variation of parameters. Fourier transforms.

MTH 312 OPTIMIZATION THEORY: (4 Units) (L45 P0: T15)
Linear programming models. The simplex Method: formulation and theory. Quality integer programming; Transportation problem. Two-person zero-sum games. Nonlinear programming: quadratic programming Kuhn-tucker methods. Optimality criteria. Simple variable optimization. Multivariable techniques. Gradient methods. MTH 201, 202, 302, 303.

MTH 313 GEOMETRY: (3 Units) (L30: P 0: T 15)
Co-ordinate in R3. Polar co-ordinates; Distances between points, surfaces and curve in space. The plane, straight line. Basic projective Geometry, Affine and Eucidean Geometries.

MTH 314 ANALYTICAL DYNAMICS: (3 Units) (L30: P0: T 15)
Degrees of freedom. Holonomic and holonomic constraints. Generalised co-ordinates lagrange's equations for holonomic systems; face dependent on co-ordinates only, force obtainable from a potential. Impulsive force.

MTH 315 DYNAMICS OF A RIGID BODY: (3 Units) (L 30: P0: T 15)
General motions of a rigid body as a translation plus a rotation. Moment, and products of inertia in three dimensions. Parallel, and perpendicular axes theorems. Principal axes, Angular momentum, kinetic energy of a rigid body. Impulsive motion. Examples involving one and two dimensional motion of simple systems. Moving frames of reference; rotating and translating frames of reference. Coriolis force. Motion near the Earth's Surface. The Foucault's pendulum. Euler's dynamical equations for motion of a rigid body with one point fixed. The symmetrical top. Procession.

MTH 316 INTRODUCTION TO OPERATION RESEARCH: (3 Units) (L 30: P0: T 15)
Phases of operation Research Study. Classification of operation Research models, linear; Dynamic and integer programming. Decision Theory. Inventory Models, Critical Path Analysis and project Controls.

MTH 317 DIFFERENTIAL GEOMETRY: (3 Units) (L 30: P0: T 15)
Vector functions of a real variable. Soundedness. Limits. Continuity and differentiability. Functions Cm. Taylor’s Formulae. Analytic functions. Curves: regular, differentiable and smooth. Curvature and torsion. Tangent line and normal plans Vector: Functions of Vector Variable: Linear continuity and limits. Directional functions of Class Cm. Taylor's theorem and inverse function theorem. Concept of a surface; parametric representation, tangent plane and normal lines. Topological properties of simple surfaces. MTH -313.

MTH 319 NUMERICAL ANALYSIS I: 3 Units) (L 30: PO T 15)
Polynomial and splines approximation. Orthogunal polynomials and chebysev approximations. Direct and interactive methods for the solution of systems of linear equations. Eigen value problem – power methods, inverse power methods. Pivoting strategies.

MTH401 THEORY OF ORDINARY DIFFERENTIAL EQUATIONS 3 Units
Differential equations: existence and uniqueness theorems dependence of solution on initial data and parameters. Properties of solutions. Sturm comparison and Sonin-Polya theorems. Linear and non-linear systems. Floguet’s theory and stability theory. Integral equations: classification, volterra and fredlhom types Neumann series. Fredholm alternative for degenerate Hilbert – Schmidt kernels. Reduction of ordinary differential equations to integral equations. Sysmmetric kernels, eigen function expansion with application.

MTH 402 THEORY OF PARTIAL DIFFERENTIAL EQUATIONS 3 Units
Theory and solutions of first-order and second order linear equations. Classification, characteristics, cononial forms, Cauchy problems. Elliptic equations; laplace's and posson's formulase, properties of harmonic functions. Hyperbolic equations; wave equations, retarded potential; transmission line equation, Riemann method. Parabolic equation. Diffusion equation, singularity function, boundary and initial – value problem.

MTH 403 FUNCTION ANALYSIS 3 Units
Hilbert Spaces, bounded linear functionals, operators an Banach spaces, topological vector spaces, Banach algebra

MTH 404 PROJECT: (6 Units)

MTH 405 GENERAL TOPOLOGY: (3 Units) (L30: P0: T 15)
Pre-requisite -MTH 301.
Topological spaces, definition, open and closed sets neighbourhoods. Coarser, and finer topologies. Basis and sub- bases. Separatic axioms, compactness, local compactness, connectedness. Construction of new topological spaces from given ones; Sub-spaces, quotient spaces. Continuous functions, homeomorphons, topological invariants, spaces of continuous functions: Pointivise and uniform convergence.

MTH 406 LEBESGUE MEASURE AND INTEGRALS (3 Units) (L30: P0: T 15)
.Pre-requisite -MTH 207, MTH 307.
Lebesgue measure; measurable and non-measurable sets. Measurable functions. Lebesgue integral: Integration of non-negative functions, the general integral convergence theorems.

MTH 407 MATHEMATICAL METHODS: (3 Units) (L30: P0: T 15)
Calculus of variation: Lagrange's functional and associated density. Necessary condition for a weak relative extremum. Hamilton's principles. Lagrenge's equations and geodesic problems. The Du Bois-Raymond equation and corner conditions. Variable end-points and related theorems. Sufficient conditions for a minium. Isoperimeric problems. Variational integral transforms. Laplace, Fourier and Hankel transforms. Complex variable methods convolution theorems. Application to solution of differential equations. MTH -201, 301, 405, 406.

MTH 408 QUANTUM MECHANICS: (3 Units) (L30: P0: T 15)
Particle wave duality.Quantum postulates.Schroedinger equation of motion. Potential steps and wells in 1-dim Heisenlberg formulation. Classical limit of Quantum mechanic. Computer brackets. Linear harmonic oscillator. Angullar momentum. 3-dim square well potential. The hydrogcn atom collision in 3- dim. Approximation methods for stationery problems.

MTH 409 GENERAL RELATIVITY: (3 Units) (L30: P 0: T 15)
Particles in a gravitational field: Curvilinear coordinates, intervals. Covariant differentiation; Chris-tofell symbol and metric tensor. The constant gravitational field. Rotation. The Curvature tensor.

The action function for the gravitational field. The energy momentum tensor. Newton's law. Motion in a centrally symmetric gravitational field. The energy moment pseudo-tensor. Gravitational waves. Gravitational fields at large distances from bodies. Isotropic space. Space-time metric in the closed and in the open isotropic models. The re shift.

MTH 410 ELECTROMAGNETISM: (3 Units) L30: P 0: T 15
Maxwell's field equations. Electromagnetic waves and Electromagnetic theory of lights. Plane detromagnetic waves in non -conducting media, reflection and refraction at place boundry. Waves guides and resonant cavities. Simple radiating systems. The Lorentz-Einstein transformation. Energy and momentum. Electromagnetic 4-vectors. Transformation of (E.H.) fields. The Lorentz force.

MTH 411 ANALYTICAL DYNAMICS II: (3 Units) (L30: P0: T 15)
Lagrange's equations for non-holonomic systems. Lagrangian multipliers. Variational principles: Calculus of variation, Hamilton's principle. Lagrange's equation from Hamilton's Principles. Canconocal transformations. Normal modes of vibrations. Hamilton-Jacobi equations.

MTH 412 FIELD THEORY: (3 Units) (L30: P0: T 15)
Gradient, divergence and curl: Further treatment and application of the differential definitions. The integral definition of gradient, divergence and curl: Line, surface and volume integrals: Green's Gauss' and Stroke's theorems. Curvilinear coordinates. Simple notion of tensors. The use tensor of notation. MTH -300. Pre-requisite.

MTH 413 FLUID DYNAMICS; (3 Units) (L30: P0: T 0)
Real and Ideal fluids. Differentiation following the motion of fluid particles. Equations of motion and continuity for incompressible invisoid fluids. Velocity potentials and Stoke's Stream functions. Bernoulli's equation with application to flow along curved paths. Kinetic energy. Sources, sinks, doubles in 2-and-3-dimensions, limiting streamlines. Images and rigid planes. MTH -314.

MTH 414 ELASTICITY: (3 Units) (L30: P0: T 15)
Particle gravitational field: Curvilinear coordinates, intervals. Covariant differentiation. Christffel symbol and metric tensor. The constant gravitational field. Rotation.

MTH 415 SYSTEMS THEORY: (4 Units)
Lyapunov Theorems. Solution of Lyapunov stability equation ATP + PA = Q. Controllability and observability. Theorem on existence of solution of linear systems of differential operations with constant coefficients.

MTH 416 MEASURE THEORY: (4Units)
Abstract integration Lp-Spaces.

MTH 417 NUMERICAL ANALYSIS II (3 Units)
Finite difference equation and operations; Discrete variable methods for solution of IUPS – ODES. Discrete and continuous Tan methods for solving IUP – ODES, error analysis. Partial differential equation. Finite difference and finite elements methods. Stability convergence and error analyses.

2.13 B.Sc. Meteorology Degree Programme

2.13.1 Philosophy, Aims and Objectives of the Degree Programmes

a. Provide students with a broad and balanced foundation and practical skills in Meteorology.

b. Develop in students the ability to apply knowledge and skills to the solution of theoretical and practical problems in Meteorology.

c. Develop in students, a range of transferable skills and attitudes that are of value in Meteorological and non-Meteorological employment.

d. Provide students with a knowledge and skills base from which they can proceed to further studies in specialized areas of Meteorology or within multi-disciplinary areas involving Meteorology.

e. Generate in students an appreciation of the importance of Meteorology in an agricultural, socio-economic, environmental and technological development.

f. Produce well-equipped personnel in the areas in which the economy is highly dependent, especially agricultural meteorology; water resources management (hydro-meteorology); transport industry as well as other dependent services such as the Nigerian Meteorological Agency and the military (especially the Air Force and Navy).

g. Instill in the student the capability to carry out and disseminate application-oriented research in the areas (i) - (iii) above.

2.13.2 Admission and Graduation Requirement

UME: The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, Physics to form the core subjects with credit in any other two relevant science subjects at the Senior Secondary School Certificate or its equivalent. In addition, an acceptable pass in the University.

Direct Entry: Candidates with two A level passes (graded A-E) at the Advanced Level in one or more relevant subjects (Mathematics, Physics and Chemistry) may undertake the three – year degree programme into 200-level.

2.13.3 Learning Outcomes

a) Regime of Subject Knowledge

All bachelors honours level, Metereology graduates are expected to develop cognitive abilities and skills relating to agro-meteorology, hydro-meteorology and space meteorology.

b) *Competencies and Skills*
They should be able to demonstrate practical skills relating to the solution on meteorological problems and its applications.

c) *Behaviourial Attitudes*
They should be able to demonstrate general skills relating to non-subject specific competencies, ICT capability, communication skills, interpersonal skills and organization skills.

2.13.4 **Attainment Levels**

Graduates of Meteorology are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in Mathematics and other related areas in relation to national and societal needs.

2.13.5 **Resource Requirement for Teaching and Learning**

a) Academic and Non-Academic Staff (See Section 1.6)
b) Academic and Non-Academic Spaces (See Section 1.6)
c) Academic and Administrative Equipment (See Appendix)
d) Library and Information Resources (See section 1.6)

2.13.6 **Course Contents and Descriptions**

YEAR I
100 LEVEL COURSES

Course Code	Course Title	Units
BIO 101	General Biology I.	3
CHM 101	General Chem. I	3
MTH 101	General Maths. I	3
PHY 101	General Physics I	3
CHM 107	General Chemistry Lab. I	1
PHY 107	General Physics Lab I	1
BIO 107	General Biology Lab. I	1
GST 101	Use of English	2
LIB 103	Library	1
CSC 101	Introduction to Computer Sci.	3
BIO 102	General Biology I.	3
CHM 102	General Chem. I	3
MTH 102	General Maths. I	3
PHY 102	General Physics I	3
CHE 108	General Chemistry Lab. I	1
PHY 108	General Physics Lab I	1
BIO 108	General Biology Lab. I	1
GST 102	Use of English II	2
		38 Units

YEAR II
200 LEVEL COURSES

GST	201	Communication Skills	2
MTH	201	Mathematical Methods	3
MTH	209	Elementary Differential Equations	3
CSC	201	Computer Programming I	3
CSP	201	General Agriculture I	1
MET	201	Codes, Observations & Plotting	2
PHY	209	Introduction to Space	2
EPS	201	Entrepreneurship Studies	2
PHY	202	Electric Circuit & Electronics	3
PHY	204	Waves & Optics	3
MTH	202	Introduction to Numerical Analysis	3
MET	202	Instruments & Environ. Measurement	2
MET	204	Introduction to the Atmosphere	2
GPH	202	Physics of Solid Earth	2
PHY	210	Basic Electronics	3
			36 Units

YEAR III
300 LEVEL COURSES

EPS	301	Entrepreneurial Studies II	3
MTH	301	Vector & Tensor Analysis	3
AGY	307	Principles of Remote Sensing & GIS	3
MET	303	Atmospheric Physics Experiment I	2
MET	305	Atmospheric Thermodynamics	2
MET	307	Fluid Dynamics	2
MET	309	Atmospheric Radiation	3
MET	302	Dynamic Meteorology	3
MET	304	Synoptic Analysis & Current Weather I	2
MET	306	Atmospheric Physics Experiment II	2
MET	308	Cloud Physics & Weather Modification	2
MET	310	World Climatology	3
			30 Units

YEAR IV
400 LEVEL COURSES

Course Code	**Course Title**	**Units**
MET 403	Agrometeorology	3
MET 405	Tropical Meteorology	2
MET 407	Boundary Layer & Turbulence	3
MET 409	Satellite Meteorology	2
MET 413	Synoptic Analysis & Current Weather II	2
MET 415	Hydrometeorology	2
MET 402 A	Industrial Training	4
MET 402 B	Industrial Training	2
MET 402 C	Industrial Training	4
		24 Units

Electives

CHM 319	Environmental Chemistry	2
FWT 409	Biometrics	3

YEAR V
500 LEVEL COURSES

MET 501	Thesis Project	3
MET 503	West African Meteorology	3
MET 505	Marine and Physical Oceanography	3
MET 507	Computer Application in Meteorology	3
CSP 501	Crop/Soil Water Management	3
MET 500	Case Study of Met. Phenomena (Seminar)	2
MET 504	Meso-scale Weather Systems	3
MET 506	Dynamical Oceanography and/sea Interaction	3
MET 508	Advanced Dynamical Meteorology	3
	& Numerical Weather Prediction	3
		29 Units

Electives

Course Code	**Course Title**	**Units**
GS 501	Industrial Management	3
GS 503	Project Analysis	3
CVE 516	Environmental Engineering	3
GS 502	Research Methodology	3

Course Description

MNE 101/201: INTRODUCTION TO MINING AND EARTH SCIENCES:
Structure and history of the earth and the solar system. Rocks and minerals: origin, distribution, diagnostic features and classification. Energy and water resources. Introduction to geophysical prospecting methods. Interpretation of geophysical data. Characteristics of the earth's atmosphere. Atmospheric variables and methods of measurement. weather systems and forecasting. Climate and climatic change. Development of mining technology. States in the life of a mine. Unit operations in mining. Mining and its consequences. Government influence and regulations.

MET 201 – CODES, OBSERVATIONS AND PLOTTING PRACTICE (2 Units)
Basic meteorological variables (wind, visibility, weather, temperature etc.). Few derived variables (QFF, QNH, Dew point etc). Simple meteorological instruments (Thermometer, wind vane, sunshine recorder, hygrometer etc). Auotgraphic Instruments: - Barograph, Thermograph, hygrograph, Pressure – dine anemograph etc. Simple care and maintenance of the instruments. Features of the Stevenson screen and meteorological enclosure (site, location, exposures of instruments e.g. rainguage etc.). WMO approved International Codes (AAXX), (PPAA & PPBB) and ((TTAA), (TTBB)). Plotting of codes on meteorological weather charts. Ease of converting from plotting to codes to observation and vice versa.

MET 202 – INSTRUMENTATION AND ENVIRONMENTAL MEASUREMENT (2 Units)
Fundamental principle of meteorological instrumentation. Basic requirements; sensitivity, errors, durability, ease of use, maintenance. Exposure problems. Spot and continuous measurements: General instrumentation to monitor precipitation, winds, evaporation, solar radiation, temperature, pressure, clouds, visibility and sea salinity. Upper air: radiosonde and radio-theodolite techniques. Use of radar and satellites: Infrared measurement and imagery. Instrumentation in micrometeorology: Soil temperature, moisture and heat flux. Leaf area index, leaf/canopy resistance, solar radiation, eddies. Pollen disposal. Hydrological measurement water current, water table. Observation system: Automatic stations, marine, aircraft and satellite observations.

MET 204 – INTRODUCTION TO THE ATMOSPHERE (2 Units)
Detailed treatment of atmospheric variables (pressure, temperature, etc); their variations in time and space. Moisture variables – mixing ratio, specific humidity etc.

Pressure systems. Pressure gradient and Coriolis force. Atmospheric motion: geostrophic, gradient and thermal wind. Lapse rates – environment, dry and wet adiabatic lapse rates; the effect of latent heat release. Types and characteristics of atmospheric stability.

Relationship between lapse rates, stability and clouds. Types of clouds and their classification. Types of precipitation associated with clouds. Scales of motion in atmosphere. Air masses and source regions. Air masses affecting tropical and temperate regions. ITD and ITCZ. The polar front and fronted slopes. Life cycles of frontal depressions. Frontal cross-sections. Introduction to divergence and vorticity.

Atmospheric optics with applications to rainbow, halo and other optical phenomena, transparency of atmosphere and visual range.

The Universe: Galaxies, stars and the sun. The solar system: Gravitation; the planets; the moons, comets and meteors. The sun: solar atmosphere; activity regions: sunspots, solar flares, solar wind, solar radiation and the Earth's atmosphere.

MET 302 – DYNAMICAL METEOROLOGY (3 Units)
Pre-requisite – MET 204, IMC 302, 303

The physical laws governing atmospheric motion; forces acting on a fluid element.

Equations of motion of a non-inertia (rotating) frame of reference. Effect of the shape of the earth on the equations. Scale analysis of the full equations leading to the hydrostatic, geostrophic approximations. The continuity equation. The thermal wind equations-Barotropic and Baroclinic atmospheres. Thermal wind and jet streams. Thermal wind and advection. Circulation and vorticity. Application to land and sea breezes. Divergence and convergence. Derivations and discussion of the vorticity equation; middle latitude and tropical cases.

The equations of motion in other co-ordinates (e.g. pressure) and their advantages. The primitive equations. The pseudo vertical velocity (w) in pressure co-ordinates. The simple pressure tendency equation. Importance and application to development or otherwise of lows and highs.

Instability mechanism: atmospheric disturbances as consequences of instability. Treatment of barotropic and baroclinic instabilities; convective instability and conditional instability of the second kind (CISK). Atmospheric wave motions.

MET 303 – ATMOSPHERIC PHYSICS EXPT. I (Units)
Basic techniques of laboratory and field research in Meteorology. Use and care of meteorological instruments. Experiments are designed to obtained instruments characteristics and errors such as in thermometers/thermistors, psychrometers and solarimeters. Pilot balloon observations including computations. Real-time data acquisition and analysis.

MET 304 – SYNOPTIC ANALYSIS AND CURRENT WEATHER I (Units)
The concept of Divergence and Vorticity. Scalar analysis of all meteorological variables (temperature, pressure, weather, visibility etc). The meaning of all isolines (isobar, isohyet etc). Streamline to isogon and isotach analysis. Limitations imposed by data sparse regions. Special problems of "Tropical Africa" analysis. Sequences of surface and upper air charts to illustrate different synoptic situations. Gridding Techniques. Evaluation of DIV, VORT, and Vertical motion (Kinematics' analyses).

MET 305 – ATMOSPHERIC THERMODYNAMICS (2 Units)
Pre-requisite – MET 204
Review of gas laws and moisture variables. Law of thermodynamics. Phase changes. Clausius-Claperyon equations. Thermodynamics of moist and dry processes. Derivation of expressions for the adiabatic lapse rates. Parcel tracers; potential temperature: equivalent, saturated and wet-bulb potential temperature etc. Types of

atmospheres. Atmospheric statics: stability criterion for both dry and moist ascent. Thermodynamic diagrams and their uses. Practical exercises with the T-Ø gram; CAPE and the determination of updraft velocities and precipitation rates.

MET 306 – ATMOSPHERIC PHYSICS EXPT. II. (2 Units)
A series of experiments to illustrate meteorological phenomena using physical and/or electrical analogues of soil heat waves, free and forced convection, aerodynamic drag coefficients in fluids, turbulence spectrum, fluid dynamics. Fields measurements of vertical wind profile, grounds heat flux, solar radiator, Bowen ratio, rain-drop size analysis, etc.

MET 307 – FLUIDS DYNAMICS (2 Units)
Pre-requisite – IMC 302, 303.
Introduction and definitions: Properties of fluids, Continuum theory; Short and long-range body forces. Viscosity and thermal conductivity and their importance in meteorology.

Laminar and turbulent motion – transition from one to the other. Reynolds number.

Boundary layer: General momentum, heat and vapour transport. Drag coefficient and roughness parameter. The equation of motion; Eulerian and Lagrangian description. Heat transfer in the fluids. Mass conservation equation. Fluid motion in an inertia system on a rotating earth. Coriolis and Centrifugal forces. Bernoullis equation: expansion and spin in a fluid. Concept of the vorticity equation in a rotating fluid; relevance in dynamic Meteorology.

MET 308 – CLOUD PHYSICS AND WEATHER MODIFICATION (2 Units)
Pre-requisite – MET 204, 305.
Physics of evaporation and condensation. Super-saturation. Atmospheric aerosol – concentrations, size spectra, sources and sinks. The solute effect and cloud condensation nuclei. Micro-structure of warm (tropical) clouds. Equations for growth, terminal velocities and evaporation of falling drops. The micro-physics of cold clouds. Ice nuclei; growth equations. Formation of precipitation in cold clouds. Thunderstorms.

1-dimensional and multidimensional cloud models. Use of satellite and weather radar for monitoring cloud development and precipitation. Artificial modification of weather: warm and cold clouds; fogs, severe storms and precipitation. Socio-economics of weather modification, prospects for the future.

MET 309 – ATMOSPHERIC RADIATION (3 Units)
Pre-requisite – MET 305, 308.
Electromagnetic spectrum and radiation laws. Black body radiation and characteristics. The sun: solar constant and its measurement. Absorption, scattering and transmission of radiation. Attenuation of radiation and radiative transfer. Solar spectral radiation under cloudy and cloudless conditions. Main absorption bands; Simpson and other empirical methods of estimation. Terrestrial radiation and energy budget. Simple radiation and climate models. Vegetation and ground heat fluxes. The greenhouse effect. Derivation of heating and cooling rates. The Elsasser radiation diagram and its uses.

MET 310 – WORLD CLIMATOLOGY (3 Units)
Scope and definition of climatology. Climatic elements. Decomposition of climatic elements into zonal, meridional, standing and transient circulations. Mean global atmospheric circulations as represented by the wind, temperature, pressure, humidity etc.

Jet stream climatology. Synoptic and dynamic considerations for their formation and maintenance. Jet streams of the world (poles, midlatitudes and tropics).

Global energy budget and heat transfer. Angular momentum consideration and implications for energy and Jet stream maintenance. Mechanisms of achieving global balance in the various climatic elements; the roles of the eddies in the general circulation. Climatic trends and climatological forecasting techniques.

MET 320 – FIELD TRIP (During Long Vacation)

MET 403 – AGROMETEOROLOGY (3 Units)
Pre-requisite – MET 204, 202, IMC 208.
Weather observations for Agriculture, the meteorological variables: winds, precipitation, evaporation, evapotranspiration (potential and actual) temperature, winds and humidity extremes. Suggestion of suitable regions for crop production (agroclimatic zoning). Local variations and crop/animal production. Investigation of atmospheric conditions within a crop. Electrical analogues.

Farming systems: Cultural practices including land preparation timing and technique as functions of the climate. Soil erosion. Crop-weather modelling for yields and growths. Microclimate modification for crop/animal production; irrigation, mulching, frost protection, wind breaks, evaporative cooling, etc.

MET 405 – TROPICAL METEOROLOGY (2 Units)
Pre-requisite – MET 301, 302.
The mean state of the tropical atmosphere. Winter and summer situations. Major motion systems: ITD, ITCZ (in detail), monsoons, TEJ, AEJ, Instability of tropical flows; structure and dynamics of easterly waves and vortices. Upper level flows. The westerly jet in winter. Usefulness of Global efforts and experiments for the tropics – GATE, FGCE, MONEX and WAMEX. Present forecasting methods and difficulties in the tropics:

El Nino, ENSO, dynamical and statistical/empirical methods. Climate change with special focus on the tropics. Influence of ocean dynamics. Future prospects.

MET 407 – BOUNDARY LAYER AND TURBULENCE (3 Units)
Pre-requisite – MET 305, 307; IMC 302.
Simplifications used in describing the boundary layer. Constant and variable eddy viscosity. Wind profile near the surface; Ekman spiral. Log and power laws for neutral stability Roughness length. Stability parameters: Richardson's number (Ri), and its flux form; Monin-Obukhov parameter, Z/L, and its relation to Ri. Similarity theory. Dispersion of pollutants in boundary layer (e.g. smoke, dust).

Specification of turbulent fields: velocity correlation and cross-correlations (with temperature and moisture). Turbulent energy equation. Eddy transfer coefficients. Turbulent transports of heat, moisture and momentum. Flux profiles. Bowen ratio and Penman's formula for heat and evaporation estimates. Importance of eddy transports especially for agriculture and tropical weather systems.

MET 409 SATELLITE METEOROLOGY (2 Units)
Satellite orbits, types of satellites, visible and infrared imagery. Surface temperature measurements; upper air temperature and moisture soundings; determination of upper winds. Problems of interpretation of data and assignment of levels to wind measurements effects of local influences (e.g. mountains). Uses of satellite information in weather forecasting, soil moisture monitoring, dust haze occurrence and movement, drought occurrence.
Pre-requisite – MET 305, 308 & 401

MET 411 – AERONAUTICAL METEOROLOGY
Pre-requisites (MET201 AND MET304).
Advanced Streamline and isobaric analysis (Emphasis on Africa and her sub-regions). Contour heights analysis. Frontal analysis and X-sections. Ascent analysis emphasising convective systems.

CODES : METAR, TAFOR, ARFOR, ROFOR, & FIFOR.

MET 413 – SYNOPTIC ANALYSIS & CURRENT WEATHER II (2 Units)
Pre-requisite – MET 304.
LOW LEVEL FORECASTING : forecast for take-off forecast for landing, wind shear and turbulence forecasting. Sutcliff development areas. A-geostrophic systems and their implications in forecasting. Forecasting of all meteorological parameters and systems (wind, visibility, fog, turbulence squall lines, Thunderstorms etc). Flight documents preparations. Briefing, de-briefing and use of AIREP. Role of jet streams in forecasting. Forecasting indices.

MET 415 HYDROMETEOROLOGY (2 Units)
Pre-requisite – MET 204.
The hydrological cycle and major precipitation processes. Conversion of rainfall measured at a point to area estimate; topographic influence. Evaporation processes; Measurement and estimation of evaporation by Penman's method.

Water balance; periods of surplus an deficit. Soil moisture infiltration, soil moisture storage and measurement of flow in natural channels and with structures. Factors affecting runoffs, storm run-off and the unit hydrograph. Effect of vegetation on water balance. River basin development in relation to river regimes. Droughts and its effect on ground water movement and table. Hyrometeorological practice & forecasting; present techniques and trends in the tropics.

MET 503 – WEST AFRICAN METEOROLOGY (3 Units)
Pre-requisite – MET 302, 405.
West African Climatology: the pressure, wind, temperature and moisture regimes; the ITD; the inter and summer situations of the distributions. The AEJ and TEJ. Weather system of West Africa: easterly waves, vortices, squall line, thunderstorms

and the monsoon. Interdependence of the systems; the significance of the two jets (AEJ and TEJ) to the weather systems. Atmospheric pollutants in West Africa: Dust haze (tropical/extratropical interactions); fog; mechanisms for occurrence and clearance prospects. Rainfall variability; the "little dry season" of West Africa. Rainfall prediction models: onset and cessation; the present and future trends.
East African Meteorology; the wind systems and peculiarities.

MET 504 – MESO-SCALE WEATHER SYSTEMS (3 Units)
Pre-requisite – MET 302.
Review of atmospheric scales of motion. Scaling analysis – equations of motion applicable to meso-scale motions. tropical meso-scale systems: vortices, shearlines. Thunderstorms/squall lines, cloud clusters, Hurricanes, typhoons. Cold and warm fronts; baroclinic instability. Theory of frontal development. Energy source for meso-scale disturbances. The CISK and other mechanisms: Divergence and vorticity in tropical meso-scale disturbances. Difficulties in studies of meso-scale systems; effects of orography. Convection (cumulonimbus) models. Lands and sea breezes and their dynamics. Economic aspects of meso-scale systems. Rainfall production by meso-scale disturbances.

MET 505 – MARINE AND PHYSICAL OCEANOGRAPHY (3 Units)
The major ocean currents; characteristics, similarities and connection with atmospheric general circulation. Under-water topography and effects on upwelling and sea surface temperatures and hence climate, with special reference to the Gulf Stream, El Nino and the Gulf of Guinea currents etc. sea fogs. Definition of water masses by temperature and salinity. Oceanic gyres, eddies and fronts; comparison with synoptic meteorology; cross-sections across oceanic fronts. Stratification in the Oceans: the creation, growth and decay of transient and seasonal thermoclines; Tracer (dye) studies of thermoclines, internal waves on thermoclines.

Ocean convection: measurement of vertical currents; slicks and windrows; importance of convection and stratification in relation to ocean pollution. Instrumentation: the bathy thermography, the temperature salinity bridge, sea surface temperature measurements of sea and swell-salinity: Instrumented buoys. Oceanographic forecasting – importance to fishermen, oil companies and the Navy. Sea surface temperature maps.

MET 506 – DYNAMICAL OCEANOGRAPHY & AIR/ SEA INTERACTION (3 Units)
Pre-requisite – MET 302, 505
Horizontal and vertical extent of oceans. Changes in salinity by molecular diffusion. Specific heat and thermal conductivity of sea-water: heat sources and exchanges; ocean heat budget; diffusion of heat and salt by turbulent mixing. Changes in oceanic salts distribution by vertical mixing and horizontal advection. Forces and the relationship to the structure of the ocean. Dynamical equations governing steady oceanic currents; the Rossby and Ekman numbers and characteristic values in some observed current. Geostropohic currents – barotropic and baroclinic mass transports.
Air-sea interaction; winds and waves; wind-driven currents in the Ekan layer; the Ekman spiral. Ekman transport; the thermocline; swells and tides.

MET 507 – COMPUTER APPLICATIONS IN METEOROLOGY (3 Units)
Review of numerical methods relevant to Meteorological applications: Finite-differences and derivative expressions in terms of forwards, backward and centred differences; implicit and semi-implicit formulations. Solution of differential equations with given boundary conditions using the FORTRAN language.

Time series analysis and filtering techniques. Statistical analysis applied to Agro-meteorological, Hydro-meteorological and climatological problems (e.g. evaluation of linear and multiple correlation and regression analysis. Auto-correlation and simple power spectrum analysis.

MET 508 – ADVANCED DYNAMICAL MET. AND NUMERICAL PREDICTION (3 Units)
Pre-requistie – MET 302, IMC 302, 413.
Derivation and study of the quasi-geostrophic system of equations. Sutcliffe's development theorem. The basic equations of motion in the sigma-co-ordinates. The geopotential tendency and omega equations. Atmospheric energetics; available potential energy; energy conversions; Lorentz's and Pearce's formulations. Applications of energetic analysis to atmospheric motions on various scales.

The set of basic equations used in numerical weather prediction; stability and filtering of unwanted waves; "initialisation and adjustment procedures and schemes in numerical modelling". Prediction models: single, two – and multi-level models. (The 2-hour practical is to be utilised for simple prediction exercises to be run on the computer by each student).

2.14 B.Sc. Microbiology Degree Programme

2.14.1 Philosophy, Aims and Objectives

The programme has been designed to provide a sound understanding of the concepts of micro-organisms in relation to mankind and the environment. The programme will elaborate the importance of micro-organisms in the industry, health and environmental sectors of the society. The Microbiology programme will also emphasis the traditional biotechnology and the linkage to the current modern biotechnology. The main objectives of the programme are to broadly educate students for positions in the industry, health sectors, research institutes and to prepare them for graduate and professional studies in the life applied areas of microbiology.

2.14.2 Admission and Graduation Requirement

UME
The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, to form the core subjects with credit in three other relevant science courses Biology, Chemistry, and Physics at the Senior Secondary School Certificate or its equivalent. In addition, an acceptable pass in the University Matriculation Examination (UME) into 100-level is required.

Direct Entry
Candidates with two A level passes (graded A-E) at the Advanced Level in one or more relevant subjects (Biology, Botany, Chemistry, Geography, Mathematics and Physics) may undertake the three – year degree programme into 200-level.

2.14.3 Learning Outcomes

All Bachelors honours degree student in Microbiology are expected to develop the following abilities and skills:

a. *Regime of Subject Knowledge*
Cognitive abilities and skills relating to solution of problems in Microbiology
b. *Competencies and Skills*
Practical skills relating to the conduct of laboratory and industrial work in Microbiology
c. *Behavioral Attitudes*
General skills relating to non-subject specific competencies, communication, ICT knowledge, interpersonal, organization skills and ethical standards.

2.14.4 Attainment Levels

Graduates of Microbiology are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in Microbiology in relation to national and societal problems.

2.14.5 **Resource Requirement for Teaching and Learning**

a) Academic and non-academic staff. (See section 1.6)
b) Academic and Non-Academic Spaces (See section 1.6)
c) Academic and Administrative Equipment (See Appendix)
d) Library and Information Resources (See section 1.6)

2.14.6 **Course Contents and Descriptions**

YEAR I
100 LEVEL COURSES

Courses	**Title**	**Unit**
MCB 121	Introduction to Microbiology	3
BIO 101	General Biology I	3
BIO 102	General Biology II	3
CHM 101	General Chemistry I	3
CHM 102	General Chemistry II	3
CHM 107	Chemistry Practice I	1
PHY 101	General Physics I	3
PHY 102	General Physics II	3
CSC 101	Introduction to Computer Science	3
MTH 101	General Mathematics I	3
MTH 102	General Mathematics II	3
GST 101	Use of English	2
LIB 101	Library Studies	1
		44 Units

Electives
To be selected from Botany, Zoology, or other Biological/Chemistry courses.

YEAR II
200 LEVEL COURSES

Courses	**Title**	**Unit**
MCB 221	General Microbiology	3
MCB 231	Basic Techniques in Microbiology	2
BIO 211	Introductory Genetics & Cell Physiology	4
ZOO 211	Invertebrate Zoology	3
TFT 211	Introduction to Food Science	3
CHM 259	Physical for the Life Sciences	3
GST 201	Communication Skills	2
EPS 201	Entrepreneurship Studies I	2
BOT 242	General Techniques in Botany	2
CHM 277	Polyfunctional Group & Aromatic Chemistry with Mechanism of Reaction	4
CHM 229	Basic Inorganic Chemistry for Non-majors	3

BIO	212	Introductory Ecology	3
STA	201	Statistics for Agriculture & Biological Sciences	4
TFT	211	Introduction to Food Sciences	3
			41
BOT	241	General Botany III	3
BOT	271	Introduction to Ethnobotany	3
ARC	211	Archaeological Theory & Practice	4
ZOO	211	Invertebrate Zoology	3
CSC	272	Information Management Systems	4

YEAR III
300 LEVEL COURSES

Courses	**Title**	**Units**
MCB 307	Immunology	3
MCB 321	Mycology	3
MCB 322	Bacterial Diversity	3
MCB 391	Industrial Attachment	3
MCB 324	Microbial Ecology	3
MCB 325	Soil Microbiology	3
MCB 326	Introductory Virology	3
MCB 328	Biodeterioration	2
		23 Units
BOT 351	Introduction to Plant Diseases	3
BIO 311	Genetic Variability & Evolution	3
EPS 301	Entrepreneur Studies II	2
TFT 311	Food Microbiology	3
ZOO 312	Biology of Tropical Parasites	3
CSC 231	Scientific Programming:	3
CSC 291	Elementary Data Processing	3
		20 Units

YEAR IV
400 LEVEL COURSES

Courses	Title	Units
MCB 491	Research Project	4
MCB 423	Industrial Microbiology	3
MCB 404	Advanced Food Microbiology	3
MCB 401	Essays in Microbiology	3
MCB 403	Pharmaceutical Microbiology	3
MCB 405	Principles of Epidemiology & Public Health Microbiology	3
MCB 407	Pathogenic Microbiology	3
MCB 412	Microbial Genetics	3
MCB 424	Microbial Physiology & Metabolism	3
MCB 425	Environmental Microbiology	3
MCB 482	Virology & Tissue Culture	3
MCB 430	Microbiological Quality Assurance	2
MCB 431	Petroleum Microbiology	3
		39

Electives

ZOO 412	Principles of Parasitology	4
BOT 451	Host Pathogen Relations & Plant Disease Management	3
BOT 417	Plants & Environmental Pollution Monitoring	3
BOT 463	Introduction to Mushroom Growing Technology	3

Course Description

MCB 121 INTRODUCTORY MICROBIOLOGY (3 Units) (L 30: P 45)
History of the Science of Microbiology. Sterilization and disinfection; Structure, ecology and reproduction of representative microbial genera. Cultivation of microorganisms. Isolation of microorganisms; isolation of bacteria, viruses.

MCB 221 GENERAL MICROBIOLOGY (3 Units) (L 30: P 45)
Nutrition and biochemical activities of microorganisms. Antigens and antibodies. Identification and economic importance of selected microbial groups. Microbial variation and heredity.

MCB 231 BASIC TECHNIQUES IN MICROBIOLOGY (2 Units) (P 45)
Culturing of microorganisms; preparation of media for microbial growth. Isolation of pure culture; streaking, pour plates etc; subculturing procedures. Staining techniques for differentiation of microorganisms. Enumeration of microorganisms, direct and indirect procedures. Identification of microorganisms to include colonial and cellular morphology and biochemical procedures.

MCB 307 IMMUNOLOGY (3 Units) (L.15: P 45)
Introduction. Historical background. Innate and acquired immunity. Antigens, antibodies, cellular immunity. Immunological tolerance and suppression. Surgical grafting. Complement System. Hypersensitivity. Immunological anomalies. Diagnostic immunology, Vaccines, effector systems of parasite killing and nature of resistance in plants.

MCB 309 FOOD MICROBIOLOGY (2 Units) (L 15: P 30: T 0)
Pre-requisite: MCB 201/202; bch 201
The distribution, role and significance of micro-organisms in food; intrinsic and extrinsic parameters of foods that affect microbial growth, food spoilage and food borne diseases. Micro-organism. Indices of food sanitary growth and food microbiology standards. Disease of animal transmitable to man via food products.

MCB 322 BACTERIAL DIVERSITY (3 Units) (L15: P 45)
The morphology, life cycle and biochemical characteristics of bacteria. Systematic study of bacteria and other prokaryotes, their nature, characteristics, identification and isolation.

MCB 324 MICROBIAL ECOLOGY (3 Units) (L30: P 45)
Microbes and ecological theory. Physiological, morphological and genetic adaptations of microorganisms to their environment. Microbial interactions; microorganisms in natural ecosystems. The life of microorganisms in air, springs, rivers, lakes and seas. Cycling of elements in water and sediments.

MCB 325 SOIL MICROBIOLOGY (3 Units) (L 15: P 45)
The characteristics of soil environment; microbial flora and fauna of soil; microbial activities in soil; Nitrogen cycle, mineral transformation by microorganisms. Ecological relationship among soil pathogens. Effect of pesticides on soil microorganisms. Biodegradation and biofuels generation. Microbiology of the rhizosphere.

MCB 326 INTRODUCTORY VIROLOGY (3 Units) (L30: P 45)
General characteristics of plant, animal and bacterial viruses; viral replication, spread and cytopathic effects. Virus classification, purification and assay. Regulation of lytic development and maintenance of the Lysogenic state in bacteriophages lambda, P2 and 14 single stranded DNA and RNA phageviroids as pathogens.

MCB 328 BIODETERIORATION (2 Units) (L 30: P 15)
Principles of microbial deterioration of materials. Materials subject to microbial deterioration: Foods, Jet fuels, paper, paints, textiles and leather, metals etc. Factors favoring deterioration of materials. Major microbial groups involved in deterioration. Impact of processing and new technologies on biodeterioration. Biodeterioration Control.

MCB 391 INDUSTRIAL ATTACHMENT (3 Units) (3 MONTHS)
Students will be posted to industrial establishments such as food processing, brewing, distillery, pharmaceutical, research institutes or medical and health institutions. A report to be submitted for grading.

MCB 401 ESSAYS IN MICROBIOLOGY (3 Units) (L 0)
Detailed literature search followed by presentation at a departmental Seminar of a scientific topic, which must be of microbiological or biotechnological interest.

MCB 403 PHARMACEUTICAL MICROBIOLOGY (3 Units) (L 15: P 45)
Concepts of growth and death in microorganisms. The chemistry of synthetic chemotherapeutic agents and antibiotics. Production and synthesis of antibiotics and antiseptics. Relationship of antimicrobial agents to different microbial groups: Gram positives, Gram negatives, spore-formers etc . The mode of action and assay of antibiotics and antiseptics. Sensitivity and resistance as related to microbial physiology. Microbiological quality control in the Pharmaceutical industry.

MCB 404 ADVANCED FOOD MICROBIOLOGY (3 Units) (L 45: P 15)
Advanced ecology, taxonomy, biochemistry and analytical technology of bacteria, yeasts, fungi and viruses associated with food spoilage, food-borne diseases and fermentations. Emphasis on new developments in Food Microbiology; economic consequences of microorganisms in food; exploitation of microorganisms in novel processes for the production of food ingredients.

MCB 405 PRINCIPLES OF EPIDEMIOLOGY & PUBLIC HEALTH MICROBIOLOGY (3 Units) (L 45: P 15)
Statistical applications to epidemiology. Nature of epidemiological investigations. Spectrum of infections. Herd immunity. Latency of infections. Multifactorial systems in epidemics. Zoonoses. Antigenic drifts. Biological products for immunization. Schedules for International control of infectious diseases.

MCB 407 PATHOGENIC MICROBIOLOGY (3 Units) (L 30: P 45)
Study of some microbial pathogens of plants and animals with emphasis on those prevalent in Nigeria. The geographical distribution, isolation, identification, morphology, life cycle, source of infection, transmission and the host. Ecology, clinical manifestations of specific bacterial, viral and fungal pathogens of man.

MCB 412 MICROBIAL GENETICS (3 Units) (L 30: P 45)
Principles of genetic analysis. Plasmids and transposable genetic elements, mutagenesis and DNA repairs, bacteriophage genetics and genetics of Nitrogen fixation. Mechanism and nature of mutation, induction, isolation and characterization of mutants. Genetic recombination in prokaryotes including transformation, transduction, phage conversion and conjugation. Recent techniques in microbial genetics. Chemical coding and expression of genetic information. Fungal genetics. Principles and applications of genetic engineering.

MCB 423 INDUSTRIAL MICROBIOLOGY (3 Units) (L30: P 45)
Fermentation systems; design and use of fermenters. Microorganisms of Industrial importance. Classification of microbial products by use. Relationship between primary and secondary metabolism; characteristics, sources and strain improvement of industrial microorganisms. Microbial growth and product formation in industrial processes; media for industrial fermentations. Foaming, Major products of Industrial Microbiology: enzyme production and immobilization; production of vitamins, amino acids, antibiotics, organic acids, beer and wine

MCB 424 MICROBIAL PHYSIOLOGY & METABOLISM (3Units) (L 15: P 45)
Dynamics of growth. Nutrition and energy metabolism of microorganisms. Effect of physical and chemical factors on growth. Biochemistry of various microbial processes such as transport, regulation and respiration. Biosynthesis of microbial products. Buffer preparation and standardization. Basic separation techniques in microbiology, dialysis, salting out, gel filtration, electrophoresis etc. Assay techniques for various metabolites including microbial enzymes, acids etc.

MCB 425 ENVIRONMENTAL MICROBIOLOGY (3 Units) (L 15: P 45)
Impact assessment of microbial contamination of soil, water and air in relation to the deterioration of the environment. Soil, air and water pollution. Waste disposal and management. Methods of water and sewage treatment with emphasis on specific microorganisms involved. Disease transmission by water. Biological and Chemical Oxygen

MCB 430 MICROBIOLOGICAL QUALITY ASSURANCE (2 Units) (L 30: P 15)
A theoretical and practical consideration of the management of microbiological quality assurance. HACCP, cleaning and sanitation. Microbiological specifications and regulations. Local and international approaches to obtaining safe food. Management and quality assurance in the microbiology laboratory.

MCB 431 PETROLEUM MICROBIOLOGY (3 Units) (L 30: P 15)
Biogenesis of fossil fuels with emphasis on the role of microorganisms. Petroleum prospecting and secondary recovery. Microbial corrosion of pipes and equipment. Methanogenesis and methanotrophy. Effects of oil spill on microbial activities in aquatic and terrestrial ecosystems. Biodeterioration and biotransformation of hydrocarbons.

MCB 482 VIROLOGY & TISSUE CULTURE (3 Units) (L 15: P 45)
Structure, properties and classification of viruses. Principles of isolation, cultivation and maintenance of plant and animal cells *in vivo*. Application of cell culture technique in virology. Viruses as agents of diseases in animals.

MCB 491 RESEARCH PROJECT (4 Units) (P 45)
A research project and dissertation to be undertaken on any topic of microbiological and/or biotechnological interest.

2.15 B.Sc. Physics Degree Programmes

2.15.1 Philosophy, Aims and Objectives of the Programme

a. To provide students with a broad and balanced foundation of physics knowledge and practical skills.

b. To instill in students a sense of enthusiasm for physics, and appreciation of its applications in different contexts.

c. To involve the students in intellectually simulating and satisfying experience of learning and studying.

d. To develop in students the ability to apply their knowledge and skills in Physics to the solution of theoretical and practical problems.

e. To develop in students through an education in Physics a range of transferable skills of value in physics and other areas.

f. To provide students with a knowledge and skills base for further studies in physics or multi-disciplinary areas involving physics.

2.15.2 Admission and Graduation Requirement

UME
The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, Physics and Chemistry to form the core subjects with credit in one other relevant science subject at the Senior Secondary School Certificate or its equivalent. In addition, an acceptable pass in the University Matriculation Examination (UME) into 100-level is required.

Direct Entry
Candidates with two A level passes (graded A-E) at the Advanced Level in one or more relevant subjects (Biology, Botany, Chemistry, Geography, Mathematics and Physics) may undertake the three – year degree programme into 200-level.

2.15.3 Learning Outcomes

All Bachelors honours degree students in Physics are expected to develop the following abilities and skills:

a. *Regime of Subject Knowledge*
Cognitive abilities and skills relating to solution of problems in Physics and Physics related disciplines.

b. *Competencies and Skills*
Practical skills relating to the conduct of laboratory and industrial work in Physics.

c. *Behavioral Attitudes*
General skills relating to non-subject specific competencies, communication, ICT knowledge, interpersonal, organization skills and ethical standards.

2.15.4 **Attainment Levels**

Graduates of Physics are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in Physics in relation to national and societal problems.

2.15.5 **Resource Requirement for Teaching and Learning**

a) Academic and non-academic staff. (See section 1.6)
b) Academic and Non-Academic Spaces (See section 1.6)
c) Academic and Administrative Equipment (See Appendix)
d) Library and Information Resources (See section 1.6)

2.15.6 **Course Contents and Descriptions**

YEAR I
100 LEVEL COURSES
CORE COURSES

Course No.	**Course Title**	**Units (L. P. T.)**
MTH 101	General Mathematics I	3
MTH 102	General Mathematics II	3
PHY 101	Mechanics, Thermal Physics & Waves	3
PHY 102	Electricity, Magnetism & Modern Physics	3
PHY 107/108	General Physics Laboratory I& II	2
CHM 101	General Chemistry I	3
CHM 102	General Chemistry II	3
CHM 107/108	General Chemistry Laboratory I & II	2
BIO 101	General Biology I	3
BIO 102	General Biology II	3
BIO 107/108	General Biology Laboratory I & II	2
GST 101	Use of English	2
CSC 101/102	Introduction to Computer Science	4
LIB 101	Introduction to Library	2
		38 Units

YEAR II

200 LEVEL COURSES
CORE COURSES

Course No.	Course Title	Units (L. P. T.)
PHY 201	Elementary Modern Physics V	3
PHY 202	Electric Circuits and Electronics	3
PHY 204	Waves and Optics	3
PHY 205	Thermal Physics	3
PHY 206	General Physics VI	1
PHY 207/208	Experimental Physics I & II	4
STAT 203	Statistics for Physical Sciences	3
MTH 201	Mathematical Methods I	3
PHY 209	Introduction to Space Science	2
PHY 210	Physics of the Solid Earth	2
MTH 202	Elementary Differential Equations	3
CSC 201	Computer Programming I	4
GST 201	Communications Skills	2
EPS 201	Entrepreneurship Studies I	2
		38 Units

YEAR III

300 LEVEL COURSES
CORE COURSES

Course No.	Course Title	Units (L.P.T.)
PHY 301	Analytical Mechanics I	3
PHY 302	Analytical Mechanics II	3
PHY 303	Electromagnetism	3
PHY 304	Electromagnetic Waves and Optics	3
PHY 305	Quantum Physics	3
PHY 306	Statistical and Thermal Physics	3
PHY 307/308	Experimental Physics II	2
PHY 320	Workshop Practice	2
PHY 314	Solid State Physics	3
PHY 315	Electronics I	2
PHY 316	Electronics II	2
PHY 309	Energy and Environment	1
EPS 301	Entrepreneurial Skills II	2
		35 Units

YEAR IV

400 LEVEL COURSES
CORE COURSES

Course No.	Course Title	Units (L. P.T.)
PHY 401/402	Quantum Mechanics I & II	6
PHY 403/404	Mathematical Methods in Physics	6
PHY 407	Computational Physics	3
PHY 455	Supervised Independent Research	6
PHY 423	Solid State Physics	3
PHY 424	Atomic and Molecular Spectroscopy	3
		27 Units

ELECTIVES

Any 9 Units from units from the following areas:

Nuclear and Particle Physics I & II
Geophysics
Medical Physics
Atmospheric Physics
Biophysics
Astronomy

Course Description

PHY 101 GENERAL PHYSICS I: (3 Units) L 30: P0: T 15)
(Mechanics, Thermal Physics and Waves)
Space and Time, Units and dimension, Kinematics; Fundamental Laws of Mechanics, statics and dynamics; work and energy; Conservation laws.
Elasticity; Hooke's law, Young's shear and bulk moduli, Hydrostatics; Pressure; bouyance, Archimedes' Principles., Surface tension; adhesion, cohesion, capilarity, drops and bubbles. Temperature; heat; gas laws; laws of thermodynamics; kinetic theory of gases. Sound, Applications.

PHY 102 GENERAL PHYSICS: (3 Units) L 30: P0: T 15)
(Electricity, Magnetism and Modern Physics)
Electrostatics; conductors and currents; dielectrics; magnetic fields and induction; Maxwell's equations; electromagnetic oscillations and waves; Applications.

PHY 107/108 GENERAL PHYSICS LABORATORY: (2 Units)
This introductory course emphasizes quantitative measurements, the treatment of measurement errors, and graphical analysis. A variety of experimental techniques will be employed. The experiments include studies of meters,. the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc., covered in PHY 101, PHY 102, and PHY 103.

PHY 201 GENERAL PHYSICS V: (3 Units)
(Elementary Modern Physics) Pre-requisite -PHY 102
Special Relativity; Defects in Newtonian Mechanics; the speed of light; the Lorentz transformation; transformation of velocities. Experimental basis of quantum theory: Black body radiation; electrons and quanta; Bohr's theory of atomic structure; Do Broglie hypothesis the uncertainty principle; Schrodinger's equation and simple applications.

PHY 202 ELECTRIC CIRCUITS AND ELECTRONICS; (3 Units)
Pre-requisite -PHY 102
D.C. Circuits; Kirxhoff's Laws, sources of end and current, network analysis and circuit theorems. A.C. Circuits. Inductance, capacitance, the transformer, sinusoidal wave-forms runs and peak values, power, impedance and admittance series RLC circuit, Q factor, resonance, Network analysis and circuit theorems, filters. Electronics; semiconductors, the pn-junction, field effect transistors, bipolar transistors, Characteristics and equivalent circuits, amplifiers, feedback, oscillators.

PHY 204 GENERAL PHYSICS IV (Waves and Optics): (3 Units)
Pre-requisites -PHY 101, PHY 102, and MTH 102
Wave phenomena; Acoustical waves; the harmonic oscillator; waves on a string; energy in wave motion; longitudinal waves; standing waves; group and phase velocity; Doppler effect; Physical Optics; Spherical waves; interference and diffraction, thin films; crystal diffraction, holography; dispersion and scattering. Geometrical Optics; Waves and rays; reflection at a spherical surface, thin lenses, optical lenses; mirrors and prisms.

PHY 205 THERMAL PHYSICS: (3 Units)
Pre-requisites -PHY 103 and MTH 102
The Foundations of classical thermodynamics including the zeroth and definition of temperature; the first law, work heat and internal energy; Carrot cycles and the second law; entropy and irreversibility, thermodynamic potentials and the Maxwell relations. Application: Qualitative discussion of phase transitions: third law of thermodynamics; ideal and real gases. Elementary kinetic theory of gases including Boltzman couting, Maxwell-Boltzman Law of distribution of velocities, simple applications of the distribution law.

PHY 206 GENERAL PHYSICS VI: (1 Unit)
Energy and Power; Principles, demands and outlook; transformation of energy and its costs; thermal pollution; electrical energy from fossil fuels; hydroelectric generation: Principles and problems. Costs, capacity, storage, reserves, efficiency, new environmental effects. Electrical energy from nuclear, reactors; energy in the future breeder reactors; fusion power, solar power, geothermal power, tidal power, etc. Promise and problems. Lectures (15)/Excursions

PHY 207/208 EXPERIMENTAL PHYSICS I & II: (2 Units)
Pre-requisite -PHY 107/108
The laboratory course consists of a group of experiments drawn from diverse areas of Physics (Optics, Electromagnetism, Mechanics, Modern Physics, etc.) It is accompanied by seminar studies of standard experimental technique and the analyses of famous and challenging experiments.

PHY 209 INTRODUCTION FOR SPACE SCIENCE
Introduction to Astronomy and Astrophysics, Satellite Communication, introduction to atmospheric Science, Space Environment, Space craft systems and Dynamics, Aero/Astrodynamic Engineering, Rocket Engineering, Cosmology, Origin of universe and life, Space Law and Business development.

PHY 210 PHYSICS F SOOID EARTH
Origin, shape, structure and major devisions of the earth. The Earth's main magnetic field and its distribution. Electrical theory of the aerth's care and origin of the magneticf field seafloor spreading, continental drift and plate tectonics.

PHY 301 ANALYTICAL MECHANICS I: (3 Units)
Pre-requisites -MTH 201, and MTH 204
Newtonian Mechanics; motion of a particle in one, two and three dimensions; systems of particles and collision theory; Newtonian gravitation; conservative forces and potentials, oscillations, central force problems; accelerated frames of reference; rigid body dynamics; generalized motion; methanics of continuous media.

PHY 302 ANALYTICAL MECHANICS II: (3 Units)
Degrees of freedom; Generalized coordinates Lagrange's formulation of mechanics, Applications. The Calculus of variations and the action principle. Hamilton's formulation of mechanics, Application. Invariance and conservation laws. Oscillatory systems, including damped, forced and coupled oscillations; Normal modes.
Pre-requisite -PHY 301

PHY 303 ELECTROMAGNETISM: (3 Units)
Pre-requisites -PHY 201 and MTH 204
Electrostatics and magnetostatics. Laplace's equation and boundary value problems; Multiple expansions, oielectric and magnetic materials. Faraday's law. A.C. Circuits. Maxwell's equations. Lorentz covatiance and special relativity.

PHY 304 ELECTROMAGNETIC WAVES AND OPTICS: (3 Units)
Pre-requisite -PHY 303
Maxwell's equations and electromagnetic potentials. The wave equation. Propagation of plane waves. Reflection and refraction. Transmission lines, waves gides and resonant cavities; Radiation, Geometrical optics, Interference of waves. Diffraction.

PHY 305 QUANTUM PHYSICS: (3 Units)
Pre-requisite-PHY201
Wave-particle duality and the Uncertainty Principle; basic principles of the quantum theory; energy levels in potential wells; reflection and transmission of potential barriers; Atomic and molecular structure and reactions, fision and fusion; magnetic resonance; elementary particles.

PHY 306 STATISTICAL AND THERMALPHYSICS: (3Units)
Pre-requisites -PHY 103 and PHY 305
Basic concept of statistical mechanics; microscopic basis of thermodynamics and applications to macroscopic systems, condensed states, phase transformations,

quantum distributions; elementary kinetic theory of transport processes, fluctuation phenomena. Applications.

PHY 307/308 EXPERIMENTAL PHYSICS II: (2Units)
Pre-requisite-PHY207/208
A year long series of mini courses on important experimental techniques. Topics covered include electronics, optics, electricity, atomic, molecular nuclear and low temperature physics, statistics and data handling and scientific writing.

PHY 314 SOLID STATE PHYSICS: (3 Units)
Pre-requisite -PHY 305
Crystal structure and crystal binding. Elastic properties; lattice vibrations. Super-conductivity.

PHY 401 QUANTUM MECHANICS I: (3 Units)
Pre-requisites -PHY 305 and MTH 202
The formulation of quantum mechanics in terms of state vectors and linear operators. Three-dimensional spherically symmetric potentials. The theory of angular momentum and spin. Identical particles and the exclusion principle. Methods of approximation. Multielectron atoms.

PHY 402 QUANTUM MECHANICS II: (3 UNITS)
Pre-requisites -PHY 401 and MTH 202.
Time-independent and time-dependent perturbation theory. Scattering theory: elastic potential scattering; Green's function and partial wave methods. Selected phenomena from each of atomic physics, molecular physics, solid-state physics, and nuclear physics are described and then interpreted using quantum mechanical models.

PHY 403/404 MATHEMATICAL METHODS IN PHYSICS: (6 Units)
Pre-requisites -MTH 202, MTH 204 and MTH 305
Linear Algebra and Functional Analysis; Transformations in linear vector spaces and matrix theory. Hilbert space and complete sets of orthogonal functions. Special Functions of Mathematical Physics. The gamma function; hypergeometric functions; Legendre functions; Bessel functions. Hermite and Languerre function, The Dirac Delta function. Integral Transforms and Fourier Series: Fourier series and fourier transforms; Laplace transform. Applications of transform methods to the solution of elementary differential equations of interest in physics and engineering. Partial Differential Equations: Solution of boundary value problems of partial differential equations by various methods which include: Separation of variables, the method of integral transforms. Sturm-Liouville theory; Uniqueness of solutions. Calculus of residues and applications to evaluation of integrals and summation of series. Applications to various physical situations, which may include -electrogagnetic theory, quantum theory, diffusion phenomena.

PHY 407 COMPUTATIONAL PHYSICS; (3 Units)
Pre-requisite -MTH.
Use of numerical methods in Physics; various methods of numerical integration, differentiation, numerical solutions of some differential equations in physics, Statistical analysis of experimental data.

PHY 411 NUCLEAR AND PARTICLE PHYSICS I: (3 Units)
Pre-requisite -PHY 305
Nuclear structure: Nuclear properties, nuclear size, nuclear masses; Nuclear forces, nuclear -nucleon scattering; the deuteron. Nuclear models. Radio-active Decay: Alpha, beta, gamma decays. Nuclear reactions.

PHY 412 NUCLEAR AND PARTICLE PHYSICS II: (3 Units)
Pre-requisite -PHY 401
Nuclear Instrumentations and radiation detection techniques; detectors. Nuclear spectroscopy. Neutron physics: Production, detection of neutrons. Fission and fussion. Nuclear reactor and nuclear energy. Elementary particles: Conservation laws, particle classification. Strong, electromagnetic and weak interactions. Resonances.

PHY 413 ADVANCE PHYSICS OF EARTHS INTERIOR
Structurer of Earth, conductivity, heat flow, Elasticity, dynamo theory, magnetic field.

PHY 414 INDUSTRIAL GEOPHYSICS
Seismic, gravitational, magneticf/electrical induced polarization, protecting for economic minerals, solution of civil engineering problems.

PHY 415 RADIATION INSTRUMENTS
Ionization Chamber, Geigercounter, scinctillation counter, X-ray equipment, Solid state detectors, Gammer ray Cameras.

PHY 416 MEDICAL NUCLEAR PHYSICS
Production of Isolopes , nuclear scanning and tracers, Nuclear magnetic resonance) Interaction of Radiation with matter, (X-ray and gammar rays, Thomson scattering photoelectric effect, Compton scattering, pair production, atternation.

PHY 417 AERONOMY
Composition of atmosphere, solar terrestial interactions magnetic fields and storms

PHY 418 METEOROLOGY
Meteorological parameters and their measurement temperature, pressure, wind etc. Weather and climate.

PHY 419 STELLAR STRUCTURE AND EVOLUTION AND GALAXIES
Hydrostatic and thermal equilibrium, Energy transport, stellar models

PHY 420: MODERN COSMOLOGY AND HIGH ENERGY ASTROPHYSICS
Hubles law, gravity, Luminousity and redshift. High energy particles, cosmic rays, solar wind schock waves, supernovae, neutron stars, pulsars.

PHY 421 BIOPHYSICS I
Ionization of biomoldes, Thermodynamic Principles Energy transfer in living systems Bioelectricity – ion charnels, action potentials nerve impulse transmission. Study of the electric cell.

PHY 422 BIOPHYSICS II
Optics of the eye, photoenergy transduction in vision, sound waves receive and the ear learning aids, Human voice, Ultrasound/applications Fluid flow and viscosity – applications blood pressure, osmotic pressure, centrifugation, surface tension and applications.

PHY 423 SOLID STATE PHYSICS II: (3Units)
Pre-requisite -PHY 401
Dielectric properties. Magnetism: Paramagnetism and diamagnetics; ferromagnetism and antifer- romagnetism; Magnetic resonance. Imperfections in solids.

PHY 424 ATOMIC AND MOLECULAR SPECTROSCOPY: (3Units)
Pre-requisite –PHY 402.
The hydrogen atom; relativistic effects and spin. Identical particles and symmetry. Many electron atoms. Coupling schemes and vector model. Seeman effecct. Hyperfine structure. The diatomic molecule; the Frank-Condon principle. X-ray diffraction. Microwave methods. Resonance phenomena; ESR, NMR, and optical pumping and Mossbauer scattering.

PHY 455 SUPERVISED INDIVIDUAL RESEARCH: (6 Units)
The course offers students the opportunity to do research in contemporary physics and under the supervision of staff. A detailed report on the research is presented by the student when the project is completed.

2.16 BSc. Science Laboratory Technology Degree Programme

2.16.1 Philosophy, Aims and Objectives of the Degree Programme

The Science Laboratory Technology Programme shall provide its students with a broad based knowledge of theoretical, technological and practical knowledge in the Multi-disciplinary fields of Laboratory Technology.
The programme provides a five-year training to candidates that meet the minimum entry requirements for university education in Nigeria. To provide students with a broad and balanced foundation of laboratory science technology knowledge and practical skills in the areas of

(i) Management of Institutional, Industrial and Research Laboratories and workshop to meet the technological needs of Nigeria.
(ii) Designing, execution and coordination of science –based experiments and research in the laboratories and workshops
(iii) Purchase and maintenance of stock of laboratory and workshop materials.

2.16.2 Admission and Graduation Requirements

(a) **UME**
Five (5) credit Level passes in SSCE (WAEC or NECO)/GCE O/L in Physics, Chemistry, Biology, Mathematics and English Language obtained at not more than two (2) sittings. Equivalent qualifications such as NABTEB are acceptable. WAEC and NECO will not be combined.

(b) Direct Entry:
OND at Upper Credit Level plus the required credit Level passes at SSCE/GCE O/L or equivalent.

Learning Areas

(i) Biology/Microbiology/Biotechnology Techniques
(ii) Chemistry/Biochemistry Techniques
(iii) Physics/Electronics Techniques
(iv) Geology/Mining Techniques
(v) Physiology/Pharmacology Techniques
(vi) Chemical/Petroleum Techniques

Course System and Grade Point Average

(i)	STB/STM	-	Biology/Microbiology Techniques
(ii)	STC, ST/BCH	-	Chemistry/Biochemistry Techniques
(iii)	ST/PE	-	Physics with Electronics Techniques
(iv)	STG	-	Geology/Mining Techniques
(v)	GLT	-	General Laboratory Techniques
(vi)	MAT	-	Mathematics
(vii)	ST/PP	-	Physiology/Pharmacology Technique
(ix)	ST/CP	-	Chemical/Petroleum Techniques (ST/CP)

To be eligible for the award of the degree, a candidate must satisfy the following conditions:

(i) Pass all University/Faculty Compulsory Courses

(ii) Pass all departmental core courses

(iii) Spend the minimum number of semesters prescribed by the University

(iv) Complete not less than six months of approved practical field work during the long vacation.

(v) Obtain the required total credit units as approved by the senate of the University.

2.16.3 **Learning Outcomes**

All Bachelors honours degree students in Science Laboratory Technology are expected to develop the following abilities and skills:

a. *Regime of Subject Knowledge*
Cognitive abilities and skills relating to solution of problems in Science Laboratory Science Technology.

b. *Competencies and Skills*
Practical skills relating to the conduct of laboratory and industrial work in Science Laboratory Technology.

c. *Behavioral Attitudes*
General skills relating to non-subject specific competencies, communication, ICT knowledge, interpersonal, organization skills and ethical standards.

2.16.4 **Attainment Levels**

Graduates of Science Laboratory Technology are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in Science Laboratory Environment in relation to national and societal problems.

2.16.5 **Resource Requirement for Teaching and Learning**

a) Academic and non-academic staff. (See section 1.6)
b) Academic and Non-Academic Spaces (See section 1.6)
c) Academic and Administrative Equipment (See Appendix)
d) Library and Information Resources (See section 1.6)

2.16.6 **Course Contents and Descriptions**

Common Courses for all Students

100 LEVEL

FIRST SEMESTER

COURSE No.	COURSE No. TITLE	UNITS
ST/PE 101	General Physics 1	3
ST/PE 103	General Physics III	2
ST/PE 107	General Physics Lab. I	1
STC 101	General Chemistry I	4
STB 101	General Biology I	4
MAT 101	Basic Mathematics 1	3
GLT 101	Technical Drawing	3
GNS 101	Use of English I	2
	Total	**22**

SECOND SEMESTER

COURSE No.	COURSE No. TITLE	UNITS
ST/PE 102	General Physics II	3
ST/PE 108	General Physics Lab. II	2
STC 102	General Chemistry II	4
STB 102	General Biology II	4
MAT 102	Basic Mathematics I1	2
GLT 102	Workshop Technology and Practice	2
GNS 102	Use of English II	2
GLT 104	Glass Technology	
	Total	**22**

MTH 101 ALGEBRA (3 CREDITS)

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

MAT 102 VECTORS, MECHANICS AND GEOMETRY (3 CREDITS)

Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, Scalar, multiplication of vectors. Linear independence. Scalar and scalar variable. Two-dimensional coordinate geometry. Straight lines. Circles, parabola. Eclipse, hyperbola. Tangents, normals, Kinematics of a particle, Components of velocity and acceleration of a particle moving in a plain. Force, momentum, laws of motion, under gravity, projectiles, resisted vertical motion, elastic string, simple, simple pendulum impulse. Impact of two smooth sphere and of a sphere on a smooth sphere.

MAT 122 STATISTICS FOR PHYSICAL SCIENCES

Measure of location and dispersion in simple and grouped data exponential. Elements of probability and probability distribution, normal, binomial, poison, geometric, Negative binomial distributions. Estimation and tests of hypothesis concerning the parameters of distribution. Regression, correlation, and analysis of variance contingency table Non-parametric inference.

MAT 201 MATHEMATICAL METHODS

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

MAT 244 STATISTI CAL FOR BIOLOGICAL SCIENCES

MAT 302 COMPLEX ANALYSIS

Functions of a complex variables. Limit and continuity of functions of a complex variable. Derivation of the Cauchy-Riemann equations. Analytic functions. Bilinear transformations conformal, mapping, Contour integral, Cauchy's integral, Cauchy's theorems and its main consequences. Convergence of sequences and series of functions of a complex variable. Power series. Taylor series.

MAT 141 INTRODUCTION TO COMPUTER SCIENCE I

History of Computers, functional components of a computer, characteristics of a computer system. Broad introduction to programming methodology. Emphasis is on problem solving strategies and techniques for developing/documenting computer applications, including principles of structured programming, problem decomposition, problem organisation, the use of procedural abstraction and basic debugging skills. Basic programming languages as a tool.

MAT 142 INTRODUCTION TO COMPUTER SCIENCE II

General introduction to computer programming. Emphasis on learning to write programs to solve problems in familiar applications, such as payroll, computer-assisted instruction, ecology, library science, etc. Structured programming. Visual BASIC programming languages as a tool in a window environment.

MAT 241 INTRODUCTION TO FORTRAN PROGRAMMING

An introduction to digital programming with emphasis on mathematical problems, using FORTRAN programming language. Introduce students to computers, compilers and editor, and they are expected to write medium-sized programs.

MAT 242 PROGRAMMING LANGUAGES AND ENVIRONMENTS

Current issues on Programming Languages and Environments. Language topics include: object oriented, concurrent, functional and logic. Programming, and other programmable applications such as symbolic manipulations and stimulation. Environment topics include: computer aided software engineering tools, user interface tools and standards, and program development tools.

GLT 102 WORKSHOP TECHNOLOGY AND PRACTICE

General safety rules and regulations in the workshop with emphasis on the following elements: workers, working tools, machines and working environment.

Introduction to Simple Woodwork Practice: Woodwork tools and equipment – types and uses. Woodwork machines and accessories – types and uses. Various types of woodwork joints and uses. Basic types of wood and use. Wood seasoning and application in the laboratory.

Introduction to Simple Metal Work Practice: Metalwork tools and equipment – types and uses. Metals in use in engineering industry – ferrous and non-ferrous castings. (Mode of production and basic applications). Bench-work practice-cutting, chipping, filing and use of taps and dies. Bench drilling machine-part, operators, and users. Students lathe machine-parts, operators and users. Arc and gas welding processes.

Scope of Practical Work: Woodwork practical designed by lecturers test students dexterity in woodwork joint and wood shaping processes such as fee square, drawing board, photo frames, chilling's saving boxes etc Metalwork practical designed by lecturers t test students dexterity in bench-work, drilling machine, and lathework practice such as male and female mating of parts.

GLT 104 GLASS –BLOWING TECHNOLOGY

The origin and nature of glass simple analysis of glass composition. Types of glass commonly used in the laboratory. Properties of different glasses commonly used in the laboratories. Identification of glass by physical, flame and chemical methods. Design of glassblowing workshop. Identification of various tools and equipment used in the glassblowing workshops. The use of **NON-RETURN** valve and didymian goggles. Hazards of glassblowing, safety measures and regulation, Glass tubing storage.

Construction of Simple Glass Apparatus: Glass cutting and various types of glasscutting techniques. Manipulations of simple glass blowing tools and machines. Burners: Surface and premix bunners. "**POINT PULLING"** and various methods of glass manipulations. End deals – for making test tables. Blow bulbs at thaw ends and in the middle of glass tubes. Butt seals of various diameters.

Bends for delivering tubes and manometers. Tee joints and the attendant problems, ring deals. Strains and stress, annealing and strain-viewer.

GLT 201 INSTRUMENT MAINTENANCE I

Electrical and Electronic Components – Electrical quantities, Ohm's Law in circuitry, resistors, capacitors, semi-conductors; transducers, photo emissive, photo-multipliers and photodiodes.

Measuring instruments – Analytical, Audio-Visual, and diagnostics. Care and safety; practical use of measuring instruments.

Study of components Layout: Circuit training, referring to manufacturer's data. Reading circuit diagrams, repair differential electronic devices.

Maintenance, services, and repair procedures of electric devices, electrical and electronic circuits, circuit diagrams and designs, types of maintenance. Factors affecting maintenance. Corrective maintenance.

Power supplies.

GLT 202 HAZARDS AND SAFETY IN THE LABORATORY/LABORATORY MAINTENANCE AND FIFTINGS

Accidents and Control Measures: Common laboratory accidents/injuries and their control measures: hazards and caution in the use of electricity supplies. Causes of fire in the laboratory. Precautions against first and explosion. Action in an emergency involving fire and explosion and implosion. Burns and scalds. Types and operation of fire fighting equipment.

First Aid Treatment: First aid treatment of more common injuries encountered in laboratories. Treatment of shock. Dealing with the various bleeding. Wounds, burns and poison, Eye injuries.

First Aid Box: Description, construction, location and contents of first aid box.

Maintenance of Laboratory Equipment: Avoidance of waste improvision techniques. Installation of common laboratory equipment. Care and maintenance of Laboratory Equipment. (a) trouble shooting and faults finding (b) Servicing and repairs of common laboratory equipment.

Laboratory Fittings: Standard laboratory fittings and services; correct use and care. The necessity to clean and tidy benches and floors in the laboratory. Cleaning of different types of bench-top and flooring materials. Identification and location of master switches and master gas corks. Colour code of compressed gas cylinders, electrical resistors and for services lines. Precaution in handling and use of compressed air and liquefied gas cylinders.

GLT 411 LABORATORY ORGANISATION AND MANAGEMENT I

Planning and designs of laboratories. Ways of acquiring laboratory accommodation. Flexibility in laboratory design. Special features of teaching, industrial, research and hospital laboratories. General space requirements; laboratory layout, provision of services; floors, windows, doors, benches; cupboards and drawer units, mechanical services – heating and ventilating, fume; cupboards, lighting, electrical supplies, water supplies, piped gases; safety in design, decoration, allocation of floors in multi-storey buildings.

Management of Stores: Stores policy; stores design and planning – storage of chemicals, hazardous materials, storage of apparatus; documentation.

Laboratory Administration: Technical information – filling systems, indexing systems, dewey decimal classification, laboratory records and record-keeping, office facilities and equipment, decision-making – seeking advice, staff meetings, advisory committee, meetings, formal committee meetings.

Maintenance of Laboratory Premises and Equipment: Planned maintenance – inspection of premises and equipment.

Service Departments and Special – Purpose Rooms: Glassware washing and sterilizing facilities; radioisotope laboratories; photographic units, cold-rooms, hot-rooms; animal houses; reprograhic units, laboratory workshops, audio-visual aids – audio-aids, visual aids; glassblowing shops.

GLT 501 PHOTOGRAPHY AND ILLUSTRATIONS

Concepts and Fundamentals of Photography: Cameras: The general principles, manipulation and care of different types of cameras in common use, their advantages and disadvantages

Photomicrography: Techniques and application

Lighting System: Daylight, "Photoflood", exposure meters, depth of field, background.

Printing Process: Projection and contact printing, choice and grades of paper, local control, finishing.

Colour Photography: Colour photography principles f reversal and of negative-positive processes. Types of materials; colour temperature, filters, exposure.

Cine Photography: Cine photography, use of 8mm cameral, video camera splicing and editing of commercially processed film.

Safety: Hazards in the use of photographic reagents. Darkroom management.

GLT 508 LABORATRY ORGANISATION AND MANAGEMENT II

Management Techniques and Functions: The concept and relevance of management to laboratory practice. Meeting of Organisation, Supervisory skills and management functions; Planning; organizing; forecasting; motivating, coordination, controlling and communicating etc. Purchasing of laboratory materials, sources of funds and different methods of purchasing. Preparation of purchasing orders Receipt and storage of ordered materials. Issuing of materials. Stock control management. Record keeping in the laboratory. Design and execution of scientific experiments and projects. Different types of scientific experiments. Scientific measurements and data collections. Literature search and retrieval. Factors affecting accuracy of experimental measurements. Preparation and presentation of experimental data – thesis/dissertation. Ways of presenting seminars.

Selection and Management of Staff: Job description; the advertisement; application forms – references; interviewing and selection – final selection; contracts and conditions of service; induction; training and further education – motivation in technical education, recent developments in technical training and education, laboratory discipline; termination of employment.

Organisation of Laboratory Practice: Elements of law. Common and statutory laws and relevance to laboratory practice such as health, and safety, welfare of employees, and cruelty to animals. Import and exercise duties. Nature of contract. Elements of contract. Contract in relation to purchasing of laboratory materials, employment etc. Legislation regulating the science laboratory practice in Nigeria (NISLT Act No. 12 of 2003). Structure of NISLT and functions. Legal and professional responsibilities of technologists. Organization of laboratory services in Nigeria – public and private laboratories. Professional code of ethics. Types of business organization. Small business management. Production, Entrepreneurship and business development. Industrial relations.

Health and Safety: The basic approach – The health and safety at work etc Act of 1974; organization of laboratory safety – line management, safety officers, safety committees, codes of practice, general attitude to laboratory safety, accident books and records, notable accidents; the hazards – fire, fire prevention, fire-fighting equipment, fire drills, fire escapes, fire prevention advice, electrical and electronic equipment; radiation and the use of radioactive substances; cylinders of compressed gas; centrifuges; cryogenic substances; physical injuries; chemical; occupational hygiene; dermatitis and skin reactions, toxic substances and threshold limit values; carcinogens; bacterial, viruses and other biohazards.

Biological Sciences Techniques

200 LEVEL

FIRST SEMESTER

FIRST SEMESTER

COURSE No.	**COURSE TITLE**	**UNITS**
STB 201	Genetics I	3
STB 203	General Physiology	2
STB 205	Introductory Developmental Cell Biology	3
STB 203	Organic Chemistry I	2
STB 209	Lower Invertebrates	2
STB 213	Basic Principles in Botany	3
STM 207	General Microbiology I	3
STB 211	Seed Plants	2
GNS 204	Information Retrieval	1
	Total	**21**

200 LEVEL

SECOND SEMESTER

COURSE No.	**COURSE TITLE**	**UNITS**
STB 202	Introductory Ecology	2
STB 204	Biological Laboratory Tech. I	3
STB 208	Cell Biology and Histology	3
GNS 202	Principles of Economics	2
MAT 224	Statistics for Biological Sciences	4
IMC 142	Introduction to Computer Science	2
GLT 202	Hazards and Safety in the Lab	2
		18

300 LEVEL

FIRST SEMESTER

COURSE No.	**COURSE TITLE**	**UNITS**
STB 301	Genetics II	3
STB 303	General Cytology	3
STB 305	Molecular Biology	3
ST/BCH 201	Gen. Biochemistry I	3
STB 315	Seedless Plants	3
STB 313	Biological Techniques II	3
	Total	**18**

300 LEVEL

SECOND SEMESTER

COURSE No.	COURSE TITLE	UNITS
STB 302	Industrial Field Course I	1
STB 304	General Ecology	3
STB 306	General physiology II	3
STM 317	General Parasitology	3
STB 310	General Entomology	3
ST/BCH 202	Gen. Biochemistr54y II	3
STM 306	Mycology	2
STM 314	Microbial Genetics and Molecular Biology	2
		20

400 LEVEL
FIRST SEMESTER

COURSE No.	COURSE TITLE	UNITS
STB 401	Population Genetics	3
STB 403	Cytogenetics of Plants	3
STM 409	Food Microbiology	3
STB 413	Biology of Pests of Stored, Products and their Control	3
STB 415	Storage Techniques	2
STB 411	Principles of Storage Engineering	2
STB 423	Microbial Ecology	2
	Total	**18**

400 LEVEL

SECOND SEMESTER

COURSE No.	COURSE TITLE	UNITS
STB 402	Industrial Training (Site Work Supervision)	4
STB 404	Industrial training (University Supervision)	4
STB 406	Industrial Training (Report)	4
	Total	**12**

500 LEVEL
FIRST SEMESTER

COURSE No.	**COURSE TITLE**	**UNITS**
STB 501	Photography and Bioillustration	3
STB 503	Project	3
STB 525	Advanced Toxanomy Of Anglosperms	3
STB 507	Vectors and Pests Management	3
STB 509	Applied Parasitology	3
STB 529	Economic Botany	3
STB 527	Plants and Environmental Pollution Monitoring	3
STB 511	Soil Ecology	3
	Total	**24**

500 LEVEL
SECOND SEMESTER

COURSE No.	**COURSE TITLE**	**UNITS**
STB 502	Applied Storage Techniques	3
STB 508	Applied Vectors and Pests Mgt	3
STB 506	Food and Storage Chemistry	3
STB 503	Project	3
STB 510	Seminar	2
STB 514	Systematic Biology	3
STB 526	Biological Techniques III	3
STB 512	Food Processing	3
STB 506	Food Analysis	2
	Total	**25**

Course Descriptions

STB 201 GENETICS 1
Hereditable and non-hereditable characteristics probability and tests of goodness of fit. Quantitative inheritance variation in genous structure introduction to population genetics.

STB 202 INTRODUCTORY ECOLOGY
Concept and definitions of ecosystems in relation to animals and plants. Established relationships.

STB 203 GENERAL PHYSIOLOGY
Physical and chemical processes in animal and plant physiology.

STB 204 BIOLOGICAL LABORATORY TECHNIQUES I

Microscopes: Types – simple and compound microscopes. Range, setting and illumination. Care, maintenance and storage of microscopes. Use of stage and ocular micrometer. Care and use of dissecting lens and microscopes. Collection, preparation, transportation, maintenance and preservation of biological specimens animal and plant materials).

Fixatives: Types and function of fixatives for plant and animal tissues:

Tissue Processing and

Microtomy. Types, use and care of microtomes. Honing, stropping and storage of microtome knives. Cutting of paraffin sections, frozen sections and Cryostat section. Adhesive – types and preparation, Methods of attachment of section to slides.

Stains and Staining Techniques and Histochemistry Methods. Theory and application of stains: The functions of dyes and impregnation, Principal stains including natural, and synthetic stains, Principles of methods for histochemistry, Haematological and Serological Techniques: Blood: Types of blood cells, structures, characteristics and formation; plasma and serum, immunoglobins (anti-bodies), antigen-antibody reactions.

Collection of blood samples and labeling,
Making of smears and staining,
Counting of blood cells,
Haemoglobin estimation,
Packed cell volume estimation, and
The significance of blood groups.

STB 213 BASIC PRINCIPLES IN BOTANY
Basic principles of plant physiology, cytology, genetics and ecology.

STB 208 CELL BIOLOGY AND HISTOLOGY
Details of structure and function of the mucles, mitochondrion, chloroplast, ribosomes, golgi complex and lysosomes. Nucleic acid, protein structure and

synthesis. Enzymes, plant tissues types, animal tissue types, organs and organ systems. Techniques in histology.

STB 209 LOWER INVERTEBRATES
Outline treatment of the protozoan and metazoan groups.

STB 210 GENERAL MICROBIOLOGY II
Systematic classification of bacteria, fungi, viruses etc. Mircobial variation and heredity, biological and biochemical reactions of micro-oganisms.

STB 211 SEED PLANTS
Morphology and reproduction of seed plants.

STB 301 GENETICS
Aspect of human genetics and plant breeding, pedigree analysis. Further consideration of various deviations from basic principles. Gene interaction.

STB 302 INDUSTRAIL FIELD COURSE I
Sampling techniques in local habitats. Applied plant Anatomy in Afforestation, Horticulture and Biotechnology. Assessment by report.

STB 303 GENERAL CYTOLOGY
Light, phase-contrast, dark field and electron Microscopy, auto-radiography, florescence, cell cycle, introductory cytogenetics.

STB 304 GENERAL ECOLOGY
The ecosystem approach to the study of ecology, energy flow and nutrients cycling. Dynamics of populations and communities ecosystem, influence of man.

STB 305 MOLECULAR BIOLOGY
Biogenesis of microtubules, microfilaments, golgi mitochondria. Membrane – membrane interactions. Introduction biogenergetics and thermo-dynamics.

STB 306 GENERAL PHYSIOLOGY
A general study of osmoregulation, excretion, transports, homoestatic and their co-ordination in animals. Plant water relation, growth and growth regulation. Physiological aspect of crop yield.

STB 307 HISTORY AND PHILOSOPHY OF SCIENCE
History and philosophy of science with special reference biological concepts.

STB 310 GENERAL ENTOMOLOGY
Evolution and systematics of insects. Insects structure and function with particular emphasis on the insect integument, antennae, mouth parts and legs including functional modifications of these parts. Life history – moulting Methods of locomotion in insects. Feeding, digestive, excretory and reproductive systems in insects. Insects of economic importance. The success of insects. Insects pests and control methods insects collection methods. Identification and preservation techniques.

STB 311 FOOD MICROBIOLOGY

The distribution role and significance of micro-organisms in food, intrinsic and extrinisic parameters of food that affect microbial growth, food spoilage and food microbiological standards. Diseases of animals transmissible to man via animal food products.

STB 313 BIOLOGICAL LABORATORY TECHNIQUES AND PRACTICE II

Preparation of physiological salt solutions and buffer solutions for use inphysiology and pharmacology, Dilution methods of drugs. Aerating systems and temperature control. Surgical instruments: use and care of catherters, cannulae, respiratory pumps, mercury manometers. The recorders (polygraphs) Care and use of transducers, Recording and measurement of physiological changes, Study of electronic and photoelectric equipment commonly used in laboratories and their applications. Preparation and measurement of buffer solutions. Buffeting of perfusion fluids and other biological fluids.

Microbiological Technique: Equipments: Types, use, care and maintenance: Preparation of culture media and the methods used in the culture of micro- organisms- agar; Broth etc. Dangers of infection in handling live culture of micro-organisms. Correct methods of disposal of pathogenic materials. Preparation of materials for sterilization. Culture maintenance. Sterile areas and rooms. Aseptic Techniques.

STB 315 SEEDLESS PLANTS

Morphology and reproduction of algae, bryophytes and pteridophytes including fossils.

STB 401 POPULATION GENETICS

An introductory consideration of mathematics models for the analysis of gene frequencies and genetic variation in populations.

STB 402 INDUSTRIAL ATTACHEMENT

Industrial attachment in Medical/Public Health of industrial establishments or storage firms corporations.

STB 403 CYTOGENETICS OF PLANTS

Aspects of cell and nuclear divisions. Morphology and behaviour of chromosomes. Chromosomal; aberrations and ploypidy.

STB 411 PRINCIPLES OF STORAGE ENGINEERING

Power of storage machine. Different types of conveyors their mechanisms. Grain Processing and grinding equipment. Grain cleaning and grading equipment. General principles of crop and grain dry, storage and handling structures. Measuring instruments for crop drying processes. A guide to the major items of equipment used for the application pesticides. Field tests for equipment. Choice of equipment grain dry installations.

STB 413 BIOLOGCY OF PESTS OF STORED PRODUCTS AND THEIR CONTROL

Invertebrates pests of stored fish, wild life products, meat, tuber root crops, vegetables, fruits, cereals, legumes, leather, and timber, the detailed life cycles, identification of various stages, behavioural pattern and structural adaptations enabling them to act as efficient pests. The effect of environmental conditions on the abundance of invertebrates pest. Vertebrate pests of stored products and the damage they cause. Micro organisms as pest factors which influence or inhibit their continued spread. The effect of storage structure on the biology pests.

STB 415 STORAGE TECHNIQUES

This course shall deal with various techniques (traditional and modern) used for the storage of diverse agricultural products with particular emphasis on dry and wet foods/food stuffs. Principles and methods of preservation of food, fish wild life products and crops. Quality of products of storage e.g degree of ripening, physical biological and chemical characteristics of the major stored products pests methods of control. Pests of stored timber. Selected diseased tubers, root crops, cereals, legumes, vegetables and fruits and the microbiological deterioration of these stored products pre and post harvest average techniques under different ecological and climatic conditions. Residue analysis of the common insecticides and fungicides used for the protection of the stored products.

STB 502 APPLIED STORAGE TECHNIQUES

This course shall involve a lot of practicals and field practical stored products protection and preservation including spraying, dusting fumigation and smoking. Formulation and application of insecticides and fungicides for controlling storage products, pests and diseases. Prevention of storage losses and assessment of damage and crop losses practical survey, design and construction of storage facilities for tubers and root products, grains, fungi and vegetables. Students shall assist farmers, visit food mills, bakeries canning factories and other food processing plants as well as cooperative facilities for transporting stored food products.

STB 503 PROJECT

A short research project involving an investigation on a selected biological problem. The project is to be written up in the form of a scientific report.

STB 506 FOOD AND STORAGE CHEMISTRY

Proximate analysis of foods e.g determination of moisture content, total ash, crude protein, amino acids, carbohydrates and lipids. Quality control tests in stored foods e.g floatation, staining test objective and subjective tests. Organoleptic properties of foods. Food enzymes e.g classification uses action and factors affecting enzyme action. The Chemistry of action of insecticides.

STB 507 VECTOR AND PESTS MANAGEMENT

Vectors and pests of economic importance e.g insects, mites, molluses birds, rodents, etc a study of some of the problems they pose in West Africa crops and vegetables mealy bugs. capsides on three crops. Cause of pest outbreak the pest management concept. The use of pesticides and chemical in pest control e.g insecticides and problem associated with their use Mechanisms of action of pesticides and antimicrobial agents. Lethal dose factors (LD50). Biological control the use of

parasitoids and pedators, microbial control-types of insect pathogens and conditions affecting their effectiveness against-insects, autocidial methods of control-types and use of phenomones, sterile male release techniques insect plant interaction, selection mechanisms of host plant resistance. Cultural control methods in West African integrated control methods in West Africa.

STB 508 APPLIED VECTORS AND PESTS MANAGEMENT

This course shall particularly emphasize practical or field demonstrations and experiments on management of vectors and pests of economic importance in West Africa. Detailed study of the biology of vectors of animal diseases and their control e.g Mosquitoes, tsetse-fly, blackfly, housefly, sandfly, fly, practical demonstration of their control in their productive habitats where possible. Invertebrates vectors of plants diseases and their control e.g Aphids, Scale insects. Vertebrate pests on farm crops e.g birds, monkeys, rodents bat and their control. Molluses as agricultural pests crop trees and their pests. Practical control of pests of farmland e.g grasshoppers in waste land/abandoned farmland/college farm. Equipment used in vectors and pests control and their practical methods used in various research/storage institutions and agricultural development schemes for the control of pests.

STB 509 APPLIED PARASITOLOGY I

Parasite nutrition nature of interfaces between associating organisms. Gross and cytopathology of parasites vertebrate defensive responses to parasites to include principles of serology and immunology in specific general of parasites of economic importance. Counter measure to vertebrate defences. Immunization method is against major.

STB 510 SEMINAR

The objectives is to give students some experience in preparing, reading and presentation of original research papers and to be familiar with current researches in Biology. A talk on experience during industrial attachment to be presented in written form. Also seminars on selected topics and projects shall be given by all students.

STB 511 SOIL ECOLOGY

Physical and chemical nature of soil. Setritur organisms. Cycling of minerals and nutrient pools.

STB 512 FOOD PROCESSING STORAGE AND PRESERVATION

Principles and practice of food processing. Techniques of processing and preservation of Nigerian foods with regards to their physical-chemical properties. Canning containers, outline of canning operation, principal spoilage organisism in canned foods. Use of radiation in food preservation. Insect contaminants as spoilage organisms. Laboratory Examination of canned foods. Methods of detecting contaminants in foods.

STB 514 SYSTEMATIC BIOLOGY

A Bio-systematic approach to the classification of organisms and nomenclature.

STB 525 ADVANCED TAXONOMY OF ANGIOSPERMS

The original of Anglosperm, their classification and nomenclature, classical experimental and numerical taxonomy. Herbarium methods and organization.

STB 526 BIOLOGICAL TECHNIQUES III

Laboratory Animal Technology and Aquarium/Vivarium Management
The Cruelty to Animals Acts. 1876
An understanding of the legal requirements covering the management of experimental animals. Licenses and certification. The conditions attached to every license. Administration of the Act.
Inspectors: recording of experiments, visitors to experimental areas. Routine care of common species and of the Rhesus Monkey. Methods of feeding and watering. Bedding and nesting materials
Cleaning of cages, equipment and premises. Environmental temperature and humidity and the option. Recommended for various species.

Inspection for injuries, including sore hocks and ever grown
Teeth and claws. Normal body temperatures. Ill-health in the common species. An elementary knowledge of the causes of ill-health. Recognition of the signs of ill-health. e.g loss of condition, respiratory infections, infestations. Breeding of the common species. Recognition of good breeding animals. Elementary knowledge of estrous cycles. Gestation periods. Average litter sizes. Average birth, weaning and adult body weights. Duration of economic breeding life. Breeding system; mating at post-partum estrous; monogamous. Pairs and colonies; inbreeding and random breeding.

Title: Practical

i) Practical topics from LAT 125
ii) Handling and sexing of laboratory animals
iii) Determination of age and body weight
iv) Principles of spring, beam and torsion balances
v) The use and care of animal and food balances

Sources of specimens. Fixing preservation and embaming of bodies, the techniques of dissection and finishing, injection techniques. Demonstrating lymphatic vessels and maceration.

STB 527 PLANTS AND ENVIRONMENTAL POLLUTION MONITORING

The use of Algae, linchens, byryophytes and higher plants in monitoring our pollution. The use Algae as indicators of acquatic pollution. The merits and demerit of using various taxonomic group as indicators.

STB 528 ECONOMIC BOTANY

Introduction to the plant kingdom, plant and the ancient man; basic plant taxonomy plants as sources of food, beverages, spices essential oils, fibres, gums, fumiforces, drugs, resins and dyes, medicinal plants and their uses, edible mushrooms and their cultivation, plants as ornaments.

Microbiology Techniques

200 LEVEL

FIRST SEMESTER

COURSE No.	COURSE TITLE	UNITS
STM 201	General Microbiology I	3
STC 205	Physical Chemistry I	2
STC 203	Organic Chemistry I	2
STC 201	Inorganic Chemistry I	2
ST/BCH 201	Gen. Biochemistry I	3
STB 201	Genetics	2
STM 203	Medical Microbiology	3
GNS 201	Information Retrieval	1
	Total	**18**

SECOND SEMESTER

COURSE No.	COURSE TITLE	UNITS
STC 202	Analytical Chemistry	2
STM 202	General Microbiology II	3
STM 204	Microbiological Techniques	3
MAT 224	Statistics for Biological Science	4
MAT 142	Introduction to Computer Science	3
GLT 202	Hazards and Safety in the Lab.	2
GNS 202	Principles of Economics	3
	Total	**20**

300 LEVEL

FIRST SEMESTER

COURSE No.	COURSE TITLE	UNITS
STM 301	Bacteriology	3
STM 303	Microbial Genetics	3
STM 305	Molecular Biology	3
ST/BCH 301	Food Chemistry	2
STC 315	Instrumental method of Analysis	3
MAT 241	Computer Programming I	4
	Total	**18**

SECOND SEMESTER

COURSE No.	COURSE TITLE	UNITS
STM 302	General Virology	3
STM 304	Environmental Microbiology	2
STM 306	Mycology	2
STM 308	Microbial Physiology and Metabolism	3
STM 310	Soil Microbiology	2
STM 312	General Parasitology	2
ST/BCH 302	Enzymology	3
STM 314	Microbial Genetics and Molecular Biol.	2
	Total	**19**

400 LEVEL
FIRST SEMESTER

COURSE No.	COURSE TITLE	UNITS
STM 401	Industrial Microbiology	4
STM 403	Pharmaceutical Microbiology	2
STM 405	Analytical Microbiology and Quality Con.	3
STM 407	Immunology & Immunochemistry	4
STM 409	Food microbiology	3
ST/BCH 417	Biochemistry of Parasites	3
GLT 411	Laboratory Organisation & Mgt I	2
		21

SECOND SEMESTER

INDUSTRIAL ATTACHMENT

STM 402	Industrial Training (Site work Supervision)	4
STM 404	Industrial Training (University Supervision)	4
STM 406	Industrial Training (Student Report)	4
	Total	**12**

500 LEVEL
FIRST SEMESTER

COURSE No.	COURSE TITLE	UNITS
GLT 501	Photography and Biollustration	3
STM 503	Petroleum Microbiology	3
STM 507	Plant Pathology	3
STM 509	Fermentation Drinks	3
STM 511	Research Project	3
ST/BCH 512	Processing Biochemistry	3
	Total	**18**

SECOND SEMESTER

COURSE No.	COURSE TITLE	UNITS
STM 502	Food Processing	3
STM 504	Principles of Epidermiology And Public Health	3
STB 502	Applied Storage Techniques	3
STB 508	Applied Vectors and Pest Mg	3
STM 510	Seminar	2
STM 512	Research Project	3
GLT 508	Laboratory organization and Mgt II	3
	Total	**20**

MICROBIOLOGY TECHNIQUES

STM 201 GENERAL MICROBIOLOGY I

Historical aspects of Microbiology with emphasis on the place of microorganisms in the World. Types of microorganism – Bacteria, Viruses, Fungi, Rikettsiae, Chlamydia, Algae, etc. Growth and reproduction of microorganisms. Sterilization and disinfection. Control of microorganism by physical and chemical methods,

STM 202 GENERAL MICROBIOLOGY II

Systematic classification of bacteria, parasites, fungi, viruses, algae, etc isolation, characterization and identification of microbes. Biological and biochemical reactions of microorganisms. Applied areas of Microbiology.

STM 204 MICROBIOLOGICAL TECHNIQUES I

Staining Techniques, sterilization techniques, preparation and uses of buffer, cell suspension, centrifugation and diluting fluids. Microscope; preparation of Microscope slides; photometer, colorimetry; Chromatography, conductorimetry, centrifugation, experimental design and data interpretation, preparation of reports.

STM 203 MEDICAL MICROBIOLOGY

Pathogenic bacteria, fungi and viruses of both human and veterinary importance. Concept of pathogenecity and virulence with respect to development of diseases.
Clinical samples; pus, urine, CSF, blood aspirates, faecess-handing and laboratory processing methods.

STM 301 BACTERIOLOGY

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

STM GENERAL VIROLOGY
Historical background and development of Virology. Structure and composition of viruses. Cultivation, isolation and identification of viruses. Antiviral agents such as interferon, bacteriophages; plant and animal viruses.

STM 303 MICROBIAL GENETICS
Survey of the current status of microbial genetics (bacteria, fungi, viruses and protozoa) including discussion of methods and findings in the area of mutagensis, inductions, isolation and biochemical characterization of mutants, adaptation, transformation, transduction, conversion and conjugation. General and specialized methods and techniques in microbial genetics; experiments with virulent phases, tempate phases and lysogenic bacteria, fungi and other lower encaryotic genetics.

STM 304 ENVIRONMENTAL MICROBIOLOGY
Microorganisms and organisms important in acquatic systems and disposals. Ecology of microorganisms in fresh water, pollution and self-purification of water, purification of water, brief studies of marine microbiology. Disease transmission by water, microbiological examination of water; microbiology of waste disposal; Biological oxygen demand and chemical oxygen demand; test for sewage and water.

STM 305 MOLECULAR BIOLOGY
Biogenesis of microtubules; microfilament, golgi bodies and mitochondria; membrane – membrane interaction, introduction to bioenergetics and thermodynamics.

STM 306 MYCOLOGY
Structure, life cycle, physiology and classification of fungi; fungi of economic importance; laboratory methods of mycology, pathology and immunology of superficial systems importance; laboratory methods of mycology, pathology and immunology of superficial systems mycoses and actinomycoses.

STM 308 MICROBIAL PHYSIOLOGY AND METABOLISM
Aspects of microbial physiology; a revision of cell structure and function; growth and death of microorganism; nutrition, types of difference in relation to their energy metabolism and biosynthetic activity.

STM 310 SOIL MICROBIOLOGY
Characteristics of soil environment, microbial and fauna of soil; microbial activities in soil, nitrogen cycle, carbon cycle; mineral transformation by microorganisms; Ecological relationship among the soil pathogens; effect of peptides on soil microorganisms; biodegradation and biofuels generation.

STM 312 GENERAL PARASITOLOGY
Nature of parasitisms; host – parasite relationship[s; concept and evolution of the parasitic mode of life; advantages and disadvantages of parasitism; host specifically and susceptibility, epidemiology and control of common tropical parasitic infections; transmission of parasites from host to host and the role of vectors in the transmission of parasitic diseases.

STM 314 MICROBIAL GENETICS AND MOLECULAR BIOLOGY

A survey of the current status of microbial genetics (Bacteria viruses, protozoa and fungi) including discussion of methods and finding in the areas of mustagenesis, inductions, isolation and biochemical characterization of nutants adaptation, transformation, transduction, conversion and conjugation. General and specialized methods and techniques in microbial genetics. Experiments with virulent phases temperate phases and lysogenic bacteria. Fungal and other lower eukaryotic genetics.

STM 401 INDUSTRIAL MICROBIOLOGY

Nature of industrial microbiology, microorganisms of industrial importance; aspects of the biology of moulds, yeasts, bacteria, actinomycetes and viruses of importance in various fermentation. Culture techniques and maintenance of selected cultures. Mutation, strain selection and development, hydridisation, media formulation and economic, optimization of fermentation media at laboratory scale, perimeter design operation; Antifoams; aspects of biochemical engineering; patents and patent law.

STM 402 INDUSTRIAL ATTACHMENT

This SIWES programme shall be undertaken in suitable laboratories in medical/public or industrial laboratories. A talk on experience during industrial attachment will be presented orally and in written form.

STM 403 PHARMACEUTICAL MICROBIOLOGY

Chemistry of synthetic chemotherapeutic agents antibodies' production and synthesis of antibiotics and anti-microbial agents. Quality control of pharmaceutics products. Concepts of growth and death in microorganisms' mode of action assay of anti-microbial agents; conceptual of antibiotic sensitivity and resistance as related to microbial physiology.

STM 405 ANALYTICAL MICROBIOLOGY AND QUALITY CONTROL

Microorganisms as reagents in quantitative analysis, selection of test organisms for assay (antibiotics, amino acids, vitamins, etc) responses of microorganisms use in assays; obtaining and measuring responses of microorganism. Preparation of assay samples; methods of assay; interpretations of results, aspects of quality control; plant and equipment sanitation; microbiological standards and specifications.

STM 407 IMMUNOLOGY AND IMMUNOCHEMISTRY

Basic concept of immunology, structure of antigen, antigenic determinants; cellular response; genetics of response to antigenic stimulation; structure and classification of immunoglobules and antibodies' microorganisms and theories of antibody formulation. Antigen and antibody interactions; role of lymphoid tissues and thymus in immunoresponses; hypersentivity; immuno-pathology, auto-immunity; immunophylaxis and immunotherapy; the practicals will in modern techniques in immunology and immunochemistry.

STM 409 FOOD MICROBIOLOGY

The occurrence and interactions of microorganisms with food. Intrinsic and extrinsic parameters of foods that affect microbal growth. Methods of detecting the presence of microbes in foods. Milk meta and water microbiology. Effects of microbial growth of

food-fermentation, spoilage and food-borne diseases; food sanitation and microbiological food quality control.

STM 502 FOOD PROCESSING

Principles and practice of food processing techniques of processing and preservation of Nigerian food with regard to their physio-chemical properties; canning containers; outline of canning operation; principal spoilage organisms in canned foods. Use of radiation in food, preservation; insect contamination as spoilage organisms; laboratory examination of canned foods; method of detecting contaminants in foods.

STM 503 PETROLEUM MICROBIOLOGY

Origin and chemical evolution of the atmosphere, hydrosphere and biosphere, biological oceanbiography. Morphology and biostratography of major groups of microfossil. Biological origin and accumulation of petroleum and sedimentary basis. Hydrobiology, petroleum pollution and its sources and biological control. Oil pillage, Petroleum degrading microorganisms, hydrocarbonoblastic bacteria. Metallo menass bacteria that cause rusting of oil pipes.

STM 504 PRINCIPLES OF EPIDEMOLOGY AND PUBLIC HEALTH

Nature of epidemiological investigation, spectrum of infection; herd immunity and latency of infections; multifactoral systems in epidemics; Zoonoses, Antigenics drifts; Biological products for recommended immunization schedules, international control of infectious diseases; statistical application to epidemiology.

STM 507 PLANT PATHOLOGY

Principles and concepts in plant pathology; some pathology of plants, animal, and especially those prevalent in Nigeria. The geographical distribution of the pathogens, their isolation, identification, morphology, life-cycles, sources of isolation, transmission and the effects on the host, aetiology, cultural characteristics and clinical manifestations of specific bacterial, viral and fungal pathogens of animals and plants, control of plant diseases.

STM 509 FERMENTATION DRINKS

Basic concepts of fermentation, alcohol fermentation resulting in production of bread, bear wine and vinegar acid, fermentation leading to production of cheese, butter, yoghurt, etc, malolactic fermentation.

STM 510 SEMINAR

Students are to participate in Departmental Seminar throughout the session. The objectivity of this course is to give students some experience in preparing, reading and presenting original research papers and to be familiar with current researches in microbiology. Topics to be presented shall be different from or closely related to the student's project topic, as approved by the project supervisor.

STM 511 AND 512 RESEARCH PROJECT

A research project involving and investigation on selected biological problems; the students will undertake research project in a current area of microbiology under the direction of a member of staff. The project is to be written in the form of a scientific report.

Chemistry Techniques

200 LEVEL
FIRST SEMESTER

COURSE No.	COURSE TITLE	UNITS
STC 201	Inorganic Chemistry I	2
STC 203	Organic Chemistry I	2
STC 205	Physical Chemistry I	2
ST/E 201	Basic Modern Physics	3
MAT 201	Mathematics Method I	3
MAT 201	Mathematics Method II	3
GNS 201	Information Retrieval	1
GLT 201	Instrument Maintenance I	3
	Total	**19**

200 LEVEL
SECOND SEMESTER

COURSE No.	COURSE TITLE	UNITS
STC 202	Analytical Chemistry I	2
STC 204	Structure and Bonding	2
ST/PE 202	Electronics and Electric Circuits	3
MAT 201	Mathematical Methods	3
MAT 122	Statistics	4
GNS 202	Principle of Economics	2
GLT 210	Hazards and Safety in the Lab.	2
ST/PE 208	Experimental Physics II	1
	Total	**19**

300 LEVEL

FIRST SEMESTER

COURSE No.	COURSE TITLE	UNITS
STC 301	Inorganic Chemistry II	4
STC 303	Organic Chemistry II	4
STC 305	Physical Chemistry II	2
STC 307	Organometallic Chemistry	1
STC 309	Industrial Raw Materials Resources	1
STC 311	Environmental Chemistry	2
STC 313	Introductory Industrial Chemistry	2
STC 315	Instrumental Methods of Analysis	2
	Total	**18**

300 LEVEL

SECOND SEMESTER

COURSE No.	COURSE TITLE	UNITS
STC 302	Atomic & Molecular Structure And Symmetry	2
STC 304	Petro-chemistry I	2
STC 306	Natural Production Chemistry I	1
STC 308	Polymer Chemistry I	2
STC 310	Colour Chemistry & Technology I	2
STC 312	Applied Speetroscopy	2
STC 314	Industrial Chemistry Process I	2
STC 316	Industrial Chemistry Technology I	2
STC 318	Quality Control & Industrial Safety	1
MAT 142	Introductory Computer Science	2
STC 320	Chemistry Techniques and Practice I	3
	Total	**21**

400 LEVEL

FIRST SEMESTER

COURSE No.	COURSE TITLE	UNITS
STC 401	Theory of Molecular Spectroscopy	2
STC 403	Reaction kinetics	2
STC 405	Radio Chemistry & Nuclear Chemistry	2
STC 407	Instrumentation & Analytical Chemistry II	3
STC 409	Heterocyclic Chemistry	3
STC 411	Coordination Chemistry	1
STC 413	Non-Aqueous Solvents	1
STC 415	Chemistry of Lanthanides & Actinides	1
GLT 415	Laboratory Organisation & Mgt	2
STC 417	Natural products II	2
STC 419	Food Chemistry	2
STC 421	Chemistry Lab. Techniques & Practice	3
	Total	**21**

400 LEVEL

SECOND SEMESTER

COURSE No.	COURSE TITLE	UNITS
STC 402	Industrial Training (Site Work Supervision)	4
STC 404	Industrial Training (University Supervision)	4
STC 406	Industrial Training (Students Report)	4
	Total	**12**

500 LEVEL

FIRST SEMESTER

COURSE No.	COURSE TITLE	UNITS
STC 501	Project	3
STC 503	Industrial Chemistry process	2
STC 505	Colour Chem. & Tech. II	2
STC 507	Polymer Chemistry II	2
STC 509	Water and Waste Water Treatment	2
STC 511	Applied Surface & Colloid Chemistry	2
STC 513	Petrochem	2
STC 515	Wood, pulp and paper Chemistry	2
STC 517	Quantum Chemistry	2
GNS 501	Industrial Management	2
GLT 501	Photography and Bio-illustration	3
STC 519	Chemistry Lab. Techniques & Practice II	3
	Total	**22**

500 LEVEL

SECOND SEMESTER

COURSE No.	COURSE TITLE	UNITS
STC 501	Project	3
STC 502	Seminar	-
STC 504	Industrial Chemistry Technology II	2
STC 506	Food Analysis	2
STC 508	Electrochemistry	2
STC 510	Analysis of Raw Materials and Drugs	2
STC 514	Dye and Texile Chemistry Technology	2
STC 516	Polymer Technology	2
STC 520	Chemistry Laboratory Techniques And Practice III	3
GLT 508	Laboratory organization and Mgt II	3
	Total	**23**

Course Descriptions

STC 101 GENERAL CHEMISTRY I
Atoms, molecules and chemical reaction, chemical equations and stoichiometry, atomic structure and, modern electronic theory of atoms; Radioactivity; Chemical kinetcs, Electrochemisty.

STC 102 GENERAL CHEMISTRY II
Historical survey of the development and importance of organic chemistry; nomenclature and classes of organic purification of organic compounds; qualitative and quantitative organic chemistry, stereochemistry; determination of structure of organic compounds; Electronic theory in organic chemistry, saturated hydrocarbons; unsaturated hydrocarbons. Periodic table and periodic properties; Valence forces, structure of solids; The chemistry of selected metals and non-metals. Qualitative analysis.

STC 201 INORGANIC CHEMISTRY I
Chemistry of First row transition metals. Introduction to coordination chemistry including basic treatment of crystal field theory. Comparative chemistry of the following elements: (a) Ga, In TI, (b) Ge, Sn, Pb, (c) As, Sb, BI (d) Se, To, Po, Basic introduction to Organometallic Chemsitry. Role of metals in Biochemical Systems.

STC 202 ANALYTICAL CHEMISTRY I
Theory of Errors, Statistical treatment of data: Theory of sampling. Chemical methods of analysis including volumetric, gravemetric and physiochemical methods; optical methods of analysis, separation methods.

STC 203 ORGANIC CHEMISTRY I
Factors affecting structure and physical properties of organic compounds; Factors availability of electronic stereochemistry. Methane, energy of activation and free radical substitution reactions in alkanes. Functional group chemistry. Electrophilic and Nucleophilic substitution reactions. Aromatically various organic reactions e.g addition, free radical, elimination reactions etc.

STC 204 STUCTURE AND BONDING
Ideal of quantum states orbitals, shape and energy. Sample valence theory, electronrepulsion theory atomic spectra. Methods of determination molecular shape, bond lengths and angles. The structure and chemistry of some representative main group compounds.

STC 205 PHYSICAL CHEMISTRY I
Kinetic theory of gases; Behaviour of real gases; the law of thermodynamics; Entropy and free energy; Reactions and phase equilibria; Reaction rates; Rate laws; mechanism and theories of elementary processes; photochemical reactions, Basic electrochemistry.

STC 301 INORGANIC CHEMISTRY II
The noble gases, hydrogen. Electronic structure and general properties and comparative study of group 11A elements. Chemistry of Boron; Carbon and Silicon. Nitrogen and phosphorus, Oxygen and sulphur. The halogens, Transition elements.

Separation of metals. Co-ordination Chemistry. Ligand and Crystal field theories. Introduction to Radiochemistry, Radioactivity and the periodic table.

STC 302 ATOMIC AND MOLECULAR STRUCTURE AND SYMMETRY

Schrodinger equation. Helim Atom, ground and excited stated. Sin and Pauli principle. Hydrogen Molecule, Comparison of molecular orbital and valence bond theory, concept of resonance and configuration interaction. Coulson-Fisher function. Molecular orbitals for diatomic molecules simple pielectron theory, Huckel theory. Huckel theory. Walsh rules Brief mention of other methods. Atomic Russel Saunders Coupling. Mention of other methods. Atomic Russel Saunders Coupling. Orbital and spin angular momentum. Use of symmetry in Chemistry.

STC 303 ORGANIC CHEMISTRU II

Alcohols and their reactions. Ethers and Epoxides. Carboxylic acids and their derivatives. Aldehydes and Ketones.

Carbanion I and B – unsaturated compounds. Carbanion II. Amines, Aromatic and Alicyclic chemistry. Polyfunctional compounds. Heterocycle chemistry.

STC 304 PETROCHEMISTY

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

STC 306 PHYSICAL CHEMISTRY II

A review of Gibbs function. Chemical thermodynamics. Introduction to statistical thermodynamics. Ideal solutions. Non-ideal solutions. Properties of electrolytes.

STC 306 NATURAL PRODUCTS CHEMISTRY

Terpenoids, carotenoids, steroids, alkaloids and Lipids.

STC 307 ORGANOMETRIC CHEMISTRY

Classification of Organometallic compounds. Preparation structure and reactions including abnormal behaviours of organometallics. Generation and detection of free-radicals, free organometallic compounds.

STC 308 POLYMER CHEMISTRY I

The nature of Polymer; Types of Polymers and Polymerisation processes; Addition, condensation polymerisations and their mechanisms. Physical properties of Polymers. Solubility and solution properties. Structure and properties of fibre forming polymers.

STC 309 INDUSTRIAL RAW MATERIALS RESOURCE INVENTORY

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

STC 310 COLOUR CHEMISTRY AND TECHNOLOGY

Colour and constitution. Chemistry, properties of dyes and pigments. Classification of dyes and fibres. Dyeing mechanisms. Preparation and dyeing of natural and synthetic fibres. Colour fastness properties. Quality Control procedures and colouration industry.

STC 311 ENVIRONMENTAL CHEMISTRY

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

STC 312 APPLIED SEPOTOSCOY

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

STC 313 INTRODUCTORY INDUSTRIAL CHEMISTRY

Review of applications of chemistry in the chemical allied industries. Sources of chemical raw materials and energy. Renewable and non-renewable resources. Resources deplating and recycling. Raw materials from coal, petroleum, wood, etc. materials and energy balances. Pilot plants, models and scales-up principles, Process optimization.

STC 314 INDUSTRIAL CHEMICAL PROCESSES

Production of primary intermediates and synthesis of industrial organic chemicals, polymers adhesives, dyes, exlposives, insecticides, pesticides, herbicide, flavouring agents and pharmaceuticals. Fermentation process.

STC 315 INSTRUMENTAL METHODS OF ANALYSIS

Spectroscopic techniques. Quantitative analysis. X-ray methods. Flourescence methods. Nuclear Magnetic resonance electronspin resonance. Refractormetry and interferometry. Polarimetry, marography. Calorimetry.

STC 316 INDUSTRIAL CHEMICAL TECHNOLOGY I

Heat transfer and Mass transfer process. Unit operations chemical technology equipment.

STC 318 QUALITY CONTROL AND INDUSTRIAL SAFETY

Quality control as applied to selected product, preservation and control of industrial and laboratory hazards.

STC 320 CHEMISTRY LABORATORY TECHNIQUES AND PRACTICE I

General direction for Volumetric Work: Types of Volumetric analysis, Volumetric apparatus – burettes, (weighing burettes) pipettes. Volumetric measuring flasks. Properties, calibration of weights; installation and maintenance of balances; construction and operation; sensitivity of balance, application of sensitivity of weighing. Theory of weighing.

Methods of Weighing: The direct method, Gauss's method of substitution, Board's method of substitution, Weighing errors.

Methods of Expressing the Concentration of Solutions: Weight/Volume, Percentage methods, Dilution ratio, Molar and Normal concentration, and Titre methods.

Equivalent Weights: Equivalent weights for reaction in which there is no electron transfer: Neutralization, Precipitation, and Equivalent weights for oxidation-reduction reactions.

Conversion from one method to another: Weight/volume to molar or normal, Molar to Normal and vice versa, Molar to Normal Titre, and Weight percent to molar or normal.

Note: Worked examples in this section should show how weights and volumes of substances are worked out when preparing various solutions and reagents used in the laboratory for both qualitative analysis.

STC 401 THEORY OF MOLECULAR SPECTROSCOPY

Quantum theory of rotation and vibration. Theory of microwave, Raman, UV, Visible and NMR spectroscopy. General introduction to electron sin resonance. Massbauer effect, nuclear quadrupole resonance and other modern techniques.

STC 403 REACTION KINETICS

Review of first, second and third order rate equation. Rate constants and equilibrium constant. Collisen theory, transition state theory, reaction coordinates. Unimolecular reaction theory; bimolecular reaction mechanisms, chain reaction mechanisms; catalysis and heterogenous reaction. Photochemical reaction mechanisms.

STC 405 RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

Natural radioactions, fusion, fission decay processes, nature of radiation. Nuclear models, energetics of nuclear reaction. Principles and measurement of radioactivity. Applications of radioactivity.

STC 407 INSTRUMENTATION/ANALYTICAL CHEMISTRY II

Theory of error. Potentiometric and pH methods. Condctomeric methods. Electrolytic methods. Radiochemical methods. Chromatography.

STC 409 HETEROCYCLIC CHEMISTRY

The synthetic and mechanistic aspects of fused heterocyclic system particularly Quinolines, Isoqinolines, Bezofurans, Bednzothiophenes, Indoles, Bezopyrylium salts, Coumarin Chromonnes. Application of heterocyclic systems in drug synthesis.

STC 411 CO-ORDINATION CHEMISTRY

Definition, Recognition and Applications Co-ordination, Nomenclature, Co-ordination formular and isomerism in complexes stereochemistry of complex molecules. Theories of structure and bonding. Physical methods of structural investigation. Magnetic properties. Absorption and vibrational spectra. The spectrochemical series. The Nephelauxetic series and the John-Teller distortions. Stabilization of unusual oxidation states by complex formation. Thermodynamic

stability of complex compounds, the stability constant, the chelote effect. Preparation and reactions of complexes kinetc and mechanisms.

STC 413 NON AQUEOUS SOLVENTS

Classification and general characteristics, solute-solvent interaction. Otonic solvents. Oxzyhalide solvents. Liquid halides. Dintrogen tetroxide, sulphur.

STC 415 CHEMISTRY OF LANTHANIDES AND ACTINDES

The elements and the position of the two series in the periodic table. Comparison of the two series.

STC 417 NATURAL PRODUCTS CHEMISTRY II

Chemistry of terpenoids, steroids and alkaloids, antibiotics, Lavanoids. Prestegladins and chlorophylis. Other natural products of Pharmaceutical importance. General methods of isolation, separation, purification and structural determination of the natural products. Classifications. Discussion of chemistry of important members; Biogenesses.

STC 419 FOOD CHEMISTRY

Occurrence, structure and functions of carbohydrates, protein, fats and oil, physical and chemical properties. Starch behaviour during baking and staling of bread. Glucose syrup-chemistry of enzymatic and non-enzymatic productions.
Ripening and maturing of fruits – Pectic substances and their uses. The chemistry of fermentation process in the food industry. Effect of enzymes in foods. Enzymatic and non-enzymatic browning.

STC 501 PROJECT

CHE 501 is a six-unit project carried out over 2 semesters constituting the final year of the undergraduate program. It is aimed at exposing the graduating students into the technique of designing and executing a research topic of relevance to the current national needs and those of the various industries that utilize the research findings of chemical and allied institutes. These projects are carried out under the supervision of members of the academic staffs of the departments.

STC 502 SEMINAR

This is a 2-unit course of critical review of current topics of chemical interest students are required to write a treatise on selected topics and to present class seminars on them.

STC 503 INDUSTRIAL CHEMICAL PROCESSES II

Chemical processing of minerals, metallurgy and hydrometallurgical processes. Industrial electrochemistry. Manufacture of some heavy inorganic chemicals. Cement and binding materials. Inorganic fertilizers.

STC 504 INDUSTRIAL CHEMICAL TECHNOLOGY II

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

STC 506 FOOD ANALYSIS

Sampling and treatment for analysis-proximate analysis of Analysis of – sugar and fruit products; Milk and diary products; Flesh food; Fermented products (beer, wine, vinegar); Flour and confectionary, and Oil valerancidity.

STC 508 ELECTROCHEMISTRY

Electrical double layer, potential at zero charge, polarizable and non-polarizable interface, mass transport, concentration polarization, Fick's Laws Levic equation. Electronics, Polagraphy.

STC 509 WATER AND WASTE WATER TREATMENT

Background, sample water analysis, flow, dispension, degradation, amounts and composition of wastes, biological aspects, particles, transport in soil and ground water sinks for water sinks for water treatment, conventional processes in handling swage, water treatment, plant wastes, advanced waste treatment. Effects
of water pollution.

STC 510 ANALYSIS OF SELECTED MATERIALS INCLUDING DRUGS

Various techniques in use for the analysis of crude materials. Analysis of environmental samples, e.g. pesticide residue, hydrocarbons and air. Analysis for heavy metal contaminants. Organic functional groups and drug analysis. Soil geochemical analysis.

STC 511 APPLIED SURFACE AND COLLOID CHEMISTRY

Some general principles relating to surfaces. Electrical potentials. Attractive forces, solid gas interface. Definition of colloid and history of colloid development. Types of colloids. Polymers. Proteins, Gels, Association colloids, Detergency.

STC 513 PETROCHEMISTRY

Petroleum in the contemporary energy scene. Nature classification and composition of crude petroleum and natural gases. Distribution of petroleum and natural gas resources (the global and Nigerian situations). Petroleum technology survey of refinery products and processes. Petrochemicals in industrial raw materials. Prospects for the petrochemicals industry in Nigeria.

STC 514 DYE ANDS TEXILE CHEMISTRY TECHNOLOGY

Principles of yarn manufacture both natural and man-made. Basic machine processes, bleaching, dyeing theory and printing. Surface activity. Colour fastness and factors affecting it. Colouring matters. Management problems in texile industries.

STC 515 WOOD, PULP AND PAPER CHEMISTRY I

Forests – conservation, exploitation and aforestation. Species, anatomy, physical properties and classification of wood. Preparation of wood for pulping. Physical and chemical methods of pulping. Bleaching reagents and pulp bleaching. Pulp-properties and uses.

STC 516 POLYMER TECHNOLOGY

Large scale industrial polymerization processes. Polymer Technology. Polymer processing, injection, extrusion, compression and transfer moulding of termoplatics. Polymer additives. Polymer surface coating and adhesive.

STC 517 QUANTUM CHEMISTRY

Postulates of Quantum mechanics; operators; angular momentum, solution of the hydrogen atom problem. Theory of atomic spectra. Self-consistent Field theory. Computational aspects. Perturbation and variation methods.

STC 519 CHEMISTRY LABORATORY TECHNIQUES AND PRACTICE II

Chemical Recovery of Substances: Solvents – (miscible and immicible; acid contaminated) precipitates cleaning of Mercury – by filtration and by distillation.

Criteria of Purity of Organic Compounds: Explanation of the terms – melting and boiling points, Construction of melting and boiling point apparatus, and Typical determination

Soxhlet Extractor- Used for the continous extraction of solid in a hot solvent.

Gravimetric Techniques – Simple treatments only: The principle of Gravimetric analysis, Steps in Gravimetric analysis, Preparation of the solution, Precipitation, Digestion, Filtration, Washing, Drying or igniting, Weighing, and Calculation

Centrifugation: Type of centrifuges, relative centrifugal force and separating factor. Use, care and maintenance: Oxidation – Reduction (Redox) Titrimetry, Primary standard substances used in Redoc titrimetry solution used in Radox Titrations, oxidations and Reductions equivalents.

Permanganate Process

General uses of permanganate
Techniques of preparing and standardizing
Potassium Permanganate solution
Storage of permanganate

Dichromate Process

Preparations and standardization of potassium
Dichromate solution

Iodimetry/Iodometry Methods

General applications of iodimetry/iodometry preparation and standardization of iodine solution.
Storage and preservation of Thiosulphase solution
Types of indicators and their preparation from Redox titrimetry.
Precipitation Titrimetry
Primary standard substances used in precipitation titrimetry preparation.
Standardization, and storage nitrate solution.
Types of indicators and their preparation for precipitation Titrimetry.

pH Measurement
Methods of measuring pH.
Colorimetric method (measurement by indicators)
(Mention should be made of the lovibond comparator
Electrometric method (Measurement by electronic meter)

Discussion should include the types, construction, use and Maintenance of the equipment as well as indicator/Reference electrodes.

STC 520 CHEMISTRY LABORATORY TECHNIQUES AND PRACTICE III

Buffer Solution, Definition, types and uses, Preparation of buffer solution (acidic and alkaline) of known pH and known molar concentration.

Colorimetric and Photoelectric Colorimetric: Introduction to the nature of radiant energy, The electromagnetic spectrum, The law of absorbance, The bouguert – Lambert law, The beer's law, Combination of Lambart and Beer's Law, Deviation from Beer's Lambart Law, Visual colorimetry Techniques (use of comparators), The duplication (litration) method, The dilution method, The method of balance or variable depth, The standard series method.

Photoelectric Filter photometer: The construction of a single beam filter photometer e.g EEL. Colorimeter should be described including the principles of operation, Operational precautions and limitations, Trouble shooting and how to correct them. Examples of the faults often associated with filter photometers are. No meter deflection; Instrument cannot set zero with blank sample; Instrument sometime gives accurate readings; Maintenance of the instrument

Spectrophotometry: Principles of photoelectric spectrophotometry, Treatment of different types of cells and their applications, Types of spectrophotometers – U. V., IR and visible (examples should include the single beam and double beam spectrophoto-meters).

Refractometry
Theory: Specific and molar refraction, working principles of a refractormeter –e.g Abbey refractometer, Applications of refractometric method of analysis. Care of the instrument.

Polarimetry: Theory equipment. Practice.

Purification of organic Compounds: The principal methods used to purify organic compounds.

Crystallization - (Application limited to solids) explanation the process in its simplest form, Choice of solvent, Experimental details for recrystallization, Use of de-colourizing carbon for the removal of traces of matter and Resinous products.

Distillation Application limited to liquids and low melting volatile solids.
Brief theory of distillation, superheating

Methods of distillation

Distillation of Atmospheric Pressure: Typical assemblies and techniques used, Distillation under diminished pressure (vacuum distillation) typical assemblies and techniques used.

Fractional distillation- Fractioning columns Azeotropes, Types, Assemblies and Techniques, Fractional distillation under Diminished Pressure

Chromatographic Methods: Principles, Classification of Chromatographic Techniques absorption, partition, Techniques of column chromatograph, Paper chromatograph, Thin-layer chromatograph, Ion exchange chromatography, and Gas chromatography

Biochemistry Techniques

200 LEVEL

FIRST SEMESTER

COURSE No.	COURSE TITLE	UNITS
ST/BCH 201	General Biochemistry I	3
STC 205	Physical Chemistry I	2
STC 203	Organic Chemistry I	2
STC 201	Inorganic Chemistry I	2
STB 207	General Microbiology I	3
STB 201	Genetics I	2
GNS 201	Information Retrieval	1
MAT 201	Mathematical Methods	3
GLT 201	Instrument Maintenance I	3
	Total	**21**

SECOND SEMESTER

COURSE No.	COURSE TITLE	UNITS
ST/BCH 202	General Biochemistry II	3
STB 204	Biological Techniques	2
MAT 224	Statistics for Biological Science	4
MAT 142	Introduction to Computer Science	3
STC 202	Analytical Chemistry	2
GLT 210	Hazards and Safety in the Laboratory	2
GNS 202	Principles of Economics	2
	Total	**18**

300 LEVEL

FIRST SEMESTER

COURSE No.	COURSE TITLE	UNITS
ST/BCH 301	Food Biochemistry	2
ST/BCH 303	Membrane Biochemistry	2
ST/BCH 305	Nutritional Biochemistry	2
STC 305	Physical Chemistry III	2
STC 303	Organic Chemistry III	3
STB 312	Microbial Genetics and Molecular Biol	3
STC 315	Instrumental Method of Analysis	2
MAT 241	Computer programming I	3
	Total	**19**

SECOND SEMESTER

COURSE No.	COURSE TITLE	UNITS
ST/BCH 302	Metabolism of Carbohydrate	2
ST/BCH 304	Metabolism of Amino Acid and Prot.	2
ST/BCH 312	Enzymology	3
ST/BCH 314	Bioengergetics	1
ST/BCH 310	Metabolism of Lipids	2
ST/BCH 308	Metabolism of Nuclei Acids	2
ST/BCH 316	General Biochemical Methods	2
STC 320	Chemistry Laboratory Techniques and Practice I	3
	Total	**17**

400 LEVEL

FIRST SEMESTER

COURSE No.	COURSE TITLE				UNITS
ST/BCH 401	Advanced Enzymology	1	1	-	2
ST/BCH 407	Biosynthesis of Macromolecules	1	-	-	2
ST/BCH 411	Bioinorganic Chemistry	1	-	-	2
ST/BCH 413	Genetic Engineering	1	-	2	2
ST/BCH 405	Plant Biochemistry	2	-	-	2
ST/BCH 415	Biochemical Reasoning	1	-	-	1
ST/BCH 409	Advanced Biochemical Methods	-	-	6	2
ST/BCH 403	Biochemical Toxicology I	3	-	-	3
GLT 411	Laboratory Organisation and Mgt I	2	-	1	2
	Total				**18**

SECOND SEMESTER

ST/BCH 402 Industrial Training (Site Work Supervision)	4
ST/BCH 404 Industrial Training (University Supervision)	4
ST/BCH 406 Industrial Training (Student Report)	4
Total	**12**

500 LEVEL

FIRST SEMESTER

ST/BCH 501	Metabolic Regulation	2
ST/BCH 503	Pharmacological Biochemistry	2
ST/BCH 505	Enzyme Biotechnology	3
ST/BCH 511	Research Project	3
ST/BCH 507	Industrial Biochemistry	3
ST/BCH 509	Biophysics	2
GLT 501	Photography and Bio-illustration	3
	Total	**18**

SECOND SEMESTER

ST/BCH 508	Special Topics/Seminars in Biochem.	2
ST/BCH 504	Advanced Biotechnology	3
ST/BCH 510	Tissue Biochemistry	1
ST/BCH 512	Process Biochemistry	3
ST/BCH 506	Biomass Utilization	2
ST/BCH 511	Research Project	3
ST/BCH 502	Biochemical Toxicology II	3
GLT 508	Lab. Organisation and Management II	3
STC 520	Chemistry Laboratory Techniques And Practice II	3
	Total	**22**

Course Description

ST/BCH 201 GENERAL BIOCHEMISTRY I
Chemistry of amino acids, proteins and their derivatives, methods of isolation and identification, acidity and alkalinity, pH and PK values and their effects on cellular activities; Buffers. Chemistry/Structures of Carbohydrate, lipids and nucleic, acids, primary, secondary, tertiary and Quantenry structures.

ST/BCH 202 GENERAL BIOCHEMISTRY II
Nomenclature of nuclesides, and nucleotides; Effects of acid and alkali on hydrolysis of nuclei acids. Structures and functions of major cell components; prokaryotic versus eukaryotic organisms

ST/BCH 301 FOOD BIOCHEMISTRY
An introduction to the theory and application of physical and chemical methods of determining the constituents of food. Food processing preservations and storage of traditional foods roots and stem tubers, fruits and fruit drinks, seeds and grains, green vegetables. Food poisoning and intoxication: prevention and cure.

ST/BCH 302 METABOLISM OF CARBOHYDRATES
Degradation and digestion of carbohydrates-sugars, storage polysaccharides and cell walls. Reactions of sugars, Glycolysis, the Tricarboxlic acid cycle the phospnogluconate pathway the gloxylate pathway, the pentose phosphate pathway and the cori cycle, the calvin pathway. Gluconegenesis and glyconeogenesis. Disorders of carbohydrate metabolism.

ST/BCH 303 MEMBRANE BIOCHEMISTRY
Structure, composition and functions of biological membranes. Isolation, characterization and classification of membranes; chemistry and biosynthesis of membranes. Molecular organization of membrane components. Natural and artificial membrane bilayers – the unit membrane hypothesis. Membrane transport system active versus passive transport systems. Transport of sugars and amino acids; ionopheres.

ST/BCH 304 PROTEIN BIOSYNTHESIS AND NUCLEIC METABOLISM
Genesome organizational biosynthesis of proteins metabolism of purines and pysimidines, nucleosides and nucleotides, abnormalities in nucleic acid.

ST/BCH 305 NUTRITIONAL BIOCHEMISTRY
Food nutrients, Energy values of foods and energy expenditure by mammalians.
Nutritive values of foods carbohydrates, fats, proteins, vitamins, mineral elements and water. Nutritional disorders, prevention and therapy. Nutritional status and nutrient requirements. Recommended dietary allowances. Assessment of nutritional status. Nutrient requirements, in relation to Physical activity and ageing, diet and disease obesity and under nutrition.

ST/BCH 308 METABOLISM OF NUCLEIC ACIDS
Genome organization and biosynthesis of proteins. Metabolism of purines and pyrimidiens, nucleosides and nucleotides; abnormalities in nuclei acid metabolism-xeroderma pigmentation and skin cancer.

ST/BCH 310 METABOLISM OF LIPIDS
Classification of lipids – fatty acids, triglycerides, glycosylglyeroles phospholipids, waxes, prostagaldins. Lipids micelles, moncalgers and bilayers Lipropropein; covalent backnbone of proteins. Amino acid sequence of protein. Protein isolation, fractionation, purification and characterization of proteins. Biological function of protein. Oxidative degradation of amino acids and metabolism of one carbon unit. Biosynthesis of amino acids and some derivatives; the urea cycle; metabolism of inorganic hydrogen. Disorders of amino acid metabolism.

ST/BCH 312 ENZYMOLOGY
Vitamins and co-enzymes. Fat and water soluble vitamins, structures and functions of vitamins and co-enzymes. Classification and nomenclature of enzymes. Genetics of enzymes and inhibition. Mechanisms of enzyme-catalysed reactions. Effects of temperature, pH, ions and inihibitors on enzyme catalysed reactions. Michaelis-Menten equation. Allosteric/Regulatory enzymes. Active sites of enzymes. Estimation of kinetic parameters, enzyme activities km, Vmax, Ki etc. Zymogen activation, digestive enzymes etc. Production, isolation, purification and characterization of enzymes. Recent advances in enzymology.

ST/BCH 314 BIOENERGETICS

High-energy compounds; chemicals potentials, electrochemical potentials, Electron transport system and oxidative phosphorylation; Regulation of ATP production. Chemical thermodynamics, Oxidations reductions.

ST/BCH 316 GENERAL BIOCHEMICAL METHODS (PRACTICAL)
Practical laboratory exercises in areas of interest to cut across a wide spectrum of general biochemistry. Laboratory practicals may be arranged on the basis of 6 hours per week or 3 hours per week for a semester.

CHEM 320 CHEMISTRY LABORATORY TECHNIQUES AND PRACTICE I

ST/BCH 401 ADVANCED ENZYMOLOGY
Steady state enzymes kinetics. Transient kinetic methods. Chemistry of enzymes catalysis. Regulatory enzymes. Molecular models for alloterism. Multienzyme complexes. Enzyme assays. Criteria for determining purity of enzymes. Enzyme reconstitution. Regulation of enzyme activity and synthesis.

ST/BCH 403 BIOCHEMICAL TOXICOLOGY I
Biochemical toxicology, definition and scope, absorption and distribution; toxicokinetics, metabolism of toxicants; comparative toxicology; physiological factors affecting metabolism of Zenobotics elimination of toxicants and their metabolities, toxicant-receptor interactions, genetics poisons' chemical carcinogenesis; trace element toxicity, hepatotoxity.

ST/BCH 405 PLANT BIOCHEMISTRY
Organization of plant cells, photosynthesis, alkoids and flavonoids, plant hormones, Biosynthesis of carotenoid Pigzents, Biochemistry of Plants Development. The plant cell wall structure, formation and growth, Lignin formation. Free amino acids, pyrimidines, purines and nucleosides in plants. Metabolism of auxins, gibberellins and cytokinins. Synthetic growth regulators and herbicides. Structure function relationship of plant hormones.

ST/BCH 406 STUDENTS INDUSTRIAL WORK EXPERIENCE (SIWES)
Students will be attached to some industrial organizations for 6 months, the exact period being determined by the institution.

ST/BCH 407 BIOSYNTHESIS OF MACROMOLECULES (2 UNITS)
Structure and functions of macromolecus. Storage and structural polysaccharides, mucopolysaccharides, glycoproteins, bacterial cell wall synthesis of complex lipids, lipoproteins and nucleic acids.

ST/BCH 409 ADVANCED BIOCHEMICAL METHODS (PRACTICAL)
The purpose of this course is to familiarize students with operations of latest biochemical equipment and with methods of assimilation and dissemination of information. Students will therefore go round lecturers and laboratories housing specialized equipment with aim of exposing them to such equipment under the supervision of lecturer. Part of the course will also cover the effective use of the library, preparation of dissertations or these, papers for journal publication and journal reviews. Special assignments and essays will be given to students.

ST/BCH 411 BIOINORGANIC CHEMISTRY
Relationship between the physiochemical properties and biological functions of inorganic ions. Ligand complexes and their biochemical significance. Electrolyte metabolism. Nitrogen fixation and sulphur cycle.

ST/BCH 413 GENETIC ENGINEERING
Replication, transcription and translation: a brief review. The genetic code and its relationship to cellular functions. DNA replication in a cell-free system. Genetic transformation, transduction and conjugation. Gene mutation, mutation, mutagenic agents and thin applications to gene transfer. Gene mapping. Structure of eukaryotic genome. Recombinant DNA and its application. Hybridomas.

ST/BCH 415 BIOCHEMICAL REASONING
Evaluation and design of experimental biochemistry from available information and data. Analysis, interpretation and inference drawing from biochemical research data.

ST/BCH 417 BIOCHEMISTRY OF PARASITES (2 UNITS)
Survey of different types of parasites. Host-parasites relation. Metabolism in selected parasites. Parasitm versus Symbiosis. Genetics of parasites. Invitro cultivation of selected parasites. Immunology of parasites, chemotherapeutical control of parasites.

ST/BCH 501 METABOLIC REGULATIONS
The relationship of Krebs Cycle to protein, carbohydrate, lipid and nucleic acids metabolism. Integration of metabolic pathways. Turnover rates and metabolic pools. Regulation of enzymes of metabolic pathways feed-back inhibition versus enzyme synthesis catabolite repression, end product, repression, the lactose operon and arabinos operon. Identification of different regulatory mechancism in metabolic pathways.

ST/BCH 502 BIOCHEMICAL TOXICOLOGY II
Resistance and tolerance of toxicants, natural toxins, chronic testing in animals; short term tests for mutagenicity in the toxicological, evaluation of chemicals, drug metabolite, isolation and structural identification, biochemical modes of action of pesticides enzymatic basis of detoxication.

ST/BCH 503 PHARMACOLOGICAL BIOCHEMISTRY
Cellular metabolism in infected cells. Biocehmical aspects of host-parasite relationships. Metabolic factors affecting chemotherapeutic agents. Theories of the mechanism of drug action. Drug resistance and other factors affecting drug efficacy. The physiological and biochemical action of some selected drugs. Nigerian traditional medicinal plants in the management and therapy of common ailments in Nigeria – malaria, sickle cell anaemia, common cold, hepatitis etc.

ST/BCH 504 ADVANCED BIOTECHNOLOGY
Coordination of microbial metabolism, biosynthesis of metabolites, media and air sterilization power requirement in fermentation vessels, instrumentation and control of fermentation processes, computers in fermentation processes; theory application and technique of continuous culture. Chemicals and fuel via fermentation oxygen transfer and scale-up; production of antibiotics cellulose, and starch hydrolysis (mechanisms and applications.

ST/BCH 505 ENZYME BIOTECHNOLOGY
Principles of industrial large-scale production of enzymes (techniques in fermentations). Large-scale extraction and purification. Principles and Designs of immobilized-enzyme reactors. Characteristics of free versus immobilized enzymes. Immobilized coenzymes and white cells. Enzyme utilization in industrial processes.

ST/BCH 506 BIOMASS UTILIZATION
The concept of biomass for energy and fuels now and in the future. Food, chemical, feedstocks. Raw materials and preparation – forest inventories, agricultural perspectives, acquatic source, municipal solid waste production of micro-algae, hydrogen from water, structure and chemical composition of biomass anatomy, ultra-structure and chemical composition of wood cellulose. Structural characteristics of aid hydrolysis of lignin. Conversion methods of biomass-biological and thermochemical. Cellulose and their applications.

ST/BCH 507 INDUSTRIAL BIOCHEMISTRY
A short review on microbial physiology and genetics. A review on general metabolic pathway control and application in industrial processes. Continous culture methods, principles and applications. The chemostat and its application in industrial fermentations. Fermentations-alcoholic, amino acids, antibiotics and its other

secondary metabolites. Primary and secondary metabolism. Process evaluation and development. Over production of metabolites – amino acids, taste enhancers, organisms of industrial importance. Induction of mutation in microorganisms and plants for the purpose of over production. Strain selection/development and enhancement. Gene dosage and its application in industrial processes.

ST/BCH 508 SPECIAL TOPICS/SEMINAR
Hormones, immunochemistry, onocology, brain biochemistry, munoclonal antibodies. These may be taught or seminars may be given by academic staff and students.

ST/BCH 509 BIOPHYSICS
Some instrumental methods of biophysics, chemical energy, structures and behaviours of macromolecules in solution. Reaction kinetics. Mechanisms in biophysics, sensory function of the nervous system.

ST/BCH 510 TISSUE BIOCHEMISTRY
Biochemistry of muscles, kidney, liver and adipose tissues. General metabolism of the brain and neuronal biochemistry. Biochemistry of reproductive tissues. Detoxification and excretion in tissues.

ST/BCH 511 RESEARCH PROJECTS
Independent research findings into selected areas/topics of interest to the academic staff. Students will be required to carry out literature survey on the topics, perform experiments and produce short reports (preferably at the end of the second semester). Students will be subjected to both seminar and oral examination on the projects undertaken.

ST/BCH 512 PROCESS BIOCHEMISTRY (3 UNITS)
Basic concepts of anaerobic metabolism, isolation, cultivation and identification of anaerobes – Thermophilic anaerobes and their unique features. Survey of useful products manufactured by microorganisms, culture of yeasts, mould bacteria actinomycetes mammalian cells, genetic programming of industrial microorganism. Microbial production of beer, wine, bread, and cheese. Microbiological production of pharmaceutics (hormones and interferon) and industrial chemicals. Methanogenesis (mechanisms and application for waste treatment) production methods in industrial microbiology, agricultural microbiology, and strain improvement strategies for industrial organism.

Physics/Electronics

Course Content

200 LEVEL

FIRST SEMESTER

COURSE No.	COURSE TITLE	UNITS
ST/PE 201	Basic Modern Physics	3
ST/PE 205	Thermal Physics	3
ST/PE 207	Experimental Physics I	1
MAT 201	Mathematics Methods	3
MAT 209	Basic Differential Equations I	3
MAT 241	Computer Programming I	4
GNS 201	Information Retrieval	1
	Total	**18**

200 LEVEL

SECOND SEMESTER

COURSE No.	COURSE TITLE	UNITS
ST/PE 202	Electrical Circuits	3
ST/PE 204	Waves and Optics	3
ST/PE 208	Experimental Physics II	1
ST/PE 210	Basic Electronics	4
ST/PE 222	Statistics for Physical Science	3
GNS 202	Principle of Economics	3
GLT 202	Hazards and Safety in the Laboratory	2
	Total	**19**

300 LEVEL

FIRST SEMESTER

COURSE No.	COURSE TITLE	UNITS
ST/PE 301	Analytical Mechanics I	3
ST/PE 303	Electricity and Magnetism	3
ST/PE 305	Quantum Physics	3
ST/PE 307	Experimental Physics III	1
ST/PE 309	Energy and Environment	1
ST/PE 315	Introduction to Solid State Electronics	3
ST/PE 313	Electrical Circuit Theory	3
MAT 301	Vector and Tensor Analysis	3
ST/PE 311	Physics Lab. Techniques & Practice I	2
	Total	**22**

300 LEVEL

SECOND SEMESTER

COURSE No.	**COURSE TITLE**	**UNITS**
ST/PE 302	Analytical Mechanics II	3
ST/PE 304	Electro-magnetic Waves & Optics	4
ST/PE 306	Statistical and Thermal Physics	3
ST/PE 308	Experimental Physics IV	1
ST/PE 314	Solid State Physics I	3
ST/PE 316	Electronics I	3
MAT 302	Complex Analysis I	3
	Total	**20**

400 LEVEL

FIRST SEMESTER

COURSE No.	**COURSE TITLE**	**UNITS**
ST/PE 401	Quantum Mechanics I	2
ST/PE 405	Mathematics Methods in Physics I	2
ST/PE 407	Computational Physics	2
ST/PE 409	Electrical Measurements & Instrument	3
ST/PE 415	Digital Electronics	3
ST/PE 419	Introduction to Telecommunication Sys.	3
ST/PE 417	Advanced Laboratory Practicals	3
ST/PE 424	Atomic & Molecular Spectroscopy	2
GLT 411	Laboratory Organisation and Mgt I	3
	Total	**22**

400 LEVEL

SECOND SEMESTER

COURSE No.	**COURSE TITLE**	**UNITS**
ST/PE 402	Industrial Training (Site Work Supervision)	4
ST/PE 404	Industrial Training (University Supervision)	4
ST/PE 406	Industrial Training (Student Report)	4
	Total	**12**

500 LEVEL

FIRST SEMESTER

COURSE No.	COURSE TITLE	UNITS
ST/PE 505	Mathematical Methods in Physics II	3
ST/PE 520	Supervised Independent Research Proj.	3
ST/PE 517	Electronics Devices: Designs and Fabrication	2
ST/PE 531	Nuclear and Particle Physics	3
ST/PE	Semiconductor Technology	3
GLT 501	Photography – Illustration	3
ST/PE 507	Physics Lab. Techniques & Practical II	3
	Total	**20**

500 LEVEL

SECOND SEMESTER

COURSE No.	COURSE TITLE	UNITS
ST/PE 504	Vacuum Physics and Thin Firm Tech.	2
ST/PE 512	Fundamental of Energy Process	3
ST/PE 520	Supervised Independent Research (Project)	3
ST/PE 522	Seminar	2
GLT 508	Lab. Organisation & Management II	3
ST/PE 510	Mechanical Methods in Physics II	3
ST/PE 514	Quantum Mechanics II	2
ST/PE 532	Nuclear and particle Physics	2
	Total	**20**

Course Decription

ST/PE 101 GENERAL PHYSICS I (MECHANICS)

Space and Time, frames of reference, Units and dimension, kinematics, Fundamental laws of Mechanics, static and dynamics, Galilean invariance; University gravitation; work and energy, rotational dynamics and angular momentum; conversation laws.

ST/PE 102 GENERAL PHYSICS II (ELECTRICITY AND MAGNETISM)

Electrostatic, conductors and currents; dielectrics, magnetic field and induction. Maxwell's equation; electromagnetic oscillations and waves; applications.

ST/PE 103 GENERAL PHYSICS III

Molecular treatment of properties of matter, elasticity; Hooke's law. Young's shear and bulk moduli. Hydrostatics; pressure; buoyancy. Archimedes principles. Hydrodynamics; Streamlines. Bemoulli and continuity equations. Turblence, REynold's number. Viscosity; Laminar flow. Poiseuille's equation. Surface tension; adhesion, cohesion, capillarity, drops and bubbles. Temperature; the zoreth law of thermodynamics; heat; gas laws of thermydynamics; kinetic theory of gases. Application.

ST/PE 107/108 GENERAL PHYSICS LABORATORY

This introductory course emphasizes quantitative measurement errors and graphical analysis. A variety of experimental techniques will be employed. The experiments include studies of meters, the oscilloscope, mechanical system, electrical and mechanical resolant systems, light, heat, viscocity, etc.

ST/PE 201 BASIC MODERN PHYSICS

Special Relativity. Defects in Newtonian Mechanics; the speed of light; the
Lorentz transformation of velocities; Experimental basis of quantum theory; Black body radiation; electrons and quanta; Bohrs theory of atomic structure; De broglie hypothesis, the uncertainly principle; Achrodinger's equation and simple applications.

ST/PE 202 ELECTRICAL CIRCUITS

D. C. Circuits, Kirchoff's law, source of emf and current, Network analysis and circuit theorems. A. C. circuits. Inductance, capacitance, the transformer, sinusoidal wave-forms, rms and peak values, power, impendence and admittance, series RLC circuit, Q factor, resonance, Network analysis and circuit theorems, filters. Electronics; semiconductors, the pn-junction, field effect transistors, bipolar transistors, characteristics and equivalent circuits, amplifier, fieldback.

ST/PE 204 WAVES AND OPTICS

Wave phenomena; Acoustical waves; the harmonic oscillator, waves on a string; energy in wave motion; longitudinal waves; standing waves; group and phase velocity; Doppler effect; physical optics; Spherical waves; interference and diffraction, holography; dispersion and scattering. Geometrical optics; waves and rays, reflection at a spherical surface, thin lenses. Optical lenses, mirrors and prisms.

ST/PE 205 THERMAL PHYSICS

The foundation of classical thermodynamics including the zeroth and definition of temperature; the first law, work heat and internal energy, Carnot cycles and second law. Entropy and irreversibility, thermodynamics potentials and the Maxwell relations. Applications; Qualitative discussion of phase transition; third law of thermodynamics, ideal and real gases, Elementary kinetic theory of gases including Boltzman counting. Maxwell-Boltzman law of distribution of velocities. Simple applications of the distribution law.

ST/PE 207/208 EXPERIMENTAL PHYSICS I/II

The laboratory course consists of a group of experiments drawn from diverse area of physics (Optics, Electromagnetism, Mechanics, Modern Physics etc). It is accompanied by seminar studies of standard experimental techniques and analysis of famous and challenging experiments.

ST/PE 210 BASIC ELECTRONICS

Thermionic emission, vacuum thermionic devices e.g valves and C.R.T. junction and zener diodes and their applications. Bipolar transistor, characteristics and blasing of bipolar transistors, small signal amplifier, waveform generators. Logic elements and circuits, amplifiers, noise, feesbac, simple resistive capacitive network, power tunnel, shot key and multifunction diodes and their applications.

ST/PE 301 ANALYTICAL MECHANICS I

Newtonian Mechanisms, motion of a particle in one, two and three dimensions, systems of particles and collision theory; Newtonian gravitation; conservative forces and potentials, oscillations, central force problems; accelerated frames of reference; rigid body dynamics generalized motion; mechanics of continuous media.

ST/PE 303 ELECTRICITY AND MAGNETISM

Maxwell's equations and electromagnetic potentials. The wave equation, Propagation of plane waves. Reflection and Refraction. Transmission lines, waves guides and resonant cavites; radiation, Geometrical optics, interference of waves. Diffraction.

ST/PE 305 QUANTUM PHYSICS

Wave – particle duality and the uncertainty principles, basic principles of quantum theory; energy levels in potential well; reflection and transmission of potential barriers; atomic and molecular structure and spectra, nuclear structure and reactions fission and fusion; magnetic resonance; elementary particles.

ST/PE 306 STATISTICAL AND THERMAL PHYSICS

Basic concept of statistical mechanics; microscopic basics of thermodynamics and applications of macroscopic systems, condensed states, phase transformation quantum distributions; elementary kinetic theory of transport processes, fluctuation phenomena. Applications.

ST/PE 307/308 EXPERIMENTAL PHYSICS II/IV

A year long series of mini courses on important experimental techniques. Topics covered include electronics, optics, electricity, atomic, molecular nuclear, and low temperature physics, statistics and data handling and scientific writing.

ST/PE 309 ENEERGY AND THE ENVIRONMENT

Energy and power, principles, demands and outlook, transformation of energy and its cost; thermal pollution; electrical energy from fossil fuels; hydroelectric generation; principles and problems. Costs, capacity, storage, reserves, efficiency, new environmental effects. Electrical energy from nuclear reactors, energy in the future breader reactors; fusion power, geothermal power, tidal power, etc. Promise and problems. Lectures (1/5) Excursions.

ST/PE 311 PHYSICS LABORATORY TECHNIQUES AND PRACTICE I

MECHANICS

Construction and graduation of meter rules. Scales. Practical use of timers
Productions of standard weights of mass 50g, 100g, etc to 500g.
Coiling of helical springs as practical means of measurements of oscillations and motion-straight line graphs elongation – introduction of Young's modulus of elasticity.
Construction of pulleys and force diagrams boards and using the pulley, boards and masses of resolve forces
Construction of simple lever systems
Construction of knife edges with wood and metal
Construction of toy track and its application to the experimental verification of uniform acceleration.
Use of burnt fluorescent tube for experimental determination of Stoke's law – Also comparison of viscosities of liquids.
Inertia and Motion – application to Newton's first law of motion.
Unit of force-Momentum – Conservation of
Action and Reaction – Practical examples – the hammer and the nail
The spring balance – construction, force resolution.
Thermometers – Capillarity.

Sound: Production of resonant tubes from dead fluorescent tubes – local materials, Construction of sonometer boxes and the calibration of the boxes,
Using either (1) or (2) in conjunction with turning forks to determine experiment in sound and wave motion.

Light (Optics: Construction of simple plane mirrors
Care and maintenance of option instruments commonly in the laboratories e.g. the cathetometer, the microscope
Use and maintenance of interferometers. Use of the Newton's ring the gratings and their use in the determination of Option Laws.
The laser. Use and care of the laser. Different types of laser available should be introduced and their characteristics studied.
Application of lesser in optical experiment
Construction of reflectors. Devices, p-n junctions, bipolar and field effect transistor, Solar cells.

ST/PE 313 ELECTRIC CIRCUIT THEORY

General outline of linear circuit analysis, linear transformations, one port and two port networks, single-phase sinusoidal alternating, current circuits, lock diagrams, poly-phase circuits, network topology.

The methods of symmetrical components; some properties of three phase systems, examples of networks of unbalanced impedances. Distribution parameter networks, periodic non-sinusoidal currents in linear circuit, Fourier series, harmonics in three phase systems. Conventional filter design and operation. Operational methods of transient analysis of distributed parameter networks, non-linear a.c. circuits, frequency response of electrical networks, Bode plots. Poles and zeroes and time delay, root-locus concepts.

ST/PE 314 SOLID STATE PHYSICS

Crystal structure and crystal binding. Elastic properties, lattice-vibrations. Superconductivity. Dieletric properties. Magnetism paramagnetism and diamagnetics; ferromagnetism and antiferromagnetism; Magneticx resonance. Imperfections in solids.

ST/PE 315 INTRODUCTION TO SOLID STATE ELECTRONICS

Electrical condition in metals and semiconductor, energy barrier, motion of electrons in electric and magnetic fields, Hall effect, Thermoelectric effects. Photoelectric and secondary Electronic Emission Phenomena. Photoconduction, Devices based on Photoelectric effects, photoconductive and secondary emission effects. Photomultipliers. Photodiodes insrinsic and extrinsic semidonductor, fabrication of simple devices, p-n junction, bipolar and field effect transistor. Solar cells.

ST/PE 316 ELECTRONICS I

Frequency response analysis of electronic amplifiers, oscillators. Power feedback instrumentation amplifiers. Introduction to operational amplifier. Field effect transistor circuits stabilized power supplied and voltage regulation circuits. Transducers, Noise and interference in systems. Introduction to multistage amplifiers. Differential amplifier circuits.

MAT 301 VECTOR AND TENSOR ANALYSIS

Vector algebra. Vector, dot and cross products. Equation of curves and surfaces. Vector differentiation and applications. Gradient, divergence and curl. Vector integrate, line surface and volume integral. Green 2 stroke's and divergence theorems. Tensor products of vector spaces. Tensor algebra. Symmetry. Cartesian Tensor.

ST/PE 401 QUANTUM MECHANICS

The formulation of quantum mechanics in term of state vectors and linear operations. Three dimensional spherically symmetric potentials. The theory of angular momentum and spin. Identical particles and the exclusion principle. Method of approximation. Multielectron atoms.

ST/PE 405 MATHEMATICAL METHODS IN PHYSICS I

Linear algebra and functional analysis; Transformation in linear vector space and matrix theory. Hilbert space and complete sets of orthogonal functions. Special function of mathematical physics. The gamma function; hyergeometric function;

Legendre function; Bassel function. Hermite and Languerre function. The Dirac Delta function. Integral Transforms and Fourier series. Fourier series and Fourier transforms; Laplace transform. Applications of transform methods to the solution of elementary differential equations of interest in Physics and Engineering.

ST/PE 407 COMPUTATIONAL PHYSICS

Use of numerical methods in Physics; various methods of numerical integration, differentiation, numerical solutions of some differential equations in Physics, Statistical analysis of experimental data.

ST/PE 409 ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

The transistor as a switch, power dissipation base over drive storage drive and switching speed, logic gates: NANO OR with close logic, the TTL AND gate, Truth table, noise margins, television pole, open collector and tristate, TTL, CMOS, NMOS, ECL combinational systems. Bolean algebra, identities, De-Morgans Law, Karmaugh maps, Quin McChusky minimization by computer aided techniques. The half and full adder. Fli-flop; R.S., J-K and D types edge and level trigger, maser slave types, the shift register. Circuit techniques. Oscillation sine wave amplitude control, sequencing frequencing stability. Waveform discrimination. Practical ramp generators. Conversion techniques, frequency to voltage staircase generators analogue to digital D to A. Termination of pulsed lines, Beageron diagram. Low noise amplifier design. Use to discrete components for minimum noise.

ST/PE 415 DIGITAL ELECTRONICS

The transistor as a switch, power dissipation base over drive storage drive and switching speed, logic gates; NAND OR with close logic, the TTL AND gate, Truth table, noise margins, Television pole, open collector and triastate, TTL, CMOS, NMOS, ECL combinational systems, Bolean algebra, identities, De-Morgan's law, Karmaugh maps. Quin McChusky minimization by computer aided techniques. The half and full adder. Fli-flop: R-S, J-K and D types edge and level trigger, master slave types, the shift register, circuit techniques, Oscillation sine wave amplitude control, sequencing frequenct stability, waveform discrimination. Practical ramp generators. Conversion techniques, frequency to voltage staircase generators analogue to digital D to A, Termination of pulsed lines, Beargon diagram, Low noise amplifier design, use to discrete components for minimum noise.

ST/PE 419 INTRODUCTION TO TELECOMMUNICATION SYSTEMS

Modulation, Radio and T.V. systems, Telephone instruments, lines loses, noise, T. & T. networks, radar and navigational aids data transmission.

ST/PE 423 SOLID STATE PHYSICS II

Dieletric properties. Magnetism paramagnetism and diamagnetics;
ferromagnetism and antiferromagnetism; Magnetic resonance. Imperfections in solids.

ST/PE 424 ATOMIC AND MOLECULAR SPECTROSCOPY

The hydrogen atom. Relativistics effects and spin. Identical particles and symmetry. Many electron atoms. Coupling schemes and vectors model. Zeeman effects, Hyperfien structure. The diatomic molecule, the FrankCondon principle. X-ray diffraction. Microwave methods. Resonance phenomena; ES, MMR and optical pumping and Mossbauer scattering.

ST/PE 501 QUANTUM MECHANICS II

Time-independent and time-dependent perturbation theory. Scattering theory, theory elastic potential scattering, Green's function and partial wave methods. Selected phenomena from each of atomic physics, molecular physics, Solid state Physics and Nuclear physics are described and then interpreted using quantum mechanics models.

ST/PE 503 SEMICONDUCTOR TECHNOLOGY

The chemical physics of semiconductors, preparation, purification, growth of simple crystals evaluation of chemical structural properties, dropping, effects mechanical and metallurgical properties. Thermodynamic and kinetic consideration in crystal growth from met and by chemical vapour transport techniques. Scanning and transmission electron microscopy, X-ray photograph, photo luminescence and mass spectroscopy, Si, Ge, GaAs and measurements of electrical properties. Processing of semiconductors material for device fabrication. Formation of p-n junction luminescence and luminescent materials, photoemissive and photoconductive materials. Materials for IC's and their fabrication.

ST/PE 504 VACUUM PHYSICSAL AND THIN FILM TECHNOLOGY

Design and characteristics of vacuum systems. Different types of vacuum pumps and their uses, measurement of low pressure, different types of pressure gauges, use of valves and other vacuum materials, industrial uses of vacuum ayatems, vacuum heating, furnaces, induction heating, electron bombardment heating.

Vacuum evaporation by various means, evaporation sources and techniques, substrate and surfaces preparation for thin firm deposition in vacuum. Epitaial grow processes. Heat treatment for thin film, compatibility of film and substrates, sputtering techniques, deposition of thin insulating films by r.f. sputtering, preparation and use of masks for thin film deposition. Characterization and application of thin films.

ST/PE 505 MATHEMATICAL METHODS IN PHYSICSL II

Partial differential equations; solution of boundary value problem of partial differential equations by various methods which include separation of variables, the method of integral transforms, Sturm-Liouvelle theory, integral and summation of series. Applications to various physical situations which may include electromagnetic theory, quantum theory, diffusion phenomena.

ST/PE 507 PHYSICS LABORATORY TECHNIQUES AND PRACTICAL II

Electricity

Collection and Classification of Conductors/Insulators

Making of Dry cells boxes
Connection of Dry cells in series and parallel
Practical use of d.c. Ammeters and voltmeters
Construction modification of d.c. and A.C. meters. Use of shunts and multipliers
Simple A.C/C tests with meters – condenser testing techniques
Making of small resistance with standard wire gauges

Testing of small resistances constructed with meters
Comparison of resistances made with standard resistances
Construction of resistance boxes
Introduction of post office box
Construction of the meter bridge
Construction of the potentiometer bridge
Application of bridges to experiments
Voltmeters and Ammeters
Wiring techniques – lamps and switching arrangements in wiring
Other electrical indication instruments – the galvanometer
Application to wheat stone bridge
Different galvanometers in common use in the laboratories.
Construction and use of jockeys
Fuses – connections
Fault finding techniques e.g trouble shooting techniques
Colour coding of resistors and condensers.
Connection of resistances – series/parallel resistivity tests
Comparison of e.m.f. of cells.
Experimental determination of Ohm's Kirchoff's Law
Simple construction of parallel plate condensers.

Magnetism

Magnetic materials – collection and classification of magnetic and non-magnetic substances
Use of magnetic needles in the determination of the earth's magnetic poles
The electroscope
The electromagnet – construction of electric bells and relays
Making of the solenoids
Transformers, construction and maintenance
Making of inductance – various winding techniques
Simple experiments involving inductance
Simple experiments involving electromagnetic inductances
The induction coil applications of simple demonstrations – A/C and D/C generations
Connection of cables to A/C sources (American, Britain and European Cable Colour Codes).

ST/PE 512 FUNDAMENTALS OF ENERGY PROCESSES

Theory of modern energy conversion, transmission and storage methods; windmills, Heat engines, Classical engines, Ocean thermal energy converters, thermoelectric, therminionic, fuel cells, production of hydrogen, electrolytic, chemical thermolytic, photolytic, hydrogen storage. Photoelectron converters, photo thermovoltaic converters, Biomass, Photosynthesis, production methanol and ethanol from vegetable matter.

ST/PE 517 ELECTONIC DEVICE/DESIGN AND FABRICATION

Relevant items/devices of commercial interest to be handled by individual units.

ST/PE 531 NUCLEAR AND PARTICLE PHYSICS I
Nuclear structure, Nuclear masses, nuclear forces, nuclear-nucleon scattering, nuclear models. Radio-active Decay. Alpha, beta, gamma decays. Nuclear reactions.

ST/PE 532 NUCLEAR AND PARTICLE PHYSICS II
Nuclear instrumentations and radiation detection techniques, detectors, nuclear spectroscopy. Neutron physics; production, detection of neutrons. Fission and fusion. Nuclear reactor and nuclear energy. Elementary particles; Conservation laws, partial classification. Strong electromagnetic and weak interactions.

Geology Techniques
Course Content

300 LEVEL

SECOND SEMESTER

COURSE No.	COURSE TITLE	UNITS
STG 302	Introductory Geochemistry	3
STG 304	Stratigraphy and Geochronology	2
STG 306	Metamorphic Petrology	3
STG 308	Hydrogeology I	3
STC 202	Analytical Geo-Chemistry I	2
STG 312	Structural Geology	3
STG 314	Exploration and Mining Geology	3
STG 316	Paleontology	2
STG 320	Independent Field Mapping	3
	Total	**19**

400 LEVEL
FIRST SEMESTER

LONG VACATION

COURSE No.	COURSE TITLE	UNITS
STG 401	Engineering Geology I	3
STG 403	Petroleum Geology	3
STG 405	Economic Geology	3
STG 407	Hydrogeology II	3
STG 409	Applied Geophysics	3
STG 413	Palynology	3
STG 411	Geological Techniques II	3
GLT 411	Laboratory Organisation and Mgt	2
		23

400 LEVEL
SECOND SEMESTER

COURSE No.	COURSE TITLE	UNITS
STG 402	Industrial Training (Site Work Supervision)	4
STG 404	Industrial Training (University Supervision)	4
STG 406	Industrial Training (Report)	4
	Total	**12**

500 LEVEL

FIRST SEMESTER

COURSE No.	COURSE TITLE	UNITS
STG 501	Research Project	3
STG 503	Exploration Geochemistry	3
STG 505	Geology of Nigeria	2
STG 507	Regional, Structural Geology And Global Tectonics	3
STG 509	Germstone Technology	3
GNS 503	Project	3
GLT 501	Photograhy/Bio-illustration	3
	Total	**20**

500 LEVEL

SECOND SEMESTER

COURSE No.	COURSE TITLE	UNITS
STG 501	Research project	3
STG 504	Energy Resources	2
STG	Remote Sensing II	2
STG 508	Engineering Geology II	2
STG 512	Industrial Rocks and Minerals	2
STG 514	Marine Geology	2
STG 516	Regional Geology of Africa	2
GLT 508	Laboratory Organisation & Management	3
	Total	**18**

Course Description

STG 200 EARTH HISTORY

The geologic time-scale and its methods of measurement. Origin and chemical evolution of the atmospheres, hydrosphere and biosphere – the his story of life from bacteria to man. Concepts of paleoclimate, paleoceangeography, paleoceanography, paleomagnetism. Basic principles of stratigraphy. Practical identificatioin of common fossils. Sedimentation – Principles and processes. Internal processes on earth. Igneous and Metamorphic.

STG 201 PHYSICAL GEOLOGY

Planet Earth. Its composition from core to crust. Minerals, rocks and weathering. Surface processes and landforms, major earth structures. Practical identification of common rock forming minerals and rocks; interpretation of topography and simple geologic maps. Deformation processes – joints, faults and folds. Metamorphism and metamorphic rocks. Minerals and rocks – origin, distribution, identification and classification.

STG 202 OPTICAL AND DETERMINE MINERALOGY

Characteristic properties and propagation of light. The polarising microscope. Principles of optical crystallography. Identification of rock-forming minerals in parallel and convergent light under the polarizing microscope, introduction to X-ray crystallography.

STG 203 CRYSTALLOGRAPHY AND MINERALOGY

Formation of a crystal; principles of crystal chemistry, crystal state; crystal structure; crystallographic notations; crystal lattice and unit cell; elements of symmetry, crystal, twinning, systematic of mineralogy, silicate structures. Systematic description, ocurrence and uses of common rock forming minerals; association of minerals and rocks; physical and optical properties and identification of common rock forming minerals.

STG 204 IGNEOUS AND METAMORPHIC PETROLOGY

Origin, occurrence, geologic setting and systematic description of igneous rocks. Metamorphism and description of metamorphic rocks; metamorphic minerals and textures or metamorphic rocks.

STG 206 FIELD GEOLOGY AND MAP INTERPRETATION

A field course involving the fundamentals of structural geology; descriptions of deformational structures; field mapping techniques and the detailed interpretation of topographic and geologic maps. Determination of geometric forms of colours; interpretation of surface data, Three-point problem.

STG 207 BASIC GEOLOGY SURVEYING

Surveying instruments and their uses e.g chair, steel measuring tape, ranging poles, land chain, arrows, dumpy levels, the odolite, planimeters. Linear surveying, leveling, area measurements, volume of earthwork, curve ranging and tachometry, barometric heightening

Note: The course is equivalent to MNE 303: Engineering surveying (3 Units).

STG 208 MINERAL RESOURCES AND ENVIRONMENTAL GEOLOGY
Metallic and non-metallic mineral resources – their composition, distribution and utilization. Fossil fuels; surface and underground water hydrology. Pollution and its source, hazards and control. Prediction and control of geologic hazards.

STG 210 ENGINEERING GEOLOGY
Introductory soil and rock mechanics. Engineering properties of soils and rocks. Principal geologic factors affecting certain engineering projects – stability of slopes and cuttings; reservoirs and dam site foundation – types and problems in dams, dykes, bridges, building, and pavements. Behaviours of water in rocks and soils. Stoppage and erosion in reservoirs. Geological exploration of an engineering site – general consideration, preliminary investigation, applied geophysical surveys, drilling boring, wrenching and pitting.

STG 301 SEDIMENTOLOGY
Origin of sediments and sedimentary rocks, sedimentary processes, quantitative and statistical study of texture; structure and composition of sedimentary rocks, description of sedimentary rocks, study records. Petrography study of sedimentary rocks under the polarizing microscope.

STG 302 INTRODUCTORY GEOCHEMISTRY
Abundance, classification and distribution of elements in the cosmic system, lithosphere; hydrosphere and atmosphere, geochemistry of different rock types and mineral deposits; weathering and soil formation, principles and methods of exploration geochemical analysis.

STG 303 SYSTEMATIC PALEONTOLOGY
Morphology, evolution and identification of major animal phyla, viz: Protozoa, Porifera, Coelonterate, Bryozoa, Brachiopoda, Mollusca, Arthropoda, Echinodermata, Graptolithina, their stratigraphic and paleoecologic distributions, vertebrates and plant fossits; trace fossils.

STG 309 GEOLOGICAL TECHNIQUES
DTA (Differential Thermal Analysis). Equipment and analysis of sample. Use of flame photometer and spectrophotometer in determining various elements. Microscopy (Transmitted and reflected light and electron microscopes. Hardness measurement of ore-minerals and other related minerals and the equipments use.

STG 304 STRATIGRAPHY & GEOCHRONOLOGY
Concepts of chrono, litho-bio-stratigraphy classification, terminology and correlation. Facies analysis, origin and revolution of sedimentary basins, geohistory analysis. Principles of geochronology, Rb/Sr, K/Ar and U/Pb dating methods. Stable isctopes; Pre-Cambrian geochronology; Pre-Cambrian of Nigeria.

STG 305 IGNEOUS PETROLOGY
Extrusive and intrusive igneous processes, associations of igneous rocks in space and time; phases equiplibrim and the genesis of selected igneous rocks. Grantitic rocks – classification and petrogenesis. Older and Younger granites of Nigeria. Charnockites, kmberlites, serpentinites, and carbonatites.

STG 306 METAMORPHIC PETROLOGY

Physcio-chemical processes in metamorphism, agents and controls of metamorphic processes: metamorphic differentiation. Classification of metamorphic rocks, metamorphic textures. Metamorphic Facies and Facies series. Facies of contact and regional metamorphism. Retrograde metamosphism, polymetamorphism and Orogeny. The carbonatite problem; eclogites. Evolution of gneisses and migmatites. Anatexis, metasomalism and granitisation.

STG 307 PHOTOGEOLOGY AND REMOTE SENSING

Concepts and foundation of Remote Sensing: types of sensors, Elements of photographic systems. Aerial photography-types; principles of stereosropic vision. Measuring and plotting instruments in photogeology. Principle of aerial photo interpretation; mapping. Introduction to non-photographic remote sensing systems. The use of Remote Sensing in reconnaissance mapping, economic mineral prospecting and hydrogeology.

STG 308 HYDROGEOLOGY I

Hydrogeology and Hydrology – definition and scope. Hydrological cycle; hydrological properties of rocks. Occurrence and movement of groundwater, groundwater and well hydraulics, fundamental hydrodynamic laws. Hyddrometerology – rainfall, overland flow, through flow interception et.c hydrograhs; unit hydrograph, theory and the application. Explanation of the basic hydrological equation.

STG 313 PRINCIPLES OF GEOPHYSICS

Gravity and magnetic methods and data interpretation, spontaneous potential and electrical resistivity methods, concepts of electrical potential, current density and conductivity of rocks, potential distribution in a homogenous earth and apparent resistivity. ER field equipment, its use and data interpretation.

STG 311 MICROBPALEONTOLOGY

Morphologic and biostratigraphic study of major groups of micro-fossil especially foraminifera. Ostraccoda and conodouts.

STG 312 STRUCTURAL GEOLOGY

Stresses and strain analysis; and the stress ellipsoid stress component and trajectories; experimental deformation behaviour or rock materials; theology in the earth's crust; fold mechanics, brittle fracture and failure, use of Mohr's circle; brittle and ductile shear zones, small scale geological structures. Salt domes and diaprism. Elements of physical metallurgy – crystal defects and dislocations, work hardened annealing, recovery, recrystallization, deformation mechanisms and development of textures and preferred orientations by plastic flow and recrystallization, solution of structural problems by stereographic projection.

STG 314 EXPLORATION AND MINING GEOLOGY

Definition and scope of mineral exploration. Mode of occurrence and factors controlling ore disposition. Concepts of ore search. Reconnaissance and detailed exploration techniques – geological, geochemical and geophysical. Types of drilling and machinery. Roles of geologist in drilling. Ore reserve estimation and

classification. Mining and mining methods. Factors controlling the choice of mining methods. Geological mapping and surveying of open-pit and underground mines. Roles of geologist in mining. Introduction to mineral economics. Mineral rights and mining law.

STG 316 PALEONTOLOGY

Paleontological sampling, paleoecologic principles and paleobiologic models, macro and micro – evolution, statistical data analysis of paleotological data.

STG 320 INDEPENDENT MAPPING

Field mapping training class during the long vacation at the end of the 300 level courses. This involves an independent mapping exercise lasting 4-6 weeks in selected parts of Nigeria. A report on the exercise must be written and submitted at the beginning of the fourth year.

STG 401 ENGINEERING GEOLOGY I

Engineering properties of rocks, concrete aggregate and quarrying techniques; elements of soil mechanics; geological site investigations, foundations; dams, influence of groundwater on engineering project slopes, roads, rail roads, dams and reservoirs. Method of ground improvement – grouting, compaction, anchoring, drainage.

STG 406 STUDENTS INDUSTRIAL WORK EXPERIENCE SCHEME

Conditions: Students who have outstanding courses of 12 or more units at the end of the first semester of 400 level will be disallowed from taking part in SIWES. During the SIWES, students will be attached to geological and allied organization for a period of 6 months.

STG 403 PETROLEUM GEOLOGY

The origin, migration and accumulation of petroleum. Source rock characteristics, maturation and destruction of petroleum. Properties of petroleum reservoirs. Subsurface and production geology. Hydrocarbon traps, abnormal pressure. Exploration methods, evaluation of petroleum potential and reserves. Reserves and basic classification. Drilling, completing and producing oil and natural gas wells. Examples of major oil depositions. Oil deposits in Nigeria. Oil and geopolitics.

STG 405 ECONOMIC GEOLOGY

The role of structure in mineral exploration. Definition of economic minerals and economic mineral deposits. ‘Ore’ and gangue minerals. Processes of formation and mineral deposits, classification of ore deposit. Mineral deposits in Nigeria.

STG 407 HYDROGEOLOGY II

Aquifers and types, ground water exploration and exploitation techniques; hydrochemistry. Case histories of basement complete hydrogeology. Applications of geophysical methods in shallow groundwater development (including springs); water quality physical, chemical and biological parameters. Effect of groundwater on rocks and soils as construction materials and sites.

STG 409 APPLIED GEOPHYSICS

Induced polarization and electromagnetic methods, seismic exploration – data acquisition, processing and interpretation.

STG 411 GEOLOGICAL TECHNIQUES II

The mechanical stability of the raw materials measured by cruching; polishing, breaking, abrasion, AIV, ACV, PSV (Published Stone Value) 10% fined value.

STG 413 PALYNOLOGY

The Geological Time Scale: The Archean; tectonism; metallogeny and crustal evolution. The Early to MJid-late Proterozic, Basic Ultrabasic intrusions, geosynclines, mineralization, Mid-late proterozic, Basinal development, crustal evolution and metallogeny. The Paleozoic petrotectonic evolution of continents form Cambrian to Permian; mineralization associated with the tectonism. Mesozoic – Cenozoid; The break-up of Ranges; the evolution of new Atlantic Ocean Petrotectonic evolution and associated mineralization.

STG 406 INDUSTRIAL TRAINING

STG 501 RESEARCH PROJECTS

Geologic mapping and independent study of an assigned area followed by laboratory analysis, data interpretation and the preparation of a geological report.

STG 503 EXPLORATION GEOCHEMISTRY

Principles of major and trace elements analysis, preparation and analytical procedures, geochemical surveys, field operations – sample collection and processing; surveying techniques, map preparation and interpretation of data. Geochemical methods in mineral prospecting and exploration. Case histories of geochemical surveys and integrated exploration programmes. The future of geochemistry in mineral exploration.

STG 504 ENERGY RESOURCES

Introduction to energy resources. Primary resources; external sources, the earth's internal heat. Secondary resources. Photosynthesis and fossil fuel, the fossil fuels bank. Global perspective of energy resources, the growth of energy demand, global requirement and distribution.

Fossil Energy: Coal, its geology – origins, stages of formation, properties and ages, world coal resources, petroleum, nature, origin and generation. World resources of petroleum. Side effects of fossil fuel conversion.

Nuclear Energy: Nuclear reactions and reactors, fuel requirement for reactors, uranium – geology and geochemistry, its occurrence in pegmatites and magnetic deposits, vein – type deposits e,g in fissures, fault zones, uncomformities etc. sandstone and quartz pebble conglomerate deposits. Uranium production and economics, its reverses and resources. Side effects of nuclear industry, radioactive waste disposal.

Geothermal Energy: Hyper-thermal resources; zones with low conductive shallow strata, hot rocks

Surface Energy Resources: Solar energy – its thermal collection, photovoltaic conversion, biomass conversion via photosynthesis. Wind energy, hydro-electric power – its contribution to global power supplies. Tidal power, wave energy. Energy supply and demand in Nigeria – present and future scenes.

STG 505 GEOLOGY OF NIGERIA

Major geomorphic and structural elements in Nigeria. The Basement complex, origin, structure and evolution of early – middle Proterozoic rocks.
In Nigeria; the Nigeria Schist Belt and problems late. Proterozoic Lithostratigraphy; Schist Belt mineralization; the Pan African Orogeny and the evolution of older granites.
The Jurassic of Nigeria – Young granites. Post-Paleozoic driffs and the emergence of sedimentary basins; stratigraphy and fossil records. A working excursion round the basement complex and sedimentary parts of Nigeria.

STG 506 REMOTE SENSING II

Review of basic concepts in Remote Sensing. Acquisition of remotely… Site investigations: principles and methods – tunneling, drilling and sampling techniques, geologic maps. Erosion problems and materials quality control.

STG 507 REGIONAL STRUCTURAL GEOLOGY AND GLOBAR TECHONICS

Analysis of large-scale regional structures; continental dirft. Sea-floor reading and plate tectonics, plate tectonic regimes in the geologic pallinspastic reconstructions of foldbelts.

STG 508 ENGINEERING GEOLOGY II

Geotechnics and application in Engineering Geology; terrain classification. Application of soil mechanics principles; water retaining structures, dams, highways, foundation, slope stability, settlement, design of structures.

Site Investigations: principles and methods – tunneling, drilling and sampling techniques, geological maps. Erosion problems and material quality control.

STG 509 GEMSTONE TECHNOLOGY

CASE HISTORIES: Applied geology methods exploration, systematic study of economic mineral deposits; ferrous metals and their alloys (iron, manganese, columbite, tantalite, tungsten, molybdenum, nickel, cobalt, Chronium, titanium); non-ferrous metals (Copper, lead, zinc, aluminum, tin); precious metals (gold, silver, platinum); radioactive elements (uranium, thorium).
Mineral deposits in Nigeria – metallic, non-metallic, radioactive, industrial rocks and minerals in Nigeria (Talc, clay, limestone, marble, asbestos, serpentine, e.t.c), their possible uses in industry. Basement complex metallogeny – spatial distribution; prospects of future. Methods of acquisition and exploitation on mineral deposits in Nigeria.

STG 510 – SPECIAL TOPICS AND CASE HISTORIES
Students will write reports and give seminars on important topic. They could take the form of a review or compilation of data in seven of the fields of geology during the two semesters. Assessment is base on depth of presentation and comprehension of subject matter.

CASE HISTORIES: Applied geology methods exploration, systematic study of economic mineral deposits, ferrous metal and their alloys (iron, manganese, columite, tantalite, tungsten, molybdenum, nickel, cobalt, chromium, titanium); non-ferrous metals (copper, lead, zinc, aluminum, tin); precious metals (gold, silver, platinum) radioactive elements (uranium, thorium).

Mineral deposits in Nigeria – metallic, non-metallic, radioactive, industrial rocks and minerals in Nigeria (Talc, clay, limestone, marble, asbertos, serpentine, etc,), their possible uses in industry. Basement complex metallogeny – spatial distribution; prospect for future. Methods of acquisition and exploitation of mineral deposits in Nigeria.

STG 514 MARINE GEOLOGY
Elements of physical, chemical and biological oceanography methods of ocean floor sampling and probling, structure and physiography of ocean basins, distribution of marine sediments and mineral resources, beach erosion and coastal management.

STG 516 REGIONAL GEOPLOGY OF AFRICA
Geology, structure, and Evolution of Africa Precambrian domains and their radiometric ages; development of Phanerozoic interior and coastal basins in Africa with emphasis on Nigeria.

Chemical/Petroleum Techniques
CourseContent

200 LEVEL

FIRST SEMESTER

COURSE NO	COURSE TITLE	UNITS
ST/CP 201	Engineering Thermodynamics	3
STC 201	Inorganic Chemistry	3
STC 203	Organic Chemistry	3
STC 205	Physical Chemistry	3
MAT 201	Mathematics Method	4
GLT 201	Technical Drawing	2
GNS 201	Information Retrieval	1
MEE 203	Applied Mechanics	2
	Total	**21**

200 LEVEL

SECOND SEMESTER

COURSE NO	COURSE TITLE	UNITS
ST/CP 200	Industrial Process Calculations	3
ST/PE 204	Experimental (Physics II)	2
GNS 202	Principles of Economics	1
GLT 202	Hazards and Safety in the Lab	3
Mat 142	Introduction to Computer Science	4
Glt 204	Workshop Practice	3
Mat 222	Statistics for Physical Sciences & Engineering	2
	Total	**20**

300 LEVEL

FIRST SEMESTER

COURSE NO	COURSE TITLE	UNITS
ST/CP 301	Chemical Thermodynamics	3
ST/CP 301	Metallurgy	3
ST/PE 303	Applied Electricity & Magnetism	3
ST/CP 301	Fluid Mechanics	2
ST/CP 303	Technology Materials	2
MAT 301	Computer Programming	3
ST/CP 303	Chemical Reaction	3
ST/CP 305	Petrochemistry	3
	Total	**22**

300 LEVEL

SECOND FIRST SEMESTER

COURSE NO	COURSE TITLE	UNITS
ST/CP 302	Int. to Transfer Processes	3
ST/CP304	Chemical Reaction Technology	3
ST/CP 306	Mass Transfer	3
ST/CP 308	Heat Transfer	3
ST/CP 311	Chemical Tech. of Petroleum	3
ST/CP 312	Chemical Engineering Lab. 1 Practicals to be designed by the institution in line with the syllabus, and materials available	2
ST/CP 314	Strength of Materials	3
	Total	**20**

400 LEVEL

FIRST SEMESTER

COURSE NO	COURSE TITLE	UNITS
ST/CP 401	Particulate Mechanics	2
ST/CP 403	Chemical Technology Laboratory II	2
ST/CP 405	Polymer Science & Technology	4
ST/CP 407	Petroleum Production Technology	4
ST/CP 409	Technology of Fossil Fuel Processing	3
STC 407	Instrumentation & Analytical Chemistry	3
	Total	**20**

400 LEVEL

SECOND SEMESTER

COURSE NO	COURSE TITLE	UNITS
ST/CP 402	Industrial Training (Site Work Supervision)	4
ST/CP 404	Industrial Training (University Supervision)	4
ST/CP 406	Industrial Training (Student Report)	4
	Total	**12**

500 LEVEL

FIRST SEMESTER

COURSE NO	COURSE TITLE	UNITS
ST/CP 501	Environmental Technology	3
ST/CP 503	Process Control	3
ST/CP 505	Process Optimization	2
ST/'CP 507	Chemical Technology Laboratory III	2
ST/CP 509	Pulp and Paper Technology	2
GLT 501	Photographic and Illustration	3
ST/CP 511	Project	3
	Total	**18**

500 LEVEL

SECOND SEMESTER

COURSE NO	COURSE TITLE	UNITS
GLT 508	Lab. Organization and Management II	3
ST/CP 502	Process Design	2
ST/CP 504	Biochemical Technology	3
ST/CP 506	Chemical Technology Laboratory iv	3
ST/CP 502	Seminar	2
ST/CP 511	Project	3
GNS 501	Industrial Management	2
	Total	**17**

Course Description

ST/CP 201 THERMODYNAMICS

Definition of terms and general concepts of system, surrounding, process, temperature heat, work & energy, First Law of Thermodynamics Application to open systems, Second Law of Thermodynamics Application to heat engines entropy. First and second law combined. Perfect Gasses. Joule Thompson coefficient. Equilibrium processes. Maxwell's relations two phase system thermodynamic functions of solution P-V-T relationship, Work from Heat energy

ST/CP APPLIED MECHANICS

Vectors, operations with forces, resultants of coplanar force systems. Resultant of spatial force systems. Equilibrium and coplanar force systems. Centre of gravity, centre of mass. Newton's laws of motion and their applications, impulse and momentum; Kinematics of a point, composition and resolution of velocities and accelerations relative velocity and acceleration, representation by vectors. Plane Kinematics of rigid body, angular velocity diagrams applied to simple mechanisms instantaneous center of rotation. Equations of motion, linear momentum and moment of momentum. Kinetic energy, moment of inertia. Free vibrations of systems with one and two degrees of freedom including damping-Tensional vibration.

ST/CP 202 INDUSTRIAL PROCESS CALCULATIONS

Units and dimensions. Stoichiometry Vaporization Processes. Material balance involving Chemical reactions. Heat balanced; simultaneous heat and mass balances. Unsteady state heat & Mass balances introductory Process Economics.

GLT 204 WORKSHOP PRACTICE

Introduction to basic manufacturing processes. Organization of workshop. Workshop hazard and safety practices and codes. Properties of engineering materials. Bench-work and fitting. Introduction to turning exercises – straight and step tuning chamfering. Screw cutting. Milling and milling exercise. Drilling techniques and

exercise. Sheet metal work. Welding and soldering technique with exercises. Properties of wood. Wood work and joinery exercises. Workshop measurements,. Refrigeration and air conditioning principled of operation, refrigerants and trouble shooting. Methods of leak detection, charging and discharging. Safety precautions. Automotive workshop practice; Principle of operation of the motor car. Turning carburetor, setting contact breaker gap setting ignition timing. Engine routine may enhance procedure and engine service. Tyre types and care. Battery care, lopping up and charging.

ST/CP 301 CHEMICAL THERMODYNAMICS

Generalzed P-V-T Relations. The P-V-T behaviour of pure substances. Equation of state for gases. The principle of corresponding state. Compressibility relations, reduced pressure, reduce volume, temperature, Pseudocritical constants. P-V-T approximations for gaseous mixture-ideal gas mixtures. Dalton's law of additive pressure, Amagat law of additive volumes. Pseudo-critical point method. Kay's rule. Gililand's method Behaviour of liquids.

Heat Effects: Heat capacities as a function of temperature. Specific of liquids and solids. Heat effects accompanying phase chage-Clausius-Clapeyron equation. Standard heats of reaction, formation and combustion. Effect of temperature on heat of reaction. Heats of mixing and solution. Enthalpyconcentration diagrams for H2S04 – H20, etc. partial enthalpies: single and multiple effect evaporators with regards to heat effects.

Industrial Stoichiomery. Gas analysis – Orsat methods, determination of components in fuels. Calculations based on fuel reaction for nitrogen and oxygen in the fuel: correction for sulphus Calculation based on fuel-gas analysis. Net hydrogen-carbon ratio in the fuel and percent excess air. Air/fuel and fuel-gas/air ratios. Interrelations of fuel and fuel-gas analysis. High nitrogen fuels. Mixed fuels.

Thermodynamics of Flow Processes: Fundamental equations: continuity equation, equation of motion, energy equation. Bernoulli's equation. Flow in pipes, laminar and turbulent flows, Reynolds anum bers, friction factor-fanning equation. Flowmeters. Nozzles. Compressors single and multistage, effect of clearance.

Phase Equilibria: Criteria of equilibrium. Fugacity of a pure component General fugacity relations for gases. Fugacities of gas mixture. Effects of temperature and pressure on fugacity. Pressure temperature composition relationship. Phase behaviour oat low and elevated pressure. Raoult's law, Henry's law. Equilibirum constant; Activity coefficient, Gibbs-Duhem equation Margules and Van Laar equations.

Chemical Reaction Equilibria: Standard free energy change and equilibrium constant. Evaluation of equilibrium constants. Effects of temperature and pressure on equilibrium constants. Calculation of conversion. Gas-Phase reactions, percent conversion. Liquid-phase reactions, herenogneous reactions.

ST/CP 301 APPLIED FLUID MECHANICS
Fluid statics; Newtonian and non-Newtonian fluids. Forces on submerged surfaces, Equations of fluid motion. Flow measurements, forces exerted by flowing fluids, laminar and turbulent flow. Reynolds number flow in pipes and channels, dimensional analysis, one, two or three dimensional steady flows of a comprehensible fluid, critical flow, small amptitude waves, shock waves fluid machinery.

ST/CP 301 METALLURGY
Introduction to Metallurgy, Hardening of metals. Deformation and Annealing of metals. Corrosion Annealing of metals. Corrosion and Oxidation phenomena. Alloy steels Stainless, creep of metal joining. The measurement of temperature. Electrical and magnetic alloys. Copper and its alloys. Polymers. Aluminum magnesium and light alloys. Titanium and other flow metals.

ST/CP 303 TECHNOLOGY OF MATERIALS
Structure of matter. Crystal imperfection. Simple phase diagrams of alloys. Physical properties of materials (i.e. wood, cement, plastics, and alloys). Mechanical properties of engineering materials. Engineering and true stress-strain curve. Ultimate strength, ductile, impact strength, hardness, torsion, creep and fatigue failure. Electrical properties –conductivity, semi-conductivity and super conductivity. Optical.

MAT 301 COMPUTER PROGRAMME II
Principles of good programming,; structured programming concepts; debugging and testing; string processing, internal searching and sorting. Data structures, recursion. Use a programming language different from that Sin CS 201.

ST/CP 303 CHEMICAL REACTION TECHNOLOGY
Review of fundamentals of Chemical Thermodynamics and of Chemical kinetics, as would be relevant to reactor design. Homogenous reactions: analysis of constant-volume batch reactor and variable-volume batch reactor. Design of single homogenous ideal batch, ideas flow and ideal back-mix flow reactors. Temperature effects on yield and selectivity timer distribution.

ST/CP 305 PETROCHEMISTRY
Origin of petroleum. Expletation technique. Parameters for evaluation (grading). Constitnents. Fractionation and methods of identification. Chemistry of refining processes. Characteristics and uses of refinery products Economic aspects of crude petroleum oil pollution and its control.

ST/CP 302 INTRODUCTION TO TRANSFER PROCESSES
Basic laws of mass momentum and energy transfer processes and their relationship. Simple problems involving dimensionless groups such as Re, Sc, Pr, Measurement, Calculation & Prediction of Transport coefficient.

ST/CP 306 MASS TRANSFER
Review of theories fore prediction of mass coefficients. Application of distillation (Mccable Thiele and Ponolion Savant method) extractive and azeotixpic distillation. Multicomponent distillation gas absorption, liquid/liquid extraction drying, leaching and humidification.

ST/CP 308 HEAT TRANSFER

Nature of processes of conduction, convection and radiation. Definition of thermal conductivity and heat-transfer coefficients. Conducting through materials with constant and varying heat-transfer areas. Unseady-state conduction: Solution of equations for simplecases.

Schmid's methods

Dimentional analysis and heat transfer by convection forced convection inside and outside tubes and tube bundless. Thermal boundary layer. Reynolds analogy and its developments. Heat exchangers – log mean temperature difference in single and multiple pas exchangers; Calculation of heat transfer coefficient. Optimum design.Finned tubes lagging effectgiveness and economic thickness. Radiation Kirchhoffs and Stefan's lawas. Emissivity. Calculation of net heat exchange between bodies – multiple reflection and net radiation methods. Radiator from gases

Heat transfer during condensation of vapours Derivation of Nussel equation Drop – wise and film-wise condensation. Effect of non-condenseble gases. Heat transfer to boiling liquids. Types of boiling and influence condition on heat fluxer and transfer coefficients.

ST/CP 310 CHEMICAL TECHNOLOGY OF PETROLEUM

Desalination processes. Atmospheric and vacuum distillation of petroleum and petroleum fractions. Gasoline stabilization and sweetening. Properties of fuelsoctane number, cetane number etc. Hydrocarbon gas purification and separation. LPG Production Gas Processing – alkylation and polymerization. Thermal processes – cooking, thermal cracking and pyrolysis. Catalytic reforming and isomerization.

ST/CP 304 CHEMICAL REACTION TECHNOLOGY II

Heterogeneous reactions: fluid-solids interacting systems. Norcatalytic, and solidcatalysed gas-phase reaction. Tubular reactors-design equation based on plug flow for isothermal and adioabtic cases. Transport effects, packed bed design

Fluidised and slurry-phase reactors and their uses. Factors affecting choice of reactor. Optimisation-output and yield problems. Conditions of stability of ractors. Rate-controlled regime in gas-solid reactions catalysed by porous catalysts. Scale-up procedure-batch and continous flow reactors. Economic evaluation and comparison of reactor types. Review of elementary theorems and operations on vectors and matrics. Theory of linear systems including rank degeneracy, difficrention and integration of matrics Linear Programming Properties of eigeavalues and eigenvectors. Cayley-Harnilton and Sylvester's theorem. Reduction to quadra-tic diagonal and canonical forms. The matrizant. Application to chemical – engineering stage processes including rectification, multicomponent distillation, staged absorbers, complex monomoleculary kinetics Strirred tank reactors and stage dynamics.

ST/CP 314 STRENGHT OF MATERIALS

Force equilibrium free body diagrams. Elasticity – concept of stress, strain tensile test. Young's modulus and other strength factors. Axially loaded barts, composite bars, temperature stress and simple indeterminate problems. Hoop stresses in cylinders and rings, bending moment, shear force and axial force diagrams for simple cases. Simple torsion and application Advance topics ion bending moments and shear force in

beams. Theory of bending of beams. Deflection of beams. Unsymmetrical bending and shear center. Application strain energy. Biaxial and Triaxial state of stress. Transformation of stresses. Morhs circle. Failure theories, springs, creep, fatigue, fracture and stress concentration.

ST.CP 401 PARTICUILATE MECHANICS

Particle-Fluid Mechanics: Motion of single particles and drops in a fluid. Terminal falling velocities. Flow past sphere assemblies. Effect of particle concentration on soning rate.

Thickener calculations. Centrifuging-characteristics of a rotating fluid. Principles of Separation by sedimentation and centrifuging. Types of centrifuges.

ST/CP 405 POLYMER SCIENCE AND TECHNOLOGY

Introduction to Polymers and their characteristics, Sources of polymers Structure and physical properties of polymers, theology, solution and molecular weights. Plasticity and elasticity the William Lande Ferry Equation Polymensation reactions and manufacturing methods. Zegler Natta catalysis Processing and Technology of Polymers.

ST/CP 407 PETROLLLEUM PRODUCTION TECHNOLOGY

Origin of Oil, conditions necessary for the accumulation of oil, Drilling fluids, hole control. Basic petrophysics, measurement of resistivity, porosity and other petrophysical properties. Resereves, measurement and production. Models of oil reservoirs. Material balances for Gas drive, solution drive and water drive fields. Elementary oil production engineering.

ST/CP 409 TECHNOLOGY OF FOSSIL FUEL PROCESSING

Source, availability and characterization of fossil fuel (petroleum, Natural gas, Tar Sands, Coal) Modern processing technology choice of product lines and products, alternative product lines and product specifications will be emphasized.

ST/CP 405 INDUSTRIAL TRAINING

ST/CP 501 ENVIRONMENTAL TECHNOLOGY

Pollution and the Environment-definitions and inter-relationships, natural and man-made pollution the economics of pollution. Air pollution-gaseous and particulate pollutants and their sources. Effects on weather, vegetation materials and human health. Legislation relating to air pollution. Methods of control of gaseous emission and destruction, cyclones inertial, separators, electrostatic precipitators, bag filters, wet washers etc. dispersal form chimneys and method of calculating chimmey height. Flare stacks.

Water pollution-river pollution by industrial effluents legislation and standards for effluent discharge. Impurities in natural and their effects. Brief survey of river ecology and the effects of effluents on the ecosystems Treatment processes including precipitation flocculation coagulation sedimentation, clarification and colour removal. Principles of biological treatment processes. Cost of treatment. Treatment for water re-use, on exchange. Cooling water treatment. Land Pollution – Disposal of solid wastes by incinerator and dumping. Possible future trends including conversion of solid wastes into useful materials or energy. Treatment of other types of pollutions-noise. Thermal and Nuclear pollutions.

ST/CP 503 PROCESS CONTROL

Classical control theory. Transfer function. Time and frequency response stability theory. Root locus method. Control system designs. Instrumentation modern control theory. Observability and controllability modern recheability. State – space analysis. Introductory sampled data analysis. Control of distillation columns, reactors and heat exchangers.

ST/CP 505 PROCESS OPTIMISATION ENGINEERING

Stationary Optimisation: Differential Approach Numerical Approach, linear and non linear programming. Trajectory optimization including dynamic programming, calculus of variation and pontryagin optimum principle Numerical computational techniques including first & second order methods.

ST/CP 509 PULP AND PAPER TECHNOLOGY

Cellulose and Hemicellullose-structures and characteristicsa. Lignin. Pulp woos-types and properties. Types of pulping processes – sulphite, alkaline, mechanical semichemical etc. bleaching Fiber preparation, neture of fiber boinding. Sheet formation Water usage and disposal in pulp and paper industries, Microbiology Internal and surface sying Wet strength Colouring Properties of paper, Pigment, coating printing, laminating and comigating saturation of paper and paper plastics

ST/CP 511 SEMINAR

Each student must present one seminar and be present at all Engineering seminars.

ST/CP 502 PROCESS DESIGN

Presentation and discussion of real process design problems. Block diagrams, process and engineering flow diagrams, process outline charts incorporating method study, and critical examination. Specification of vessels, examples include distillation towers and ancillaries, heat exchangers vapouriser, knock-out vessel Emphasis on conception and invention of processes as well as analysis and economic balance to specify optimum design and operating conditions Discussion of a variety of cases throughout the course.

ST/CP 504 BIOCHEMICAL ENGINEERING

Aspects of living processes. Microbiology and control of microorganisms. Microbial Kinetics. The Biochemistry and phyusico-chemical properties of biological compounds. Biochemical pathways and metabolism of simple substrates. Fermentations. Enzyme kinetics. Biochemical reactors. Design of microbial culture processes in the manufacture of pharmaceuticals, commercial enzymes and alcoholic beverages. Batch and continuous culture. Biological waste disposal

GNS 501 INDUSTRIAL MANAGEMENT

The course is designed to focus attention of students on certain management principles and practice which they can apply to achieve efficiency in an establishment. The course therefore emphasizes the management functions, tools of management forecasting planning, execution, organization, control delegation of authority – human relations, motivation, work groups in an industrial set-up, leadership, personnel management, capital structure, sources of fund, financial and operating ratios to measure results and efficiency, shares/dividend/profit plans, break.

ST/CP 511 PROJECT
A research project involving an investigation on a selected Chemical/Petrochemical Engineering problem. The project is to be written up in the form of a scientific report or paper

Physiology/Pharmacology Techniques

Course Content

200 LEVEL

FIRST SEMESTER

COURSE NO	COURSE TITLE	UNITS
ST/PP 203	Blood and Body fluids	2
STC 201	Inorganic Chemistry	2
ST/PE 107	General Physics (Lab)	1
ST/PE 205	Thermal Physics	2
ST/PP 205	Cardiovascular System	2
STPP 209	Respiratory System	2
ST/PP 211	Alimentary System	2
GNS 201	Information Retrieval	1
ST/PP 213	General Practical (Physiology)	2
ST/PP 207	Renal System	2
	Total	**18**

200 LEVEL

SECOND SEMESTER

COURSE NO	COURSE TITLE	UNITS
ST/PP 202	Introductory Pharmacology	3
ST/PP 204	Autonomic Nervous System	3
ST/PP 206	Central Nervous System	3
STC 202	Analytical Chemistry	3
MAT 224	Statistics for Biological Science	3
GNS 202	Principles of Economics	2
MAT 142	Introduction to Computer	2
GLT 210	Hazards and Safety in Lab	2
	Total	**23**

300 LEVEL

FIRST SEMESTER

COURSE NO	COURSE TITLE	UNITS
ST/PP 301	Principles of Drug Action	3
ST/PP 303	Parasympathetic/Sympathetic	3
ST/PP 305	Neuromuscular Transmission	3
STC 305	Physical Chemistry II	4
STC 303	Organic Chemistry II	3
MAT 241	Computer Programming 1	2
	Total	**17**

300 LEVEL (2nd Semester)

COURSE NO	COURSE TITLE	UNITS
ST/PP 302	Hypertension	3
ST/PP 304	Endocrinology	3
ST/PP 306	Practical Pharmacology	3
St/PP 308	Animal Management	4
ST/PP 307	Instrumentation	3
ST/PP 309	Practical Pharmacology	2
	Total	**18**

400 LEVEL (First Semester)

COURSE NO	COURSE TITLE	UNITS
ST/PP 401	Central Nervous System	3
ST/PP 403	Pharmacology of pain	3
ST/PP 405	Mechanisms – Extraphyramidal side effects	2
ST/PP 407	Antidepressant drugs	3
ST/PP 409	Anti-eplleptic drugs	3
ST/PP 411	Conversant agents	3
ST/PP 413	Practical	3
GLT 411	Laboratory Organization and Management	1
	Total	**23**

400 LEVEL (2nd Semester)

COURSE NO	COURSE TITLE	UNITS
ST/PP 402	Industrial Training Site Work Supervision	4
ST/PP 404	Industrial Training University Supervision	4
ST/PP 400	Industrial Training Students Report	4
	Total	**12**

500 LEVEL (2nd Semester)

COURSE NO	COURSE TITLE	UNITS
ST/PP 501	Principle of Chemotherapy	6
ST/PP 503	Trypanocides	3
ST/PP 505	Project	3
GLT 501	Photography and illustration	3
ST/PP 505	Practical Pharmacology	3
	Total	**18**

Course Descriptions

ST/PP 203 BLOOD FLUIDS
Blood and Body fluids. Composition of blood and lymph. Chemistry of Blood plasma and Serum proteins. Red blood cell functions, white blood cell functions. Defence mechanisms, antibody-antigen interactions. Mechanism of blood coagulation. Blood disorders (anemia's and leukemia's) and treatment.

ST/PP 205 CARDIOVASCULAR SYSTEM
Anatomy and Physiology of the heat. The electrocardiogram. Principles of blood circulation (systemic, pulmonary and coronary). Cardiac output, arterial venous and capillary pressures. Control of blood pressure. Auto-nervous and normal regulations. Cardiac failure and hypertension.

ST/PP 207 RENAL SYSTEM
Anatomy and functions of the kidney, formation of urine, mictirition. Regulation of extracellular fluids – diuretics. Regulation of Aci-base balance. Therapeutic alterations of urinary pH. Renal disease and treatment. Control of body pH. Some selected practicals on the above and histology.

ST/PP 209 RESPIRATORY SYSTEM
Physiology of the respiratory system. Pulmonary ventilation. Mechanism of breathing. Volumes, pressure and composition of respiratory gases. Mechanism of and factors affecting gaseous exchange. Diffusion of oxygen and carbon dioxide through the respiratory membrane. Transport of oxygen and carbon dioxide in the blood and body fluids. Nervous and chemical control oaf respiration. Respiratory insufficiency. Extraneous influences affecting respiration. Drugs affecting respiration and respiratory disorders.

ST/PP 211 ALIMENTORY SYSTEM
Physiology of the alimentary tract. Movement of food through the alimentary canal. Secretary functions of the alimentary tract Digestive juice. The liver and biliary system. Absorption and storage of metabolites carbohydrates, protein and fat metabolism. Water absorption in the large intestine. Defecation and cathartics. Diseases of the alimentary system (ulcer, diahoea, constipation and drug treatment)

ST/PP 213 PRACTICAL (PHYSIOLOGY)
Practical involving the anatomical and functional organizations of autonomic (parasympathetic and sympathetic) and central nervous systems and reproductive systems. Introductory practical knowledge on effects of drugs on selected tissues.

ST/PP 202 INTRODUCTORY PHARMACOLOGY
The link between physiology and pharmacology. Defiation of pharmacology, drugs etc. Sources and typed of drug. Classification, sites and mechanisms of drugs action. Drug receptors and interaction of agonists and antagonist. Methods of drug administration. Principles of drug absorption. Drug biotransformation. Drug excretion.

ST/PP 204 AUTONOMIC NERVOUS SYSTEM

Anatomical and functional organization of the ANS. Sympathetic and parasympathetic systems. Sympathetic transmission – synthesis, storage, release and distribution of noradrenaline. Evidence for noradrenaline as a neurotransmitter. Parasympathetic – synthesis storage, release and distribution of acetylcholine Neuromuscular transmission .

ST/PP 206 CENTRAL NERVOUS SYSTEM – ANATOMY OF THE CNS

Spinal cord and pathways. Control of muscle movement. Cortical and cerebella control of motor functions Basal ganglia and control of movement Transmission and processing of information. The reticular activating system Wakefulness, sleep and attention – EEG waves. The limbic system and emotions. Reproductive System – Anatomy and physiology of sex organs. Some selected practicals on the above

ST/PP 301 PRINCIPLES OF DRUG ACTION, AGONISTS, ANTAGONISTS, AFFINITY CONSTANTS

Theraupetic index. Principles, design and tguypes of bioassay. Routes of drug administration, factors determining absorption, distribution and excretion of drugs. Drug dosage regimen. Introduction to drug metabolism enzyme induction and drug interaction. Introduction to Pharmacokinetics.

ST/PP 303 PARASYMPATHETIC/SYMPATHETIC

Pharmacology of drug affecting cholinergic nerve transmission. Site of action – Cholinergic receptors and classification. Cholinesterases and anti-cholinesteraces. Pharmacology of drugs affecting adrenergic nerve transmission, storage uptake and release of catecholamine, structure-activity relationships in sympathominetic amines.

ST/PP 309 PRACTICAL PHARMACOLOGY

ST/PP 307 Instrumentation

Introduction to the apparatus and instruments used for experimental physiology i.e. surgical instruments, recording apparatus, stimulators, levers, baths, transducers, physiography, Cathode Ray Oscillograph, Oscilloscope and electrodes.

Recording methods, isotonic and isometric musclecontractions. Mechanical and electrical recordings. Measurement of temperature, force, displacement and pressure. Contraction of muscle, characteristics of muscle twitch and contaction of skeletal muscle in the body. Record membrane potentials and action potentials e.g. Manophasic and Biphasic.

ST/.PP 302 HYPERTENSION

Types of antihypertensive drugs and mechanisms of action. Cruretics vasodilators and antianginal drugs – cardiac glycosides quinidne and cuinidine-like drugs, antiarrhythmic drugs. Clacium channel blockers Autocoids – histamines, 5-hydrpxypahmine prostaglandins and their antagonistgs. Leukotrienes and the roles in phaarmacodynamics Endocnnology – organizational function of the endocrine system. Gene and membrane active hormones. The hypophyseal homone and pineal gland. ACTH, Insulin, Glucagon, Parathroid hormone. Local haormones

ST/PP 304 SEX HORMONES
Pregnancy and lactation, Contraceptive steroids and fertility regulation

ST/PP 306 PRACTICAL PHARMACOLOGY
Relevant topics by the unit to be designed and performed by the students.

ST/PP 308 ANIMAL MANAGEMENT
Design of animal house for various colonies of laboratory animals
Breeding and handling methods
Diseases and control of infections
Collection of blood and humane killing methods e.g. physical and chemical means
Routes of drug administration
Laws governing the use of laboratory animals

ST/PP 401 CENTRAL NERVOUS SYSTEM PHARMACOLOGY
Central neurotransmitters Local and general anaesthetics differentiation of action.

ST/PP 403 PHARMACOLOGY OF PAIN
Aspirin, morphine, mechanism of anti-pyretic and inflammatory analgesics, opitates and receptors. Tolerance and dependence Anxiety-reducing drugs sedatives and hypnotics, Antipsychotic drugs.

ST/PP 405 MECHANISMS – EXTRAPHYRAMIDAL SIDE EFFECTS
Parkinsons's disease Huntington's chorea. Wilson's disease

ST/PP 407 ANTIEPILEPTIC DRUGS – DEPRESSION
Types of antidepressant drugs – tricyclics – typical and atypical Modes of action and side effects

ST/PP 409 ANTIEPILEPTIC DRUGS
Epilepsy – types of scissors and drugs used in each case

ST/PP 411 CONVULSANT AGENTS
Strychnine, bicuculine picrotoxin, tetanus toxin. Psychotominetic drugs. Physco and neuropharmacology practicals on the aetiology of cancer, bacterials infections, and common tropical diseases, and the various pathophysiological states associated with these diseases. The mechanisms of actions of the various chemotherapeutic drugs and their toxic agents. The chemistry and the structural activity relationship of these therapeutic agents. The mechanisms of drug resistance, role of immunity in chemotherapy and the rationale for combination therapy.

ST/PP 501 PRINCIPLES OF CHEMOTHERAPY
The chemistry and mechanisms of action of antiparastic, antimicrobial and antimeoplastic agents, antimalarials, and antiviral agents.

ST/PP 503 ANTIPARASTIC DRUGS:
Trypanocides – schisto micides and amoebicides Resistance to chemotherapeutic agents antimalarias and antibiotics

ST/PP 505 PRACTICAL PHYSIOLOGY

General principles of technology Toxicity testing Organotoxicity – ocular toxicity, nepphrotoxicity and hepatotoxity. Adverse drug interactions and generic components in clinical practice. Agricultural, environmental and industrial toxicology. Principles of antidotal treatment, Cacinogenesis and teratro-genesis. Toxicological evaluation of a new drug. Postmarketing surveillance of drugs.

ST/PP 513 ALCOHOLISM AND DRUG THERAPY

Definition and classification of alcohols. Sources and uses of alcohols. Pharmacology of ethanot, pharmaco-kinetics, pharmacological action on body systems, metabolism and excretion, effects of ethanol and drug metabolizing systems. Therapeutic uses of ethanol. Classification and alcohol contents of alcoholic beverages, intoxication definition, classification and associated with the assurance of product quality.

ST/PP 515

General principles of drug quality control and assurance systery

Structural organization and functions of a Quality Control Department

Sources of impurities in pharmaceutical substances, sources quality variation of pharmaceutical products

Monographs and specifications for drugs and dug product. Critical evaluation of the Pharmacoloieas including the African Pharmacopoiea and the role of WHO in drug quality assurance.

Application of chemical and physicochemical analytical techniques in purity determination, identification and quantitation of drugs in pharmaceutical and radiopharmaceutical preparations, including multicomponent formulations from a regulatory and quality control standpoint.

Evaluation of crude drugs

Microbiological evaluation of sterile and non-sterile pharmaceutical products.

Practical

Practical work will involve comprehensive analysis of some selected raw materials and finished drug products using a combination of analysis of principles treated in the theory. It will be supplemented by visits to Local manufacturing units where the students may examine the practice of quality control.

2.17 B.Sc. Statistics Degree Programmes

2.17.1 Philosophy, Aims and Objectives of the Degree Programmes

The aims and the objectives of Bachelor Honours Degree and pass degree programmes in Statistics should be:

a. To instill in students a sense of enthusiasm for statistics, an appreciation of its application in different areas and to involve them in an intellectually stimulating and satisfying experience of learning and studying.

b. To provide students a broad and balanced foundation in statistics knowledge and practical skills in statistics and computer science.

c. To develop in students the ability to apply their statistics knowledge and skills to the solution of theoretical and practical problems in statistics.

d. To develop in students, through an education in statistics, a range of transferable skills of values in statistics related and non-statistics related employment.

e. To provide students with knowledge and skills- base from which they can proceed to further studies in specialized areas of statistics or multi-disciplinary areas involving statistics.

f. To generate in students an appreciation of the importance of statistics in an industrial planning, economic planning, environmental and social planning.

2.17.2 Admission and Graduation Requirement

UME
The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, Physics to form the core subjects with credit in any other two relevant science subjects at the Senior Secondary School Certificate or its equivalent. In addition, an acceptable pass in the University.

Direct Entry
Candidates with two A level passes (graded A-E) at the Advanced Level in one or more relevant subjects (Mathematics, Physics and Further-Mathematics) may undertake the three – year degree programme into 200-level.

2.17.3 LEARNING OUTCOMES

a) Regime of Subject Knowledge

All bachelors honours level, Statistics graduates are expected to develop cognitive abilities and skills relating to statistics.

b) *Competencies and Skills*

They should be able to demonstrate practical skills relating to the solution of statistical problems and its applications.

c) *Behaviourial Attitudes*

They should be able to demonstrate general skills relating to non-subject specific competencies, ICT capability, communication skills, interpersonal skills and organization skills.

2.17.4 **Attainment Levels**

Graduates of Statistics are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in Statistics and other related areas in relation to national and societal needs.

2.17.5 **Resource Requirement for Teaching and Learning**

a) Academic and Non-Academic Staff (See Section 1.6)
b) Academic and Non-Academic Spaces (See Section 1.6)
c) Academic and Administrative Equipment (See Appendix)
d) Library and Information Resources (See section 1.6)

2.17.6 **Course Contents and Descriptions**

YEAR I
100 LEVEL COURSES

Courses	**Title**	**Units**
BIO 101	General Biology	3
PHY 101	General Physics I	3
PHY 102	General Physics II	3
CHM 101	Chemistry	3
STA 111	Descriptive Statistics	4
STA 112	Probability I	4
STA 121	Statistics Inference I	4
STA 131	Statistical Computing I	2
MTH 101	Algebra General Math. I	4
MTH 102	Trigonometry II	4
CSC 101	Introduction to computer Science	4
GST 101	Use of English	2
LIB 101	Library Studies	1
		41 Units

YEAR II
200 LEVEL COURSES

Courses	Title	Units
STA 201	Statistics for Agriculture & Biological Sciences	4
STA 202	Statistics for Physical & Engineering Sciences	4
STA 211	Probability II	4
STA 212	Introduction to Social & Economic Statistics	3
STA 221	Statistics Inference I	4
STA 231	Statistics Computing	2
MTH 213	Algebra I	4
MTH 223	Analysis (for non-majors)	4
MTH 241	Ordinary Differential Equations	4
CSC 201	Computer Programming	3
CSC 291	Elementary Data Processing	3
GST 102	Communication SkillS	3
or 105	Land use, Agriculture and Animal Husbandry	
EPS 201	Entrepreneurship Studies I	1
		43 Units

YEAR III
300 LEVEL COURSES

Courses	Title	Units
STA 311	Probability III	3
STA 312	Distribution theory I	3
STA 321	Statistical Inference III	3
STA 322	Regression and Analysis of Variance I	2
STA 323	Design and Analysis of Experiments I	2
STA 324	Survey methods and sampling theory	3
STA 331	Statistical Computing III	2
STA 332	Laboratory /Field-work for Experimental design	2
STA 333	Laboratory/field-work for survey methods and sampling theory	2
STA 341	Statistical Quality Control	2
STA 342	Demography I	3
STA 343	Operation Research I	3
STA 351	Biometric methods	3
MAT 341	Mathematical methods I	3
MAT 342	Mathematical methods II	3
MAT 352	Probability Distribution and Elementary Limit Theorems	3
CSC 202	Systems Analysis and designs	3
EPS 301	Entrepreneurship Studies II	2
		47 Units

YEAR IV
400 LEVEL COURSES

Courses	**Titles**	**Units**
STA 411	Probability II	3
STA 412	Distribution Theory II	4
STA 413	Statistical Inference IV	3
STA 414	Stochastic Processes	3
STA 415	Regression and Analysis of Variance II	4
STA 421	Time series Analysis	3
STA 422	Logical Background of Statistics and Decision theory	4
STA 423	Design and Analysis of experiments II	3
STA 424	Sampling Techniques	3
STA 431	Project	6
		36 Units

Electives

STA 441	Multivariate methods	3
STA 442	Non – parametric methods	3
STA 443	Operations Research II	3
STA 444	Econometric Methods	3
STA 451	Biometric Methods II	3
STA 452	Psychometric Methods	3
STA 453	Bayesian Inference and Decision Theory	3
STA 454	Environmental Statistics	3
STA 455	Educational Statistics	3
STA 456	Health Statistics	3
STA 457	Medical Statistics	3
STA 458	Energy Statistics	3
STA 459	Demography II	3
STA 461	Acturian Statistics	3

Course Description

STA 111 DESCRIPTIVE STATISTICS: 4 Units (L 30)
Statistical data: types, sources and methods of collection. Presentation of data: tables chart and graphs. Errors and Approximations. Frequency and cumulative distributions, Measures of location, partition, dispersion, skewness andKurtosis. Rates ration and index numbers.

STA 112 PROBABILITY 1: 4 Units (L 60)
Permutation and Combination. Concepts and principles of Probability. Random variables. Probability and distribution Functions. Basic distributions: Bernoulli, Binomial, Hypergeometric, Poisson and Normal.

STA 121 STATISTICAL INFERENCE I: 4 Units (L 60)
Population and samples. Random sampling Distribution, estimation (Point and interval) and Tests of hypotheses concerning population mean and proportion (one and two large sample cases). Regression and Correlation. Elementary time series analysis.

STA 131 STATISTICAL COMPUTING I: 2 Units (L 0) (P 90)
Introduction to and use of calculators. Computations (using calculators), involving topics in STA 101,111 and 131. Introduction to computer: structure, involving, type, uses and applications,

STA 201 STATISTICS FOR AGRICULTURE AND BIOLOGICAL SCIENCES 4 Units (L60)
Scope for statistical method in Biology and Agriculture. Measures of location, partition and dispersion. Elements of probability. Probability distributions: binomial, Possion, geometric, Hypergeometric, negative binomial normal. Estimation (point and Interval) and tests of hypotheses concerning population means, proportions and variances. Regression and correlation. Non–parametric tests. Contingency table analysis. Introduction to design of experiments. Analysis of variance.

STA 202 STATISTICS FOR PHYSICAL SCIENCE AND ENGINEERING: 4 Units (L60)
Scope for statistical methods in physical sciences and engineering. Measures of ocation, partition and dispersion. Elements of probability. Probability distribution: binomial Posssion, geometric, hypergeometric, negative-binomial, normal Possion, geometric, hypergeometric, negative-binomial, normal. Estimation (Point and internal) and tests of hypotheses concerning population means proportions and variances. Regression and correlation. Non-parametric tests. Contingency table analysis. Introduction to design of experiments. Analysis of variance.

STA 211 PROBABILITY II: 4 Units (L 45)
Further permutation and combination. Probability laws. Conditional probability. Independence. Bayes' theorem. Probability distribution of discrete and continuous random variables: binomial, Possions, geometric, hypergeometric, ectangular (uniform), negative exponential, bormal. Expectations and moments of random variables. Chebyshev's inequality. Joint marginal and conditional distributions and moments. Limiting distribution and moments. Limiting distribution.

STA 212 INTRODUCTION TO SOCIAL AND ECONOMIC STATISTICS: 3 Units (L 45)
Statistic systems. Nature, types, sources, methods of collection and problem of official Statistic. Index numbers, theory, construction and problems. Socio-economic indicators: nature types uses and computation. Nature sources contents and problems of official Statistic in selected sectors.

STA 221 STATISTICAL INFERENCE I: 4 Units (L 45)
Sampling and sampling distribution. Point and interval Estimation. Principles of hypotheses testing. Tests of hypotheses concerning population means, proportions and variances of large and small samples, large and small sample cases. Goodness –fit tests. Analysis of variance

STA 231 STATISTICAL COMPUTING II: 2 Units (L 0) (P 90)
Uses of computers in statistical computing. Introduction to package. Word Star, WordPerfect, Spread Sheets, SYSTAT, D-Base, C-stat, MINETAB, SPSS. Use of BASIC and FORTRAN programmes in solving problems in STA 211 and STA 231

STA 311 PROBABILITY III: 4 Units (L 60)
Discrete sample spaces. Definitions and rules of probability. Independence Bayes' theorem. Um models. Sampling with and without replacement. Inclusion-exclusion theorem. Allocation and matching problems. Probability generating function. Bemoulli trials, Binomial, Possion, Hypergeometric negative binomial and multinomial distribution, Possion process.

STA 312 DISTRIBUTION THEORY I
Distribution and frequency functions. Documents, cumulants and their generating functions. Some special univaiate distribution. Laws of large numbers. Central limit theorem. Distribution: Stochastic independence. Bivariate moment generating functions of random variable. Biratiate distribution: Stochastic independence. Bivariate moment generating functions. Bivariate normal distributions. Distribution associated with the normal, X^2, t and F distribution

STA 321 STATISTICAL INFERENCE III: 4 Units (L 45)
Criteria of estimation consistency unbiasedness, efficiency, minimum variance and sufficiency, Methods of estimation; maximun likehood, least squares and method of moments. Confidence intervals. Simple and composite hypotheses. Likehood ratio test. Inferences about means and variance.

STA 322 REGRESSION AND ANALYSIS OF VARIANCE I: 2 Units (L 60)
Total Partial and multiple correlation ratio. Simple and multiple linear regression, Polynomial regression. Orthogonal polynomials. Simple non-linear way classification. Two-way classification. Three-way classification. Balanced and unbalanced two factor nested (hierarchical) classifications. Multiple comparisons component or variance estimates and tests.

STA 323 DESIGN AND ANALYSIS OF EXPERIMENTS I: 3 Units (L 60)
Basic principles of experimentation, Randomisation, replication and blocking. Local control. Basic designs: completely randomised, randomised blocks, Latin squares,

Balanced incomplete blocks, split plot. Missing values. Relative efficiency. Estimation and tests of variance components. Multiple comparisons. Departures from underlying assumptions. Applications to agriculture, biology and industry.

STA 324 SURVEY METHODS AND SAMPLING THEORY
Survey design, planning and programming. Methods of data collection. Design of form and questionnaires. Data processing, analysis and interpretation. Errors and biases, Probabilities and non-probability sampling: selection procedure. Estimation of mean, totals, ratios and proportions in simple random, systematic, stratified cluster and two-stage sampling. Probability proportion-to-size sampling. Nigeria's experience in sampling survey.

STA 331 STATISTICAL COMPUTING III: 2 Units (P 90)
Use of advanced packages: SAS, TSP, GENSAT, SYSTAT, BMPD, CONCOR, CENTS,EPI-INFO, ISSA. Analysis of statistical and numerical algorithms. Introduction to Monte Carlo Methods.

STA 332 LABORATORY/FIELD WORK ON EXPERIMENTAL DESIGN I: 2 Units (P 90)
Computations based on field and laboratory appraisal of some of the techniques and problems on experimental design.

STA 333 LABORATORY FIELD WORK FOR SURVEY METHODS AND SAMPLING THEORY 2 Units (P 90)

STA 341 STATISTICAL QUALITY CONTROL: 3 Units (L 45) (P 0)
Basic concepts, Standardization and Specifications. Sources and detection of process variation. Control charts for attributes and variables and their properties: d, p, x and charts. Process capacity studies. Cumulatives sum charts and their properties. Sampling inspection for attributes and variables and their properties: single, double, multiple and sequential plans. Continuous sampling plans.

STA 342 DEMOGRAPHY I: 3 Units (L 45)
Types and sources of demographic data. Methods of collection of Population censuses, sample surveys and vital registration. Evaluation of the quality of demographic data. Measures of fertility, mortality, nuptiality and migration. Standardization and Decomposition. Life tables: construction and application. Framework for developing demographic information systems.

STA 343 OPERATIONS RESEARCH I: 3 Units (L 45)
Nature and scope of operations research. Linear programming and graphical, simplex (including big M and two-phase) methods. Sensitivity analysis. Duality theory. Transportation and assignment problems. Network analysis: CPM and PERT. Inventory theory and applications. Sequencing and scheduling.

STA 351 BIOMETRIC METHODS I: 3 Units (L 45)
Introduction to population genetics. Statistical methods in Biology. Sampling and estimating biological populations. Design and analysis of biological experiments. Design and analysis of clinical trials Bioassays: types and nature. Direct and indirect assays: Parallel line assays, slope ratio assays..

STA 411 PROBABILITY IV: 3 Units (L 45)
Probability spaces measures and distribution. Distribution of random variables as measurable functions. Product spaces; Products of measurable spaces, product probabilities. Independence and expectation of random variable. Convergence of random variables: Weak convergence almost everywhere, convergence in path mean. Central limit theorem, laws of large numbers. Characteristic function and Inversion formula.

STA 412 DISTRIBUTION THEORY II: 4 Units (L 90)
Distribution of quadratic forms. Fisher – Cochran theorem, Multivariate normal distributions. Distribution of order Statistics from continuous populations. Characteristic and moment generating functions. Uniqueness and inversion theorems. Limit theorems.

STA 413 STATISTICAL INFERENCE IV: 4 Units (L 60)
General linear hypothesis and analysis of linear models. Further treatment of estimation and hypothesis testing extension of uniparameter results to multiparameter situation. Basic ideas of distribution – free test. Bayesian Inference.

STA 414 STOCHASTIC PROCESSES: 3 Units (L 45)
Generating functions: tail probabilities and convolutions. Recurrent events. Random walk (unrestricted and restricted). Gamblers ruin problem. Markov processes in discrete and continuous time. Poisson, branching, birth and death processes. Queuing processes: M/M/I, M/M/s, M/a/I queues and their waiting time distributions.

STA 415 REGRESSION AND ANALYSIS OF VARIANCE II: 4 Units (60)
Multicollinearity, autocorrelation and heteroscedasticity. Residual analysis. Transformations. Comparison of intercepts and slopes. Simple non – linear regression. Logistic regression. Use of dummy variables. Departures from ANOVA assumptions. Transformations. Missing values. Analysis of covariance in one-way, two-way, three-way and nested (hierarchical) classifications. Analysis of covariance with two concomitant variables.

STA 421 TIME SERIES ANALYSIS: 3 Units (L 45)
Estimation and isolation of components of time series. Non-stationary and stationaryprocesses: theoretical moments, auto – correlation and partial auto-correlation; Sample moments: auto-correlations; partial auto-correlations; univariate Time Series model: identification and estimation - Auto-regressive (AR) Moving (MA) and Auto regressive Moving (ARMA). Diagnostic checking of models, Linear prediction and Forecasting pectral (Harmonic) analysis.

STA 422 LOGICAL BACKGROUNDS OF STATISTICS AND DECISION THEORY 4 Units (L 45)
Empirical sources of knowledge-hypothesis, observation and experiment. Deductive sources of knowledge and scientific attitude. The concept of causation. Probability, a brief historical treatment to show conflicting definitions. Bayesian statistics and the notion in inverse probability. The place of statistical methods in science. Principles of decision making. Utility functions and their properties. Role of uncertainty. Bayes

Strategies. Problems of prior and posterior distributions: value of prior information Minimax strategies. Statistical inference. Theory of games.

STA 423 DESIGN AND ANALYSIS OF EXPERIMENTS II: 3 Units (L 45)
Further split plot design and nested designs, unbalanced designs, incomplete block designs, 2'' factorial designs, Yates – Algorithm confounding and fractional replication. Diallel cross Analysis. Introduction to response surface methodology.

STA 424 SAMPLING TECHNIQUES: 3 Units (L 45)

Ratio, Regression and Difference estimation procedures. Double sampling. Interpreting scheme. Multiphase and multistage sampling, cluster sampling with unequal sizes; problem of optimal allocation with more than one item. Further stratified sampling.

STA 431 PROJECT: 6 Units (L 0)

STA 441 MULTIVARIATE METHODS: 3 Units (L 45)
Multivariate normal and related distributions. Inference about mean vectors. Hotellings T^2 and Mahalanotis D^2 statistics. Multivariate analysis of variance. Tests of independence and homogeneity. Discrimination and classification. Principal omponents and factor analysis. Canonical correlation analysis. Cluster analysis.

STA 442 NON-PARAMETRIC METHODS: 3 Units (L 45)
Order statistics and their distributions. Tests based on runs. Tests of Goodness of Fit. One sample and two sample linear ranks tests for location and scale. Tests for independent samples. Measure of association for bivariate samples and multiple classifications.

STA 443 OPERATIONS RESEARCH II: 3 Units (L 45)
Integer programme problem: formulations and solution methods. Non – linear Programming: search methods Newtons-raphson method, Frit-John optimality conditions and Lagrangian multipliers. Network analysis. Path methods including Bellman's equations, cyclic and network with positive paths. Dynamic programming: routine of problems, resource allocation and equipment replacement.

STA 444 ECONOMETRIC METHODS: 3 Units (L 45)
Nature of econometric. Econometric models: nature types and characteristics. Econometric problems related to single equation models. Construction estimation and tests. Models involving lagged variables. Simultaneous equation systems; structural form, reduced form, identification, estimation and test. Application of econometric models: demand analysis, production functions, consumption and investment function.

STA 451 BIOMETRIC THEORY II: 3 Units (L 60)
Stability models, simultaneous selections models. Path analysis. Discriminant analysis. Parallel line and slope ratio assays in completely randomized block and incomplete block designs. Logistic curve and logic transformations in relation to bio-assays.

STA 452 PSYCHOMETRIC METHODS: 3 Units (L 60)
The foundations of mental measurement theory: Measurement in Psychology and education. The Construction of true and error scores. The classical test theory model: fixed length, variables length: Some estimates of parameters of the classical model. Other weak type – score models: parallel measurements. Types of reliability co-efficient and their estimation. Some test theory for equivalent measurements. Item, sampling in test theory and in research design.

STA 453 BAYESIAN INFERENCE AND DECISION THEORY: 3 Units (L 45)
Baye's Theorem, Prior and posterior distributions for proportion, means and variances. Choice of prior distribution. Simple non-informative prior distributions. Entropies and decomposition analysis. Principles of decision-making. Roles of uncertainty, utility functions and their properties. Bayesian strategy; Minimax strategies. Theory of games.

STA 454 ENVIRONMENTAL STATISTICS: 3 Units (L 45)
Scope, nature and sources of environmental statistics. Assessment of environmental quality and measurement of air and water pollution. Sampling methods in natural and applied sciences. Environmental Impact Assessment. Requirement for environmental reporting system. Characteristics and uses of the United Nations frame work for the development of environmental statistics. Capacity development for environmental reporting system.

STA 455 EDUCATIONAL STATISTICS: 3 Units (L 45)
Scope, nature and uses of educational statistics. Sources and methods of collection of educational statistics. Educational indicators, Design of education information systems, Education flow models and performance evaluation, Multivariate methods in educational analysis, operations research in educational management.

STA 456 HEALTH STATISTICS: 3 Units (L 45)
Scope and types of health statistics. Classification of disease; injuries and causes of death. Sources and methods of collecting health statistics; census, sample surveys, vital registration and administrative statistics. Health indicators: types, uses and problems. Health systems. Health planning and financing. Health information systems. Operations research in the health services.

STA 457 MEDICAL STATISTICS: 3 Units (L 45)
Scope and nature of medical statistics. Epidemiology methods: relative risks and odds ratios, adjustment of data with and without use of multivariate models, cohort studies (life tables). Competing risks, survival analysis. Sequential methods in clinical trials. Stochastic models epidemiology.

STA 458 ENERGY STATISTICS: **3 Units (L 45)**
Energy sources: renewable and non-renewable, Nature, scope and uses of energy statistics. Concepts, definitions, and units of measurements in use in energy statistics. Energy production and consumption surveys. Data requirements and the procedure for developing an energy database. Constructing an energy balance sheet with Nigeria as a case study. Modelling energy supply and demand.

STA 459 DEMOGRAPHY II: 3 Units (L 45)
Estimating fertility, mortality and nuptiality from limited and defective data. Stationary, stable and quasi-stable population models: theory and applications. Multiple decrement life tables. Population projections: mathematical models, component methods and matrix analysis. Path analysis and multiple classification analysis.

STA 461 ACTUARIAL STATISTICS: 3 Units (L 45)
The time value of money; compound interest and discounting; present values and Accumulated values of streams of payments. Decremental rates and other indices; Annities and sinking funds; solving equations of value; Investment and Appraisal Techniques; Analysis of experiments data and derivation of exposed to risk formulae. Graduation methods (and their applications to curve fitting). Construction of mortality, sickness, multiple decrements and similar tables with applications to life insurance. National social security and pension schemes.

2.18 B.Sc. Zoology Degree Programmes

2.18.1 Philosophy, Aims and Objectives of the Degree Programmes

The programme has been designed to provide a sound understanding of the concepts and methodologies of Zoology in key areas that meet the needs of society. The main objectives of the programme are to broadly educate students for positions in the conservation and bio-diversity sectors, and to prepare them for graduate and professional studies in the animal sciences at the molecular level.

2.18.2 Admission and Graduation Requirement

UME
The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, to form the core subjects with credit in three other relevant science courses Biology, Chemistry and Physics at the Senior Secondary School Certificate or its equivalent. In addition, an acceptable pass in the University Matriculation Examination (UME) into 100-level is required.

Direct Entry
Candidates with two A level passes (graded A-E) at the Advanced Level in one or more relevant subjects (Biology, Botany, Chemistry, Mathematics and Physics) may undertake the three – year degree programme into 200-level.

2.18.3 Learning Outcomes

All Bachelors honours degree student in Zoology are expected to develop the following abilities and skills:

a. *Regime of Subject Knowledge*
   Cognitive abilities and skills relating to solution of problems in Zoology
b. *Competencies and Skills*
   Practical skills relating to the conduct of Laboratory and Field work in Zoology
c. *Behavioral Attitudes*
   General skills relating to non-subject specific competencies, communication, interpersonal, organization skills.

2.18.4 Attainment Levels

Graduates of Zoology are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in Zoology in relation to national and societal needs.

2.18.5 Resource Requirement for Teaching and Learning

a) Academic and non-academic staff. (See section 1.6)
b) Academic and Non-Academic Spaces (See section 1.6)
c) Academic and Administrative Equipment (See Appendix)
d) Library and Information Resources (See section 1.6)

2.18.6 **Course Contents and Descriptions**

YEAR I
100 LEVEL COURSES

Courses		Title	Units
BIO	101	General Biology I	3
BIO	102	General Biology II	3
ZOO	113	Diversity of Animal	3
GST	102	Culture and Civilization	3
MTH	101	General Mathematics I	3
MTH	102	General Mathematics II	3
CHM	101	General Chemistry I	3
CHM	102	General Chemistry II	3
PHY	101	General Physics I	3
PHY	102	General Physics II	3
PHY	105/107	Physics	2
AGC	122	Environment and Humans	5
GST	101	Use of English	2
CSC	101	Introduction to Computer	3
LIB	101	Library Studies	2
			43 Units

Electives
To be selected from other Botany and other Biological Science Courses.

YEAR II
200 LEVEL COURSES

Courses		Title	Units
BIO	201	Introductory Genetics I	2
BIO	202	Introductory Ecology	2
BIO	203	General Physiology I	2
BIO	204	Biological Technique	2
ZOO	111	Invertebrate Zoology	3
ZOO	212	Chorodata Zoology	3
CHM	229	Basic Inorganic Chemistry for non majors	3
CHM	259	Physical Chemistry for the life Science	3
CHM	279	Basic Aromatic and Natural product chemistry for non majors	3
BOT	211	General Botany I	3
MCB	221	General Microbiology	3
STA	201	Statistics for Agriculture and Biological Sciences	4
ARC	222	Introduction to Environmental Archaeology	5
GST	201	Communication Skills	2
EPS	201	Entrepreneurship Studies I	2
			42 Units

YEAR III
300 LEVEL COURSES

Courses	**Title**	Units
BIO 301	Genetic II	3
BIO 302	Field Course I	3
BIO 304	General Ecology	3
ZOO 311	Comparative Annual Physiology	3
ZOO 312	The Biology of Tropical Parasites	3
ZOO 313	Arthropod Diversity	3
ZOO 314	Vertebrate Zoology	4
ZOO 315	Principles of Development	3
ZOO 316	Histology	3
ZOO 399	Industrial and Field Experience	6
EPS 201	Entrepreneurship Studies II	3
		37 Units

YEAR iV
400 LEVEL COURSES

Courses	**Title**	**Units**
ZOO 411	Entomology	4
ZOO 412	Principles of Parasitology	4
ZOO 413	Hydrobiology and Fisheries	4
ZOO 414	Special Topics in physiology	3
ZOO 415	Wildlife Ecology and Conservation	3
ZOO 416	Animal Behaviour	3
ZOO 417	Local Fauna	3
ZOO 418	Essay topics in Zoology	2
ZOO 419	Project	4
		30 Units

Course Description

ZOO 211 INVERTEBRATE ZOOLOGY: 3 Units (L30) (P45)
The systematic, inter-relationship and basic organization of the invertebrates.

ZOO 212 CHORDATE ZOOLOGY: 3 Units (L30) (P45)
The systematic inter-relations and basic Organization of the vertebrates.

ZOO 311 COMPARATIVE ANIMAL PHYSIOLOGY: 3 Units (L30) (P45)
Nutrition and Digestion, Respiration. Blood and circulation. Excretion and homeostasis. The physiology of movement, Hormones. Nervous communication and the sense organs.

ZOO 312 THE BIOLOGY OF TROPICAL PARASITES: 3 Units (L30) (45)
Classification, adaptation morphology. Anatomy, life cycle and other features of interest in the protozoans, plathyhelminthes, nematodes and parasitic arthropods;

drawing particular attention to the various adaptations to the drawing of life exhibited by selected members of the group

ZOO 313 ARTHROPOD DIVERSITY: 3 Units (L30) (45)
Adaptive radiation within the phylum arthropoda with particular reference to the structure and functions of the body appendages. General biology of selected arthropod groups. Biological success of the arthropods

ZOO 314 VERTEBRATE ZOOLOGY: 4 Units (L30) (P90)
Vertebrate systematics, evolution and functional anatomy; geographical distribution of recent vertebrates; the Nigeria vertebrate fauna.

ZOO 315 PRINCIPLES OF DEVELOPMENT: 3 units (L30) (P45)
Problems and processes of development Gene-activity, in cogenesis. Cytoplasmic localization in the nature egg. Gastrulations and cell interactions. Cellular and molecular basis of embryogenesis. Tissue interactions in development. The significance of the placenta and the development of immunity

ZOO 316 HISTOLOGY: 3 Units (L15) (P90)
The cellular basis of tissue formation. Cell communication. Stability of the differentiated state. The formation, distribution, structure and function of vertebrate tissues. The organization of the tissues into organ systems.

ZOO 399 INDUSTRIAL/FIELD EXPERIENCE: 6 Units (L 0) (P 0)

(a) Fisheries
(b) Wildlife Management
(c) Biology of Aquatic Environment
(d) Entomology
(e) Animal and Public Health
(f) Biotechnology
(All are 6 units each)

ZOO 411 ENTOMOLOGY:4 Units (L 45) (P 45)
Origin and phylogeny of insects. Biology of control of selected groups which are of economic importance in the tropics (Particularly in Nigeria) aspects of crops; stored products and vectors diseases of man and his domestic animals. Insect physiology.

ZOO 412 PRINCIPLES OF PARASITOLOGY: 4 Units (L 45) (P 45)
Evolution of parasitic mode of life. Nature of Parasitism in relation to other forms of animal Associations. Host-parasitic relationships. Epidemiological studies and control measures of importance Tropical parasitic diseases and the role of vector in the Transmission of these diseases.

ZOO 413 HYDROBIOLOGY AND FISHERIES: 4 Units (L45) (P45)
A comparative study of the hydrobiology and cycle of life in marine, brackish and fresh water. Fisheries biology including the food and feeding Habits of fish populations. Fecundity and reproduction, age and growth. Aquaculture with

particular reference to Nigeria. The Fish fauna of Nigeria. Fishing gear and fishing techniques.

ZOO 414 SPECIAL TOPICS IN PHYSIOLOGY: 3 Units (L30) (P45)
Specialized aspect of animal physiology, for Example; muscle contraction and cytoskeletal Elements, intracellular microenvironment and Metabolic compartmentation: membrane Organization, receptors and endocytsis, cell Communication.

ZOO 415 WILDLIFE ECOLOGY AND CONSERVATION: 3 Units (L30) (P45)
Dynamics of wildlife population. Techniques of wildlife investigation. Principles of wildlife Management. The wildlife resources of Nigeria Conservation policies, problems and prospects. World wildlife resources: differences in values, Management philosophies and traditions.

ZOO 416 ANIMAL BEHAVIOUR: 3units (L 30) (P 45)
The basis of behaviour orientation Mechanism in animals, instinct and Intelligence, feeding behaviour social Life, courtship and meeting, migration and navigation. Biological clocks and Rhythms.

ZOO 417 LOCAL FAUNA: 3Units (L30) (P45)
General survey of local molluscs, Anthropods and vertebrates. Equivalent existing course – None.

ZOO 418 ESSAY TOPICS IN ZOOLOGY: 2 Units (L0) (P0)
An essay based on a review of the literature on a Zoological topic.

ZOO 419 PROJECT: 6 Units (L0) (P0)
A research project involving an investigation in Zoology and a written presentation and discussion of results.

3.0 EQUIPMENTS (ACADEMIC AND NON-ACADEMIC)

APPENDIX 1

LIST OF IMPORTANT EQUIPMENT (MINIMUM) REQUIRED FOR TEACHING IN A BIOCHEMISTRY DEPARTMENT

S/NO.	DESCRIPTION	QTY. REQD.
1.	Water Bath (Thermostatic)	4
2.	Drying Oven (Thermostatic)	1
3.	Spectrophotometers and Colorimeters	6
4.	pH Meters with Electrodes	4
5.	Electrophoretic Units (Shandon) (Tanks and Power Packs)	4
6.	Centrifuges with Buckets (1000 – 6000 RPM)	4
7.	Incubators	12
8.	Hot Plates and Heaters	12
9.	Test-Tube Mixers	12
10.	Gas Cylinders and Valves and Tubings	6
11.	Distillers (All Glass)	2
12.	Deionizers	2
13.	Gas Chromatography Equipment	1
14.	Fraction Collector	1
15.	Micro-Keldjhal Apparatus	2
16.	High Speed Refrigerated Centrifuge	1
17.	Column Chromatography Equipment	1
18.	Rotary Evaporator	2

APPENDIX 2

LIST OF IMPORTANT EQUIPMENT (MINIMUM) REQUIRED FOR TEACHING IN BIOLOGY, BOTANY AND ZOOLOGY DEPTS.

S/NO.	DESCRIPTION	QTY. REQD.
1.	pH Meter Model 7020	2
2.	Water Bath	1
3.	Skeletal System	1
4.	Muscular System	1
5.	Brain and Nervous System	1
6.	Circulatory System	1
7.	Digestive System	1
8.	Eye and Vision	1
9.	Ear	1
10.	Skin and Excretory Organs	1
11.	GB 28 Concealing and Warning Adaptations	1
12.	Microscopes Swift	16
13.	Olympus Microscope Binocular	5
14.	Nikon Microscope	22
15.	Shermond Microscope	2
16.	Olympus Microscope Monocular	1
17.	Swift Microscope Monocular	1
18.	Wild Microscope Binocular (Heerbrugg)	1
19.	Ice Cube Maker (OSBORNE)	1
20.	Incubator/Sterilizer	1
21.	Embedding Bath	1
22.	Autoclave Portable	1

23.	Chemical Balance (Top-Loading)	1
24.	Dial-B-Gram (2kg. capacity)	1
25.	Tripe Beam Balance	1
26.	Hot Plates (S. No. 72525/19)	1
27.	Hot Plates (S. No. 72431/9)	1
28.	Water Bath No. A08382	1
29.	Incubator Model 516	1
30.	Manesty Still No. 725503	1
31.	Stereoscopic Microscopes (OSM)	20
32.	Refrigerator (Algor)	1
33.	Water Filter	1
34.	R. Humidity with Thermometer	1
35.	Embedding Oven	1
36.	Drying Oven (30^{o} – 120^{o}C)	1
37.	Thermostatic Incubator Model 85164	1
38.	Oven (Gallenkamp) 40o – 60oC	1
39.	Anhydric Incubator	1
40.	Microtome Leiz/Knife	1
41.	Automatic Tissue Processor	1
42.	Water Bath 45300	1
43.	Hot Plate	1
44.	Water Bath 45300	1
45.	Centrifuge	1
46.	Herbarium Index Boxes (Bio. Quip with glass)	9
47.	Herbarium Cabinet (Big Size)	4
48.	Micro-haematocrit Centrifuge	4
49.	Chemical Balance (Analytical)	3
50.	Tissue Embedding Centre	1
51.	Air Pumps (Diaphragm)	9
52.	Tissue Grinder Glass	8
53.	Potometer and Atometer	10
54.	Shadon Unit Kit No. 1	4
55.	Barothermograph	4
56.	Kymograph Muscle	2
57.	Nikon Phase Contrast	18
58.	Dissecting Microscope (Bech Type)	50
59.	Dissecting Microscope (b)	24
60.	Dissecting Microscope Prior	21
61.	Dissecting Microscope Osk	25
62.	Micro-projector Microscope	3
63.	Spirometer (Students' Type)	9
64.	Photoelectric Colorimeter Model	2
65.	Insect Light Traps	1
66.	Insect Box (Large) 61 x 46 x 8 cm	4
67.	Slide Projector (35mm)	1
68.	Over-head Projector	2
69.	Bench Centrifuge	1
70.	Steel Frame Aquaria (Model 5600)	2
71.	Auxanometer Electric	9
72.	PH Meter Model 7020	2
73.	Oxygen Meter (Completer)	1
74.	SHALI Meamoglobinometer	6

APPENDIX 3

LIST OF IMPORTANT EQUIPMENT (MINIMUM) REQUIRED FOR TEACHING IN A CHEMISTRY DEPARTMENT

S/NO.	DESCRIPTION	QTY. REQD.
1.	Ultraviolet-Visible Spectrophotometer	2
2.	Infra-red Spectrophotometer	2
3.	NMR Spectrometer (Multiprobe)	1
4.	Gas Chromatograph-Mass Spectrometer	1
5.	Atomic Absorption Spectrophotometer	1
6.	Differential Scanning Colorimeter	1
7.	Differential Thermal Analyser	1
8.	Xray Diffraction Machine	11
9.	Electron Microscope	1
10.	Colorimeter	1
11.	Light Fastness Testing Machine	1
12.	Wash Fastness Testing Machine	1
13.	Membrane Osmometer	1
14.	Vapour Phase Osmometer	1
15.	Gel Permeation Chromatograph	1
16.	Light Scattering Photometer	1
17.	Automatic Viscometer	1
18.	Magnetic Susceptibility Balance	2
19.	Elemental Analyser	1
20.	Microanalytical Balance	1
21.	Ice Making Machines	4

APPENDIX 4

LIST OF IMPORTANT EQUIPMENT (MINIMUM) REQUIRED FOR TEACHING IN A COMPUTER SCIENCE DEPARTMENT

S/NO.	DESCRIPTION	QTY. REQD
	HARDWARE	
1.	CPU with minimum of 2 MB of main memory	1
2.	Disk Drive	1
3.	Tape Drive	1
4.	Line Printer (300 LPM)	1
5.	VDU Terminals (Ideally there should be one terminal per every 5 students)	6
	SOFTWARE	
6.	COBOL Compiler	
7.	FORTRAN Compiler	
8.	BASIC Compiler	
9.	PASCAL Compiler	
10.	C Language	
11.	DOMS	
12.	Word Processing	
13.	Time Sharing Operating System	

	HARDWARE LABORATORY	
14.	Logic Development System with necessary accessories	1
15.	Logic Analyser with Scope	4
16.	Micro Trainer Kits	6
17.	Digital Oscilloscopes	6

APPENDIX 5

LIST OF IMPORTANT EQUIPMENT (MINIMUM) REQUIRED FOR TEACHING IN A GEOLOGY DEPARTMENT

S/NO.	DESCRIPTION	QTY. REQD
1.	Atomic Absorption Spectrophotometer (Perkin-Elmer) Model 400 (Complete with accessories and spares)	1
2.	Ultra-violet/Visible Spectrophotometer, Cecil CE 505 (complete with accessories)	2
3.	Rock Cutting and Grinding Machine Tyoe Cutrock MK 3	2
4.	Hydraulic Press-Becham P3	1
5.	Rock Cutler-Cutrock GSP 201	1
6.	Lathe Machine Type Vuxford TUD 22	1
7.	Jaw Xrusher – Creston Model 001/A	1
8.	Colorimeter (Gallenkamp) Model COL-400 (complete with accessories)	2
9.	Sieve Shaker – Pas. Model 1972	1
10.	X-Ray Diffractometer (complete with accessories and spares) (Philips Model)	1
11.	X-Ray Fluorescence (complete with accessories and spares (Philips Model)	1
12.	pH Meter (with accessories and spares)	1
13.	Brunten Compasses (Bruntons)	66
14.	Field Hammers (Geological)	60
15.	Rock/Mineral Polishing Machine Model 28W 300	6
16.	Electron Microprobe Analyser (Philips Model)	1
17.	Titration Potentiometer (TLB-200 Gallenkamp) (with accessories and spares)	1
18.	Lloyd Gas Analyser (Gallenkamp) Model GAS-560-A	2
19.	Petrographic polarizing Microscopes (with 4-nose pieces and 19x, 12x eye-pieces)	50
20.	Binocular Microscopes (complete with accessories & spares)	50
21.	Hotspot Furnace (Muffle) 1000^{o}C to 1100^{o}C; Model FSE-250-010F (complete with spares & Accessories)	2
22.	OS Ovens, 250^{o}C (Gallenkamp) Model Oven-230-526D (complete with spares and accessories)	2
	Notes: All electrical appliances must be 220-230V AC.	

APPENDIX 6

LIST OF IMPORTANT EQUIPMENT (MINIMUM) REQUIRED FOR TEACHING IN A MATHEMATICS DEPARTMENT

S/NO.	DESCRIPTION	QTY. REQD
1.	Computers	6
2.	Computer Softwares	6
3.	CPU with minimum of 2 MB of main memory	1
4.	Disk Drive	1
5.	Lime Printer (300 LPM)	1
6.	VDU Terminals	5

Note: Both University wide computer facility and Departmental Micro-Computer Laboratory are mandatory.

APPENDIX 7

LIST OF IMPORTANT EQUIPMENT (MINIMUM) REQUIRED FOR TEACHING IN A MICROBIOLOGY DEPARTMENT

S/NO.	DESCRIPTION	QTY. REQD
1.	Incubator (Large)	2
2.	Cold Incubator	1
3.	Anerobic Incubator	2
4.	Refrigerator	6
5.	Deep Freezer	2
6.	70^{o}C Freezer (Ultra-low)	1
7.	Freezer-dryer	1
8.	Binocular Light Microscope	60
9.	Phase-Contrast Microscope	2
10.	Fluorescent Microscope with Camera	1
11.	Darkfield Microscope	2
12.	Portable Autoclave	4
13.	Giant Autoclave	2
14.	Water Bath	6
15.	Hot-Air Oven	6
16.	Bacteriological Hood with UV Lamp	2
17.	Safety Cabinet	3
18.	Laminar Flow Unit	1
19.	Portable Centrifuge	5
20.	High-Speed Refrigerator Centrifuge	2
21.	Spectrophotometer	1
22.	Electrophoresis System	2
23.	pH Meter (digital)	5
24.	Inspissator	1
25.	Vacuum Pump	2
26.	Colony Counter	3
27.	Waring Blender	4
28.	Mettler Balance	2
29.	Membrane Filter (Bacteriological)	6
30.	Vacuum Dessicator	1

31.	Anaerobic Jar	4
32.	Seitz Filter	6
33.	Hot Plate/Magnetic Strirrer	6
34.	Slide Projector/Screen	1
35.	Overhead Project	1
36.	Animal Cages	10
37.	Restraining Cages	5
38.	Glassware Washer	3
39.	Glassware Dryer	3
40.	Shaker Incubator	4
41.	Electronic Toploader Balance	4
42.	Triple-Beam Balance	6
43.	Multiple Dialyzer	3
44.	Electric Stirrer	2
45.	Gas Chromatograph/HPLC	1
46.	Digital Colorimater	6
47.	Rotary Evaporator	2
48.	Test-Tube Shaker	4
49.	Bunsen Burner	80
50.	Ultrasonic Dismambrator	2

APPENDIX 8

LIST OF IMPORTANT EQUIPMENT (MINIMUM) REQUIRED FOR TEACHING IN A PHYSICS DEPARTMENT

S/NO.	DESCRIPTION	QTY. REQD
1.	Meter rule	40
2.	½ Meter rule	40
3.	Venier Callipers	10
4.	Screw Gauge	10
5.	Beaker-various sizes	10 each
6.	Chemical Balance	5
7.	Travelling Microscope	15
8.	Spring Balance (various)	5 each
9.	Stop Watch	20
10.	Retort Stand	20
11.	Slotted Weights	
12.	Spiral Spring	
13.	Knife Edge	
14.	Inclined Plane	10
15.	Prisms (various)	
16.	Optical Pins (boxes)	15
17.	Drawing Board	15
18.	Optical Benches	10
19.	Converging lens (Various Focal lengths)	10 each
20.	Ray box	10
21.	Diverging lens (various focal lengths)	10 each
22.	Ammeter (various types and ranges)	10 each
23.	Voltmeter (various types and ranges)	10 each
24.	Rheostat (various ranges)	10 each
25.	Resistors (various ranges)	20 each
26.	Resistance box (various ranges)	5 each

27.	Key	20
28.	Potentiometer	10
29.	Metre bidge	10
30.	Galvanometers (various types and ranges)	10 each
31.	Daniel Cell	10
32.	Leclanche Cell	10
33.	Calorimeter	10
34.	Thermometer (various types and ranges)	100
35.	Battery (various ranges)	10
36.	Lee's conductivity apparatus	5
37.	Connecting wires (various Lengths)	20 each
38.	Boyle's Law apparatus	5
39.	Linear expansion apparatus	5
40.	Equation of State of Ideal gas apparatus	5
41.	Maxwellian velocity distribution apparatus	5 each
42.	Tuning fork (various)	10
43.	Resonance tube	10
44.	Ripple tank	10
45.	Air Track	10
46.	Specific gravity bottle	10
47.	Glass Capillary tubes	100
48.	Young's Modulus apparatus	5
49.	Rectangular glass block	20
50.	Moment of inertia and angular momentum apparatus	5
51.	Free fall apparatus	5
52.	Phite Screen	10
53.	Lens Holder	100
54.	Sonometer box	10
55.	Concave mirror (various radii)	20 each
56.	Convex Mirror (various radii)	20 each
57.	Bunsen Burner	10
58.	Spectrometer	5
59.	Mercury Lamps	5
60.	Sodium Lamps	5
61.	Water Distillation apparatus	2
62.	Battery Charger and accessories	2
63.	Wall Clock	2
64.	Refrigerator	2
65.	Centre-zero (universal moving coil) Galvanometer	5
66.	Thermal Conductivity apparatus	5
67.	Vapour Pressure apparatus	20
68.	Oscilloscope (various types)	10
69.	Dry Batteries	20

2. INTERMEDIATE AND ADVANCED PHYSICS

As in the case of General Physics, the list below is not exhaustive. Some of the equipment listed under General Physics are also used in this level and so need not be listed here.

1.	Signal generator (various types)	10
2.	Low voltage power supply	10
3.	H.T. Power Supply	5
4.	Transformers (various grades)	5
5.	Avometers	5

6.	Refractometers	5
7.	Polarimeter	5
8.	Leser spectral unit with power supplies	5
9.	Michelson interferometer	5
10.	Digital Meters	5
11.	Plotters	10
12.	Capacitance meter	10
13.	Recorder	10
14.	Video Monitor	5
15.	Stabilizers	10
16.	Pulse generators	5
17.	Microscope	5
18.	Amplifier	10
19.	Multivibrator	5
20.	Transistor (various types)	
21.	Radioactive Source	2
22.	Ionization Chamber	5
23.	Ratemeter	5
24.	Digital Counter	5
25.	Diffraction grating	5
26.	X-ray tube	5
27.	Cathode ray tube	5
28.	Helmholtz Coils	
29.	Electric oven	
30.	Thermocouple	5
31.	Filters	
32.	Electromagnet	
33.	GM - Counter	
34.	Atomizer	
35.	Frank Hertz Tube	5
36.	Cadmium Lamp and accessories	5
37.	Lummer-Gehrcke Plate	5
38.	Coils	
39.	Inductors	
40.	Capacitors	
41.	Thermistor	5
42.	Photocell	
43.	Diodes	
44.	Loudspeaker	
45.	Digital Multimeter	5
46.	Function generator (various ranges)	5
47.	Biprisms	
48.	Simpson meter	5
49.	Noise generator	5
50.	Flux Meter	5
51.	Microphones	
52.	Coaxial cable	
53.	Electrostatic voltmeter	5
54.	Van de graaf Generator	2
55.	Luminescence tube	5
56.	Immersion heater	5
57.	Diesel engine model four stroke	2
58.	Model of four stroke engine	2
59.	Micro-computers	20
60.	Soft wares	Several

APPENDIX 9

LIST OF IMPORTANT EQUIPMENT (MINIMUM) REQUIRED FOR TEACHING IN A STATISTICS DEPARTMENT

S/NO.	DESCRIPTION	QTY. REQD
1.	Electronic Calculators	200
2.	Programmable Desk Calculators	5
3.	Programmable Pocket Calculators	205
4.	Mini Apple Computers	5

APPENDIX 10

MINIMUM SPACE REQUIREMENTS FOR OFFICE ACCOMMODATION, CLASSROOMS, LABORATORIES, SEMINAR AND CONFERENCE ROOMS

1.	Professor (2)	10.5m2 (x2 – 37.0m2)
2.	Academic Staff (24)	13.5m2 (x24 – 324m2)
3.	Faculty Officer (1)	18.5m2 (x1 – 18.5m2)
4.	Other Senior Staff (10)	13.5m2 (x10 – 135m2)
5.	Classroom Accommodation	0.7m2/Student
6.	Departmental Office and storage space	0.7m2/Student
7.	Seminar Room	0.2m2/Student
8.	Laboratories	7.5m2/Student
9.	Conference Room	18.5m2

APPENDIX 11

LIST OF IMPORTANT EQUIPMENT (MINIMUM) REQUIRED FOR TEACHING IN THE SCIENCE LABORATORY TECHNOLOGY DEPARTMENT

S/No	EQUIPMENT		QTY REQD.
1.	PH Meters	Digital	3
2.	Test – Tube	Mixers	12
3.	Distillers		2
4.	Deronizers		2
5.	Spectrophotometers (UV/VIS/IR/R)		2
	X-ray Diffractometer (Philips Model with accessories)		2
	Osmometers		
6.	Atomic Absorption Spectrophotometer with accessories		1
7.	Ice making Machine		3
8.	NMR Spectrometer (Multiprobe)		1
9.	Incubator		10
10.	Rotary Evaporator		2
11.	Bunsen Burner		60
12.	Gas Chromatograhy –Mass Spectrometer		1
13.	Colorimeter (Gallenkamp Col. 400)		1
14.	Light Scattering Photometer		1
15.	Micro-analytical Balance		

Geology/Min.

1.	Rock cutting and Grinding Machine (Tyoe Cutrock Mk3)	1
2.	Hydraulic Press-Becka, P3	1
3.	Lathe Machine (Vuxford Tud 22)	1
4.	Sieve Shaker – Pas Model 1972	1
5.	X-ray Flouresence (Philips Model with Accessories)	1
6.	Brunten Compasses (Bruntons)	60
7.	Field Hammers (Geological)	60
8.	Binocular Microscopes (with accessories)	40
9.	Hotspot Furnace (Muffle) 1000oC – 1100oC (Model FSE – 250 – 010F with Accessories)	2

MCB

1.	Refrigerator	4
2.	Deep Freezer	2
3.	70o Freezer (Ultra Low)	1
4.	Freezer Dryer	1
5.	Binocular Light Microscope	50
6.	Phase-Contrast Microscope	2
7.	Flourescent Microscope with Camera	1
8.	Dark Field Microscope	1
9.	Autoclave (Portable and Giant)	4
10.	Water Bath (Thermostatic)	4

11.	Drying Oven (Hot Air Oven)	2
12.	Bacteriological Hood with UV Lamp	2
13.	Metter Balance	

PHY/ELEC

1.	Meter Rule	50
2.	½ Meter Rule	50
3.	Vernier Callipers	10
4.	Screw Gauge	10
5.	Glass Bearers (Various Sizes)	10 of each
6.	Travelling Microscope	15
7.	Spring Balance	
8.	Stop Watch	25
9.	Retort Stand	25
10.	Slotted Weights	
11.	Spiral Spring	
12.	Knife Edge	
13.	Inclined Plane	
14.	Prisms (Various)	10
15.	Optical Pins (boxes)	20

1.	Drawing Board	20
2.	Optical Benches	10
3.	Converging Lens (Various focal lengths	10 each
4.	Ray Box	10
5.	Divergin lens (various focal Lengths)	10 each
6.	Ammeter (various types and ranges)	10 each
7.	Voltmeter (Various types and ranges)	10 each
8.	Rheostat (Various ranges)	10 each
9.	Resistors (various ranges)	20 each
10.	Resistance box (various ranges)	5 each
11.	Key	20 each
12.	Potentiometer	5
13.	Metre Bridge	5
14.	Galvanometer	10 each
15.	Calorimeter	10
16.	Thermometer (various types and ranges)	50
17.	Boyle's Law Apparatus	4
18.	Linear Expansion Apparatus	4
19.	Turning Fork	10
20.	Resonance Tube	10
21.	Specific Gravity Bottle	10
22.	Glass Capillary Tubes	100
23.	Young's Modulus Apparatus	5
24.	Rectangular Glass Block	20
25.	Lens Holder	100
26.	Sonometer Box	10
27.	Concave Mirror (various radii)	20 each

28.	Convex Mirror (various radii)	20 each
29.	Mercury Lamps	5
30.	Sodium Lamps	5
31.	Battery Charges and Accessories	2
32.	Wall clock	2
33.	Oscilloscope (various types)	10
34.	Daniel Cell	5
35.	Leclanche Cell	5
36.	Dry Batteries	20
37.	Battery (Various ranges)	10

APPENDIX 12

Equipment for B.Sc. Degree in Environmental Management and Toxicology

1.	Water Distiller
2.	Water Dionizer
3.	Water Bath
4.	Hot plate
5.	Orbital Shaker
6.	Overhead Steerer
7.	Analytical Balance
8.	Top loading Balance
9.	Deep Freezer
10.	Oven
11.	Heating Mantle
12.	Autoclave
13.	Muffle Furnace
14.	Centrifuge
15.	Rotary Vacuum Pump
16.	TLC Kit
17.	pH meter
18.	Conductivity meter
19.	UV - Visible
20.	Spectrophotometer
21.	Infra – Red
22.	spectrophotometer
23.	Atomic Absorption spectrophotometer
24.	Flame Photometer
25.	Gas Chromatograph

APPENDIX 13

Minimum Basic Equipments for Departments offering the B.S.c. Biotechnology Program

2	Sterile work station
1	Ice chip maker
2	Agarose gel electrophoresis units
2	Polyacrilamide gel electrophoresis units
1	U.V.Gel-viewing unit
1	Gel documentation system
1	Electroporator
1	Vortex mixer
1	-80oC freezer
7	Sets micro pipettes (35 pieces
10	Electricity current stabilizers
1	PCR machine
1	Microcentrifuge
3	Microcentrifuge rotors
1	Incubator
1	Hibridisation oven
1	Shaker water bath
1	Autoclave
1	Regular oven
1	Microwave oven
1	Water distilling unit
1	UV – Visible spectrophotometer
4	Quartz cuvettes for 20 – 200µ
1carton	5ml reaction tubes
1 carton	5ml microcentrifuge tubes
1carton	Micropipettes tips
1 carton	PCR tubes
1 carton	2.5 ml reaction tubes
20	Microcentrifuge tube racks
20	5ml reaction tube racks