# KHALIFA ISYAKU RABIU UNIVERSITY, KANO-NIGERIA (KHAIRUN)

## FACULTY OF SCIENCE AND COMPUTING

# STUDENT HANDBOOK

# NOVEMBER, 2023

## STUDENT'S PERSONAL INFORMATION

Name: ______________________________________________

Date of Birth: _________________________________________

Faculty: ____________________________________________

Department: __________________________________________

Programme: __________________________________________

Level ______________________________________________

State of Origin ________________________________________

Nationality ___________________________________________

GSM NO. ___________________________________________

**NOTE**

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## BRIEF HISTORY OF THE FOUNDER

**SHEIKH KHALIFA ISYAKU RABIU**
**KADIMUL QUR'AN**

**Khalifa Sheikh Isyaku Rabiu** was born in the ancient city of Kano, in the year 1928 at Jingau quarters. His parents were Sheikh Muhammadu Rabi'u and Hajiya Fadimatu. Khalifa started studying and the recitation of the Holy Qur'an under the guidance of his father from 1936, up to 1942 when he had the traditional ceremony of completing the reading and learning of the Holy Qur'an. Kalifa Sheikh Isyaku Rabiu proceeded to Maiduguri, Borno State, where he completed the memorization of the Holy Qur'an in 1946. Khalifa continued with the study of Tasawwuf and Dariqa under Sheikh

Abubakar Mijinyawa at Bakin Ruwa Quarters in Kano city. He later returned to his father's school and studied the science of Tajweed. However, Khalifa Sheikh Isyaku Rabiu subsequently transferred to Sheikh Abdullahi Salga's school at Sanka in the city of Kano, to study Islamic Law, Hadith and Jurisprudence where he graduated in 1949.

After Khalifa's graduation, his father gave him permission to start a business, where he started trading in Kurmi Market, in the ancient city of Kano, in 1949. In February 1952 Khalifa registered his business as a company called Isyaku Rabiu and Sons Limited. As time went on in 1973, Khalifa changed the company's name to Isyaku Rabiu Group of Companies a conglomerate of twelve companies dealing in Trading, Manufacturing, Insurance, Banking, Aviation and Real Estate with over 1000 employees. Khalifa Sheikh Isyaku Rabiu is the Chairman and Chief Executive Officer of Isyaku Rabiu & Sons Ltd, Kano Vehicle and Accessories Ltd, Bagauda Textile Mills Ltd, Rabiu Bottling Company Ltd, Kano Suit and Packing Cases Factory Ltd, IRS Rice Mills Limited, IRS Airlines Limited, Afro Sacks Nigeria Limited, Kano Sugar Industries Limited and Combined Services Nigeria Limited.

In 1969 Khalifa and some other Businessmen in Kano established the first indigenous trading company, Kano Merchants Trading Company which later switched to Bagauda Textile Mills Ltd. He also played active role in the establishment of companies like, Nigerian Victory Assurance Company, Stanbic Merchant Bank Nigeria (first Chairman), Habib Nigeria Bank Limited, Giwarite Nigeria Limited and Combined Services Nigeria Limited. Khalifa Sheikh Isyaku

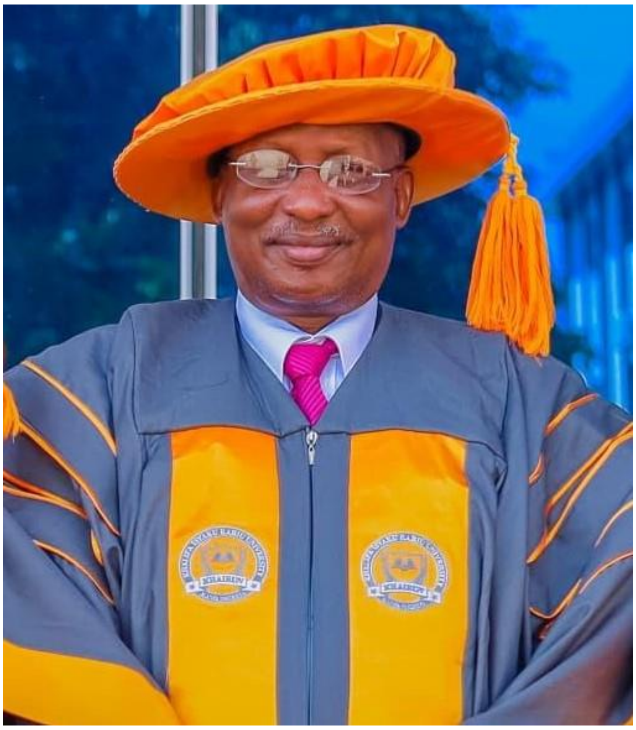
Rabiu was a Director in many other companies across the nation and other countries and was also a member of University of Ibadan Governing Council, Islamic University of Niger, Niamey, International University of Africa, Khartoum Sudan, Senate Member, Faisal University, Njamena, Tchad, Member of Organisation of Islamic Conference (OIC), Saudi Arabia, Member, Muslim World League, Saudi Arabia. And also a member of its committee on mosques, Member Council of Ulama, Nigeria.

Sheikh Isyaku Rabiu was appointed as leader of the Tijjaniyya Movement in Nigeria and the neighbouring countries in 1994, and also gained the title of 'KHALIFA'. He was the President of Sheikh Muhammadu Rabiu Islamic Foundation International, an Islamic organization for both humanitarian and Islamic propagation.

Khalifa received award of Men of Achievement Award in 1991 by the Cooperate Press Services Ltd, Lagos and Kano State Government Sports Award, the Industrial Giants Merit Award in 1998, Ahmadu Bello International Award in 1999 and also honoured with the Order of the Federal Republic (OFR) during the government of President Olusegun Obasanjo, in recognition of his contributions in uplifting the standard of living in his community and the nation at large. And so many other awards.

He is just the one single person in history of Kano, and the Northern Nigeria that has succeeded in the establishment of Private schools from kindergarten to university level. May his gentle soul continue to rest in Jannatul Firdaus.

## Vice-Chancellor’s Welcome Message



**Abdulrashid Garba,** *PhD; fcasson; mnae, icasson*
Vice-Chancellor

# INTRODUCTION

In the year 2022, the National Universities Commission (NUC) announced an addition of a new private university in Kano State. That was the proclamation of the Khalifa Isyaku Rabiu University, Kano (KHAIRUN). The Founder of the University, was Khalifa Isyaku Rabi'u (Khadimul Qur'an), rahimahulLah. Until his demise he demonstrated keen interest and desire to witness the completion of his long standing ambition of building an educational empire, from Kindergarten to the University level. Allah (SWT) in His infinite mercies did not plan for that. In His divine wisdom, Allah SWT has however, blessed the worthwhile ambition of this gentleman - today, KHAIRUN is a reality. It is an addition to the various schools he has established from the scratch. May Allah SWT continue to rest his gentle soul in Jannat el-Firdaus.

Presently, KHAIRUN has three Faculties, ten Departments and sixteen academic programmes, namely: Allied Medical Sciences with three Departments and three programmes; Science and Computing with five Departments and ten programmes; and Engineering with two Departments and three programmes. Each of these programmes has been equipped with state of the art equipment in classes and in the laboratories. In addition to all these there are smart classrooms for easy tutelage, strong internet access, and a vibrant website. The University Library is well equipped with current holdings and e-resources. There is also a well-equipped hostel facility for both male and female students as well as for international students. All these are provided for students in order to ease academic pursuit.

While we remain prayerful for Allah's protection, the University has provided adequate security measures to protect lives and properties, and against any incursion by insurgent elements. To crown all these, the University has a well-planned arrangements on ground to ensure strict compliance to all University regulations, social norms and values, and for the observance and enforcement of our highly cherished Islamic traditions. Staff and students are therefore encouraged to be wary of, to support and be ready to imbibe the peculiarities of KHAIRUN environment.

I want to, on behalf of Proprietors, Board of Trustees, Governing Council and Management of KHAIRUN, welcome all the newly admitted students to this promising citadel of learning. I also wish to congratulate you for the single advantage and rare privilege of being pioneer students.

**Abdulrashid Garba,** *PhD; fcasson; mnae, icasson*
Vice-Chancellor

**The University Logo**

The Logo is circle in shape containing a book and a pen embossed on brown strip. The book and pen depicts hallmark of knowledge. The brown colour represents soil from which life began; on to which the resources for sustaining life on earth exist; and into which life shall end. This signify that the University emphasizes knowledge and its translation into real life applications guided by code of ethics that leads to good ending. The writing printed in the Logo's upper semicircle is the name of the **Founder** of the University:

**Khalifa Isyaku Rabiu**

This represents an exemplary life of commitment, dedications, hardwork and sacrifice in the service to humanity, worthy of emulation by students and staff of the University

**Motto**

**"Functional Education is Light"**

The University is dedicated at producing total person with the requisite skills, knowledge and values relevant to the $21^{st}$ century.

## The University Colour (Orange and Ash)

The **Orange,** as a blend of red and yellow is associated with energy and happiness that boosts aspirations, stimulates mental activity and enhances confidence and understanding. Thus, the University emphasize to stimulate its students to attain utmost capabilities in their educational pursuits.

The **Ash** characterizes transparency which portrays the uniqueness of the colour. It is sometimes equated with grey and can be used for font colour, headers, graphics, and even products to appeal to mass audience. KHAIRUN's stunning façade is decorated in soft ash and its variations

## Vision

The vision of the University is to be a World-Class teaching and research University, producing educated, self-discipline, confident and independent minded graduates (Character and Learning)

## Mission

The mission of the University is to produce educated, morally sound and skilled graduates that will respond to the Challenges of 21$^{st}$ century

## Philosophy Goals and Objectives

The University will embrace openness in the pursuit of knowledge and will welcome intellectually restless students, who use their talents to put ideas to test. Education in the University will not be viewed only as a gateway to personal development but also as a pathway to improve society. The University will strive to help students develop knowledge, appreciation, understanding, ability and skills which will prepare them for responsible living in a complex World

The university has a faith-based philosophy presupposes the integration of faith and learning. The university is prepared to invest the time necessary to prepare students intellectually and spiritually to be productive citizens in the $21^{st}$ century. The students will be assisted to reach their highest potentials.

**Goals and Objectives**

a) Encourage the advancement of learning and to hold out all persons without distinction of race, creed, sex or political conviction the opportunity of acquiring a higher and liberal education;

b) Provide resources for instruction and other facilities for the pursuit of learning in all its branches, and to make those facilities available on proper terms to such persons as are equipped to benefit from them;

c) Encourage and promote scholarship and conduct research in all fields of learning and human endeavor;

d) Evolve academic programmes to suit the changing social and economic needs of the society through continuous review of curricular and development of new programmes through programme structural flexibility to respond to societal technological changes;

e) Create and expand access and opportunities for education, attract and retain quality students, researchers, teachers, and other academic and non-academic staff thereby assisting in developing human capital development and mitigation of the brain drain currently afflicting Nigeria;

f) Produce internationally acceptable graduates that would compete favorably with their peers anywhere in the World;

g) Cary out basic and applied research leading to the domestication and application of new technology to the Nigeria context through collaborative linkages with other academic and research institutions in Africa and the rest of the world;

h) Establish a center for entrepreneurial studies to stimulate job creation and innovative capacity in students from onset of their studies, in such a way that graduates shall be resourceful, self-reliant and job creators; and

i) Undertake other activities appropriate for teaching and community service as expected of a University of high standard.

**Academic and Official Costume**

The official costume for academic ceremonies will be in line with university academic colours (Ash, Dark Ash and Light Ash)

## AUTHORITIES OF THE UNIVERSITY

The University Authority are the Proprietors, Officers of the Board of Trustees, the Council, the Senate, Faculty Board, the Congregation and Convocation.

**Proprietor**

The proprietor of KHAIRUN is the Muhammad Rabiu Islamic Foundation International responsible for the appointment of Board of Trustees.

**Board of Trustees**

Board of Trustees is the highest governing body of the University charged with the overall policy direction and financing of the University.

**Council**

Council is another governing body appointed by Board of Trustees which is charged with general management of the affairs of the University, and in particular, the control of the property and expenditure of the University. The membership of the Council consist of the Pro-Chancellor, Vice-Chancellor and representatives of the senate, congregation, convocation NUC, interest groups, Kano State government, proprietor’s nominee and the Registrar.

**Senate**

The senate is responsible for the organization and control of admission, teaching, and discipline of students and promotion of research at the University. The membership of the senate consist of the Vice-Chancellor, University Librarian, Dean of faculties, including Dean, Student Affairs, Directors of academic centers, Heads of academic departments, Director academic planning, all Professors of the University, one elected from each faculty not below the rank of senior lecturer, and the registrar who shall be the secretary.

**Faculty and Departmental Administration**

Faculties shall be the center of teaching and research. It is directly responsible for the control of teaching, examination and evaluation of students. Each faculty should have faculty board while a department shall have departmental board. The Dean and Head of department shall handle the administration of the faculty and the department respectively.

**Congregation**

The congregation provide an opportunity for members to meet and express their views on all matters affecting the interest and welfare of the University and its members. Members consist of all academic staff and non-academic staff holding degree conferred by recognized universities or any other qualifications recognized by the University.

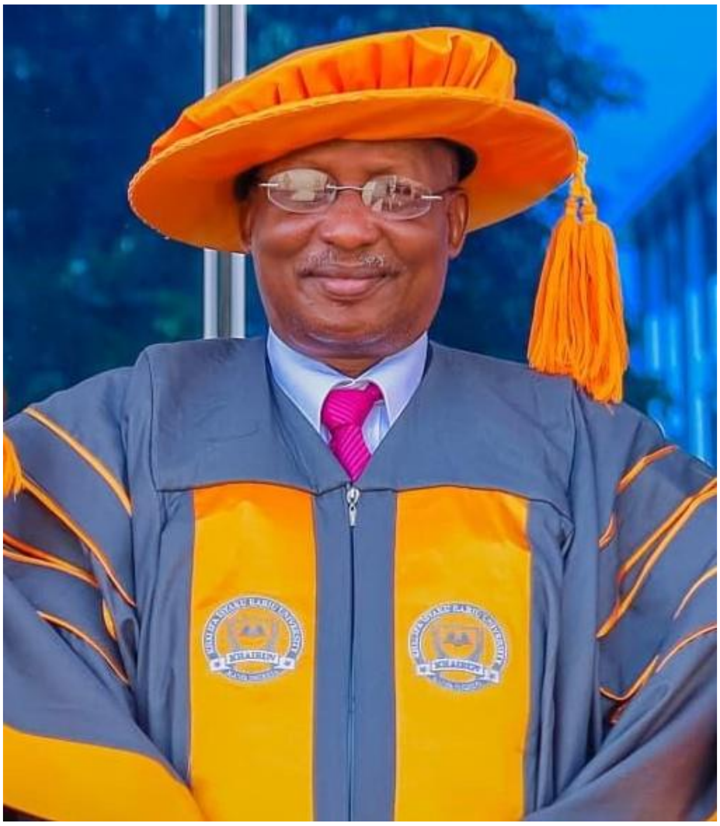
**Convocation**

The convocation shall have the functions of awarding certificate, diplomas and degree, both undergraduate and post graduate of the University. Members consist of Pro-Chancellor and chairman of council, Vice-Chancellor, University Librarian, Bursar, registrar, all full time academic staff, and graduate of the University.

**Chancellor and Principal Officers of the University**

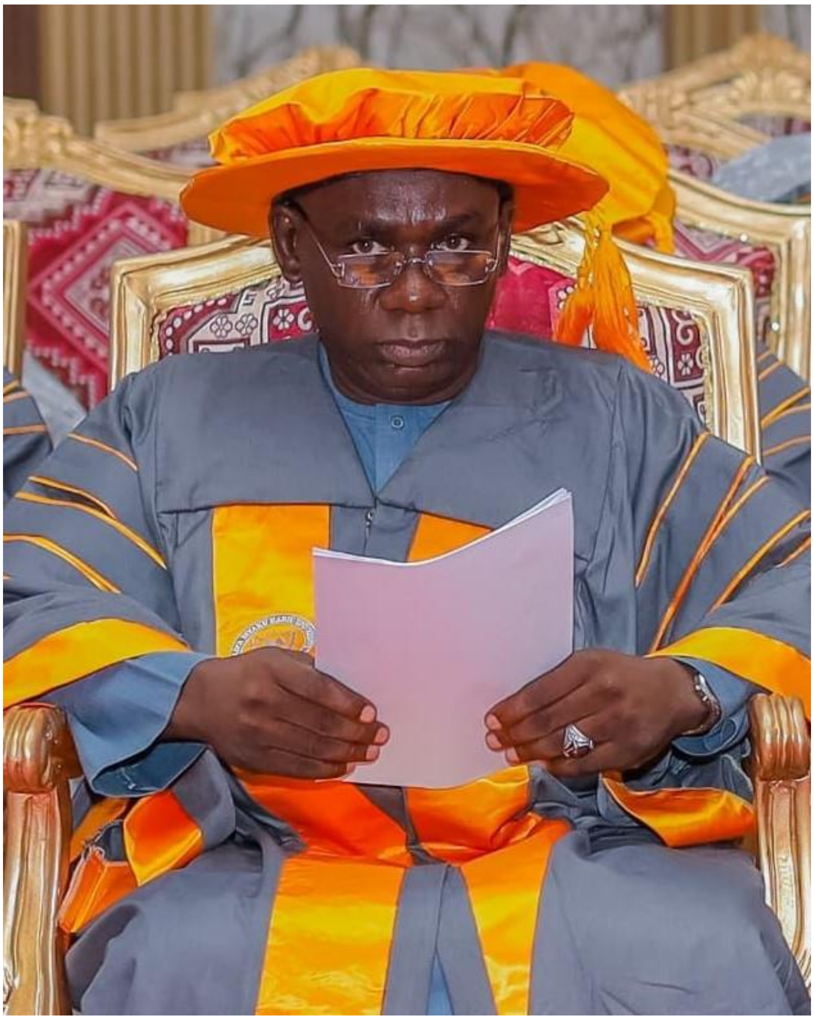
**CHANCELLOR**
Alhaji Samaila Mohammed Mera (CON)
Emir of Argungu

**PRO-CHANCELLOR**
Prof. Kabiru Isyaku OON, FNAE, mni



**VICE-CHANCELLOR**

**Prof. Abdulrashid Garba,** *PhD; fcasson; mnae, icasson*



**REGISTERAR**
**Malam Yusuf Datti**

**BURSAR**

**Dr. Najaatu Bala Rabiu** CNA, ACTI,

**UNIVERSITY LIBRARIAN**
**Nazir Muhammad,** CLN, MNLA

## 1.0 ORGANIZATION OF THE ADMINISTRATION

**The organization of the administration:** The University Central Administration is made up of Vice-Chancellor`s Office, the Registry Department and Bursary Department.

1.1 **The Vice-Chancellor`s Office** This is headed by Vice-Chancellor.

1.2 **The Student Development Division:** The division, headed by the Dean, is under the Vice-Chancellor`s Office. It is responsible for the administration of non-academic affairs of student in the university;

1.3 **Information, Publication and Marketing:** This is headed by a Principal Assistant Registrar and is responsible for the public relation matters, publication and marketing for the University.

1.4 **Directorate of Academic Planning**: This is headed by a Director and is responsible for various statistics and accreditation matters of the university;

1.5 **Security Division:** This is headed by a Director and deals with the security of lives and properties of the university community;

1.6 **Registry Department:** The registry is headed by the Registrar, who is chief administrator of the university and is responsible to the Vice-Chancellor for all the administrative matters of the university; and

1.7 **The Bursary Department:** the Bursary is responsible for the administration of all financial matters in the university. It is headed by the Bursar and has among other sections, a student section, which handles student Account (fees and charges paid by students).

1.8 **Quality Assurance Unit QAU**

The primary function of **Quality Assurance unit** is to improve the service delivery and capacity of the available resources of the university i.e. The capacity of human and material resources (facilities) of the University. The Unit of the University is headed by the Head, QAU and assisted by the following:

1. KHAIRUN QUA Committee;
2. Complaint Desk Officer;

**The Functions of Unit**

The Function of the QAU includes:

1. Production, monitoring the performance and review of the QUA within the university;

2. Managing the University complainant relation policy, including providing opportunities for complainant feedback on their services;

3. Institute a complaints procedure, including grievance and redness mechanism;

4. Ensure the improvement of service delivery of the university through QAU compliance;

5. Investigate reason for poor/excellent service delivery in the University;

6. Contributing business improvement plans of the University;

7. Ensure the periodic review of QAU activities.

8. The ability to analyze all complaints and report issues to management relevant to addressing the causes of service failure;

9. Advocacy and change management skills to ensure other officers and management to resolve justified complaints and address the causes of the complaints to ensure improve service delivery over time;

10. To investigate and analyse complaints to ascertain and differentiate the complaints about service delivery; and

11. To keep record of all complaints, comments compliment and suggestions by the staff and students.

**DEAN, FACULTY OF SCIENCE AND COMPUTING**

**Prof Ibrahim Tajo Siraj**
FICCON, FPIN, MCSN; BSc, MSc (BUK), PhD (Strathclyde)
Acting Dean,
Faculty of Science and Computing, KHAIRUN.

## INTRODUCTION TO FACULTY STUDENTS' HANDBOOK

It is my privilege to welcome you to this great University, Khalifa Isyaku Rabiu University of Nigeria, Kano (KHAIRUN). The Faculty of Science and Computing is the largest Faculty in the University and it has the highest number of well experienced, dedicated and hardworking staff both academic and non-teaching. The laboratories and lecture rooms are equipped with state of the art equipment and facilities needed for cutting edge research. This will definitely provide a more conducive atmosphere for a better teaching, learning and research experience. In addition, the faculty is committed to achieving professional excellence in its delivery to ensure that you get the best training in some of the most sought-after science and computing courses to meet up with the entrepreneurial and life skills needed for the 21$^{st}$ century and beyond.

KHAIRUN'S values for knowledge, empathy, integrity, respect and kindness will be your guide throughout your stay in the university. This Handbook is designed to give you the necessary information needed to have the best KHAIRUN'S experience and to become an important member of the Science and Computing community in particular and the society at large. It gives information on courses offered, registration, orientation, examination regulations and other rules and regulations governing your stay in the University. I advise and encourage you to read and understand the content of the hand book and abide by all the rules and regulations stated therein.

Furthermore, we enjoined you to take full advantage of all the resources available in the University for your comport and excellent learning experience. I will always be willing to be your partner in achieving your most desired dreams here in the Science and Computing community and in KHAIRUN in general.

The Faculty wish you all the success in your study and please do not hesitate to contact me or any concerned staff if we can be of any help to you.

Thank you and once again, you are most welcome.

**Prof Ibrahim Tajo Siraj**
FICCON, FPIN, MCSN; BSc, MSc (BUK), PhD (Strathclyde)

## FACULTY OF SCIENCE AND COMPUTING

The Faculty of Science and Computing was among the take-off faculties with Prof Ibrahim Tajo Siraj as the pioneer Dean. The faculty started in 2022/2023 session has five Departments with ten programmes to run.

**Programmes are Science and Computing** which covers the following degree areas

**Table 1.1: List of Programmes and Degrees**

| S/N | Programme | Degree in View |
|---|---|---|
| 1. | Biochemistry | B.Sc. |
| 2. | Biotechnology | B.Sc. |
| 3. | Forensic Science | B.Sc. |
| 4. | Industrial Chemistry | B.Sc. |
| 5. | Mathematics | B.Sc. |
| 6. | Microbiology | B.Sc. |
| 7. | Computer Science | B.Sc. |
| 8. | Cyber Security | B.Sc. |
| 9. | Software Engineering | B.Sc. |
| 10. | Physics with Electronics | B.Sc. |

### Duration

The duration of first degree for UTME candidate is Four (4) academic sessions or eight (8) semesters. Whereas the duration for Direct Entry candidate is Three (3) academic sessions or six (6) semesters. A student will not be allowed to exceed an additional 50 per cent of the duration of the programme if he/she fails to graduate within the minimum number of years.

Meaning there is a provision for a maximum of first and second spill overs.

**Table 1.2: Mode Entrance / Duration**

| S/N | Mode of Entrance | Potential Level | Duration | | | |
|---|---|---|---|---|---|---|
| | | | Minimum | | Maximum | |
| | | | Year | Semester | Year | Semester |
| 1 | UTME | 1 | 4 | 8 | 6 | 12 |
| 2 | DE | 2 | 3 | 6 | 4 | 8 |

**Philosophy, Aims and Objectives of the Science Programmes.**

**Philosophy**

The philosophy of the Science discipline is to train graduates who will apply scientific approach through verifiable and reproducible methodologies to solving developmental needs of the society. While the philosophy of computing is, specifically concerned with the analysis, design, and development of software and hardware systems for specific purposes. In particular, computing encompasses a broad-based exposure to the concepts, theories, technologies of computing, practices and experiences that are utilised for solving problems in all aspects of human endeavour through building safe, reliable, secure and resilient computer systems.

**Objectives**

**The main objectives of Science Discipline are to:**

1. provide students with scientific knowledge and skills from which they can proceed to further studies in specialized

and/or multi- disciplinary areas;

2. provide students with a broad and balanced foundation of scientific knowledge and practical skills as may be applicable in their different programmes;

3. develop in students the ability to apply scientific knowledge and skills to solving theoretical and practical problems;

4. develop in students, a range of transferable skills that are of value in any employment and society they might find themselves;

5. provide, through training and orientation, an appreciation of the rewards inherent in inter- and multi- disciplinary approach to the solution of complex life problems; and

6. engender in students an appreciation of the fact that no nation can develop without science and its application.

**While:-**

**The broad objectives of the computing Discipline are to**:

1. Apply the principles and practices of Science, Technology, Engineering and Mathematics in the design and construction of computer-based systems;

2. Advance the frontiers of computing by developing effective ways for solving computing problems;

3. Prepare students to meet the computer technology needs of business, government, healthcare, schools, and other kinds of organisations;

4. Provide training on integrating information technology solutions and business processes to meet the information needs of businesses and other enterprises, enabling them to achieve their objectives in an effective, efficient way;

5. Provide advanced coverage on developing and maintaining affordable software systems that meet customer requirements and that behave reliably and efficiently;

6. Provide training and develop competency in data engineering, big data and data analytics; and

7. Provide technical knowledge, principles, technologies and tools required for safeguarding the computer systems, cyberspace and network infrastructure of organisations as well as the data stored on those systems.

## Admission Requirements

### UTME MODE

The entry requirements shall be at least passes at Credit level at Senior School Certificate (SSC) or its equivalents in five subjects at not more than two sittings. Such subjects must include English Language, Mathematics and three other relevant subjects. In addition, an acceptable pass in the Unified Tertiary Matriculation Examination in (UTME) is required for admission into 100 Level. The required score shall be provided by JAMB and the University respectively.

**DE MODE**

Candidates with at least two A level passes in relevant subjects at the GCE Advanced Level/ IJMB/ JUPEB or equivalent, may be considered for admission into 200 Level, provided they satisfy the ‘O’ level qualifications above.

**Graduation Requirements**

The expected duration for UTME candidates shall be 4 years and students are required to pass a minimum of 120 units, while for Direct entry students, the expected duration for graduation shall be 3 years and would be expected to pass a minimum of 90 units which must include all compulsory courses. Students in 5 years programmes are expected to pass a minimum of 150 units which must include all compulsory courses. Note that all science courses are having 4 year duration.

**Course System**

Credits are weights attached to a course. 1 credit is equivalent to 1 hour per week per semester of 15 weeks of lectures or three hours of laboratory/studio/workshop work per week per semester of 15 weeks.

**Definition of Course System**

This means 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 complexity or in levels of academic progress. Level 1 courses are for example 100 and 101; Level II courses are for example 200 and 202. The second aspect of the system is that courses are assigned weights allied to Units.

**Units**

Consist of specified number of student-teacher contact hours per week per semester. Units are used in two complementary ways: one, as a measure of course weighting, and the other, as an indicator of student workload. As a measure of course weighting for each Unit course (e.g. BCH 105, BTG 203, FRS 504), the credit unit to be earned for satisfactorily completing the course is specified; e.g. a 2-credit unit course may mean two 1-hour lecture per week per semester or one 1-hour lecture plus 3-hour practical per week per semester.

As a measure of workload, “One Credit Unit” means 1 hour of lecture or 1 hour of tutorial per week per semester. For other forms of teaching requiring student teacher contact, the following equivalents may apply: 2 hours of seminar, 3 hours of laboratory or field work, Clinical practice/practicum, studio practice or stadium sporting activity, six hours of teaching practice; four weeks of industrial attachment where applicable.

Normally, in Course Credit System, courses are mounted all year round. Thus, enabling students to participate in examinations in which they are unsuccessful or unable to participate on account of ill health or for other genuine and acceptable reasons. In such a system, no special provisions are made for re-sit examinations.

The minimum number of credit units for the award of a degree is 120 units. Subject to the usual Department and

Faculty requirements. A student shall therefore, qualify for the award of a degree when he has met the conditions.

The minimum credit load per semester is 15 credit units. For the purpose of calculating a student's cumulative GPA(CGPA) in order to determine the class of Degree to be awarded, grades obtained in all the courses whether compulsory or optional and whether passed or failed must be included in the computation.

Even when a student repeats the same course once or more before passing it, or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA. Pre - requisite courses must be taken and passed before a particular course at a higher level.

## Grading of Courses

Grading of courses shall be done by a combination of percentage marks and letter grades translated into a graduated system of Grade Point as shown in Table 1.2

**Table 1.3.Grade Point System**

| Mark % | Letter Grade | Grade Point |
|---|---|---|
| 70 – 100 | A | 5 |
| 60 – 69 | B | 4 |
| 50 – 59 | C | 3 |
| 45 – 49 | D | 2 |
| 40 – 44 | E | 1 |
| 0- 39 | F | 0 |

**Grade Point Average and Cumulative Grade Point Average**

For the purpose of determining a student's standing at the end of every semester, the Grade Point Average (GPA) system shall be used. The GPA is computed by dividing the total number of Units x Grade Point (TUGP) by the total number of units (TNU) for all the courses taken in the semester as illustrated in Table 1.3.

The Cumulative Grade Point Average (CGPA) over a period of semesters is calculated in the same manner as the GPA by using the grade points of all the courses taken during the period.

**Degree Classifications**

Classes of degree are to be awarded depending on the cumulative GPA obtained. The classes of degrees that may be awarded are: First Class Honours, Second Class Honours (Upper Division), Second Class Honours (Lower Division) Third Class Honours and Pass (see Table 1.4).

**Table 1.4: Degree Classification**

| CGPA | Class of Degree |
|---|---|
| 4.50 – 5.00 | First Class Honours |
| 3.50 – 4.49 | Second Class Honours (Upper Division) |
| 2.40 – 3.49 | Second Class Honours (Lower Division) |
| 1.50 – 2.39 | Third Class Honours |
| 1.00 – 1.49 | Pass |

**Probation**

Probation is a status granted to a student whose academic performance fall below an acceptable standard. A student whose Cumulative Grade Point Average is below 1.00 at the end of a particular year of study, earns a period of probation for one academic session.

**Withdrawal**

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

a. Failure to register within the time set by Senate for registration.

b. A candidate whose Cumulative Grade Point Average is below 1.00 at the end of a particular period of probation should be required to withdraw from the University. Where possible, consideration may be given to a student withdrawn from a programme of study for transfer to any other programme within the same university.

c. i) A failure rate so great that, at the point of consideration, the student would not be able to graduate within the remaining time available to him/her even if he/she is to register for, and pass, the maximum number of credits allowed by the regulations in each of the sessions available to him/her. [For example, if a student has only a maximum of two sessions to earn 90 credits but he can register for only 40 credits per session.]

   ii) A failure rate so great that, at point of consideration even with “A” in the remaining course(s) a student cannot be able to go out of second probation.

d. Failure to attend classes for a period which exceeds 30 consecutive days except upon approved medical or other grounds.

e. Failure to complete the stated requirements for the award of a degree within the maximum number of semesters laid down for the programme.

f. Failure to sit for the entire semester examinations without any admissible reason.

g. Subject to the conditions for withdrawal and probation, a 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.

**Modes of Student Assessment**

All courses taken must be evaluated and a final grade out of 100 will be assigned at the end of the semester. To arrive at the final grade, the evaluation must be a continuous process consisting of some or all of the following where applicable:

(i) Continuous Assessment.

(ii) Examinations.

**A. Continuous Assessment (CA)**

This component involves ongoing evaluations throughout the semester or session, which may include assignments, quizzes, tests, practical, presentation and attendance or participation.

Continuous assessment provides a holistic view of student's performance and progress. The continuous assessment shall account for 40% for taught courses and 50% for laboratory-based courses. A student repeating a failed course loses the CA obtained when the course was taken previously. Thus, such a student must repeat all aspects of the course. The CA marks for a course graded 'Incomplete' shall be carried forward and added to the examination marks obtained by the student when he/she completes the course. CA must be completed, and the students must receive their results before the end of semester examination.

This component encompasses various methods of evaluating student performance throughout the semester or session. Key elements include:

- **Attendance**

Attendance can be seen as a frequency with which student has been present during lectures or other academic activities. Monitoring attendance to gauge student engagement and participation in lectures and activities.

a. It is part of KHAIRUN regulations that no student should be allowed to sit for any course examination if he/she doesn't have 75% lecture attendance.

b. Depending on the lecturers, some marks are sometimes accorded to students who have full lecture attendance.

c. It helps in making decision to either assist students on the border line to escape carrying over or spilling over a course.

- **Practical**

This can be explained as a part of exam or series of exams in which the student has to demonstrate his/her practical ability. It include laboratory or field experiment and survey. It help student understand the theories learnt in the class. Reasonable percentage from the total assessment is accorded to practical section of all taught and practical courses.

- **Test and Quizzes**

A test is a mini examination given to students during the academic semester to assess understanding of course material at different stages. A quiz is a short assessment to evaluate student grasp of specific topics.

Students should note that punishments reserved for students who involved themselves in examination malpractice are equally applicable to test and quiz malpractices. This component carry greater proportion of the continuous assessment.

- **Presentation**

This is another component of continuous assessment in which student(s) will be asked to deliver a lecture or speech on the relevant topics in front of an audience. Some marks out of the total assessment are accorded to presentation.

- **Assignments and Projects**

It refers to the tasks assigned to students by their lecturers to be completed outside the class. This is to assess the application of concepts and deeper understanding.

**(ii) Examinations**

This component consists of formal examination administered at the end of semester or session. It assesses the students understanding of the course material and their ability to integrate and apply knowledge acquired throughout the period.

i. End of semester examinations should be 60% for all taught courses and 50% for practical courses.

ii. End of semester examinations should all be in essay type for all taught courses.

iii. Each credit should have a minimum of 45 minutes and a maximum of one hour of examination. However, the duration of the examination of any course should not be less than one hour, and no more than three hours, except for students with special needs, in which case additional 30 minutes is allowed.

iv. For every two-credit course there should be five examination questions for students to answer three, for one credit course four questions to answer two, and for three credit course seven questions to answer five.

v. Course tutors are at liberty to create a compulsory question as part of the total number of questions to be attempted by students. Compulsory question in any examination should not be more than one.

vi. Examination shall be administered at the end of each course, per semester.

vii. A student must have at least a 75% attendance of all lectures and practical in order to be eligible to sit for an examination in a course. This provision can only be implemented if the Department is satisfied that proper attendance record has been kept.

**Pass Mark**

The procedure for marking of examination scripts shall be a matter for agreement between the examiners for the course concerned. The mark for each course shall be expressed as a percentage. A fractional mark of 0.5% or above should be rounded up to the next whole number, and one less than 0.5% should be dropped.

The pass mark shall be 40% for all courses in the faculty. Students who fail courses are permitted to carry over these failed courses in subsequent semesters as per the usual academic regulation.

Students will be permitted to take a paid re-sit of the failed examination, provided it is approved by the senate. Students who fails the re-sit examination will have to carry over the failed courses to the next session.

**External Examiner System**

The involvement of external examiners from other universities is a crucial quality assurance requirement for all courses in Nigerian University System. In this regard, external examiner should go beyond mere moderation of examination questions to examining of examination papers to scope and depth of examination questions vis-a-vis the curricular expectation.

**Students' Evaluation of Courses**

There should be an established mechanism to enable students to evaluate courses delivered to them at the end of each semester. This should be an integral component of the course credit system to serve as an opportunity for feedback on the effectiveness of course delivery. Such an evaluation which should be undertaken by students at the end of each course, should capture, among others:

1. improvement in the effectiveness of course delivery;

2. continual update of lecture materials to incorporate emerging new concepts;

3. effective usage of teaching aids and tools to maximize impact of knowledge on students;

4. improvement in students' performance through effective delivery of tutorials, timely in; and

5. presentation of continuous assessment and high-quality examination.

It is very important that students' evaluation of courses and lecturers be administered fairly and transparently through the use of well-designed questionnaires. The completed questionnaires should be professionally analyzed and results discussed with the course lecturer(s) towards improvement in course delivery in all its ramifications.

**SIWES Rating and Assessment**

All students taking any degree in the Bachelor of Sciences must undergo industrial training to earn a minimum of 3 credit units. The minimum duration of the Students Industrial Work Experience Scheme (SIWES) should be 12 weeks. Students should be assessed using the Logbook, a report and a Seminar presentation.

# B.Sc. BIOCHEMISTRY

## Overview

Biochemistry programme is designed to enable graduates acquire broad based knowledge of chemical processes in living organisms ranging from single to multi- cellular organisms, both plants and animals. The first year of the programme is designed to prepare the students to acquire sound background knowledge of relevant science subjects, which would be a foundation to prepare them for specialized knowledge of Biochemistry. During the second and third year, the programme will expose the students to fundamental constituents (macro and micro) that constitute life processes and their dynamics. This will prepare them to appreciate the consequences of various deviations from normal during the final year.

## Philosophy

Biochemistry programme provides broad based knowledge that explains chemical processes that take place in living organisms and the causes of various deviations, which can invariably lead to pathological conditions. It also provides basis for manipulation of normal processes to achieve desired outcome. Products of the programme will be suitable for employment in health, food, leather and related industries among others. They can also be employed in tertiary education and research institutions as well as fit into all administrative officers or even be self- employed.

**Objectives**

Some of the major objectives of the degree programme in biochemistry would be to:

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

2. develop the ability of the students to apply knowledge and skills to solving theoretical and practical problems in Biochemistry;

3. develop in students, a range of transferable skills that are of value in biochemical and non-biochemical employments,

4. provide students with knowledge and skills base from which they can proceed to further studies in specialised areas of Biochemistry or multi-disciplinary areas involving Biochemistry;

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

6. generate in students an appreciation of the importance of Biochemistry in industrial, economic, environmental, technological and social development.

**Unique Features of the Programme**

The unique features of the programme include:

1. development, of high cognitive abilities and skills related to Biochemistry and other life sciences for the students;

2. students would be introduced to properties of flora and fauna, which are abundant in the tropics that may enable their use for drug development;

3. graduates would be capable of exhibiting practical skills in Biochemistry, including knowledge of safety issues in laboratories and instrumentation;

4. graduates would be able to develop scientific information literacy skills to support independent learning and industrial knowledge; and

5. graduates would be able to demonstrate critical thinking skill to solve problems relating to Biochemistry and other life sciences.

6. Graduates would be able to teach and import the requisite knowledge and skills to upcoming generations.

**Employability Skills**

1. Graduates would be familiar with various biochemical processes used in industries.

2. They will imbibe a sense of enthusiasm for Biochemistry as central to other life sciences.

3. Appreciation of biochemical application in molecular biology, medical sciences and other related fields.

4. They can be self-employed by establishing relevant small and medium scale enterprises.

**21st Century Skills**

1. Critical thinking, problem solving, reasoning, analysis, interpretation and synthesizing information.

2. Predictability skills without using live specimen.

3. Creativity, imagination, innovation and personal expression.

4. Research skill and practices and interrogative questioning.

5. Oral and written communication.

6. ICT literacy, data interpretation and analysis.

**Admission and Graduation Requirements**

**Admission Requirements**

1. The entry requirements for a four-year degree programme shall be senior secondary certificate (SSC) credit passes (WASC; NECO or equivalent) in five subjects at not more than two sittings. Such subjects shall include English language, Mathematics, Biology, Chemistry and Physics. In addition, an acceptable pass in the Unified Tertiary Matriculation Examination (UTME) is required for admission into 100 Level.

2. Candidates with five SSCE (or equivalent) credit passes with at least two at the GCE Advanced Level or IJMB or JUPEB in Biology and Chemistry, may be considered for admission into 200 Level.

**Graduation Requirements**

Expected duration for UTME candidates shall be 4 years and students are required to pass minimum of 120 units. For direct entry students, expected duration for graduation shall be 3 years and would be expected to pass a minimum of 90 units which must include all compulsory courses.

## Global Course Structure

**100 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST 111 | Communication in English | 2 | C | 15 | 45 |
| GST 112 | Nigerian Peoples and Culture | 2 | C | 30 | - |
| MTH 101 | Elementary Mathematics I | 2 | C | 30 | - |
| MTH 102 | Elementary Mathematics II | 2 | C | 30 | - |
| COS 101 | Introduction to Computing Sciences | 3 | C | 30 | 45 |
| BIO 101 | General Biology I | 2 | C | 30 | - |
| BIO 102 | General Biology II | 2 | C | 30 | - |
| BIO 107 | General Biology Practical I | 1 | C | - | 45 |
| BIO 108 | General Biology Practical II | 1 | C | - | 45 |
| CHM 101 | General Chemistry I | 2 | C | 30 | - |
| CHM 102 | General Chemistry II | 2 | C | 30 | - |
| CHM 107 | General Chemistry Practical I | 1 | C | - | 45 |
| CHM 108 | General Chemistry Practical II | 1 | C | - | 45 |
| PHY 101 | General Physics I | 2 | C | 30 | - |

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| PHY 102 | General Physics II | 2 | C | 30 | - |
| PHY 107 | General Physics Practical I | 1 | C | - | 45 |
| PHY 108 | General Physics Practical II | 1 | C | - | 45 |
| BCH 101 | Introductory Biochemistry I | 1 | C | 15 | - |
| BCH 102 | Introductory Biochemistry II | 1 | R | 15 | - |
| **Total** | | **31** | | | |

**Level 200**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST 212 | Philosophy, Logic and Human Existence | 2 | C | 30 | - |
| ENT 211 | Entrepreneurship and Innovation | 2 | C | 15 | 45 |
| BCH 201 | General Biochemistry I | 2 | C | 30 | - |
| BCH 202 | General Biochemistry II | 2 | C | 30 | - |
| BCH 203 | General Biochemistry Practical | 1 | C | - | 45 |
| STA 201 | Statistics for Agriculture & Biological Sciences | 3 | C | 45 | - |
| ANA 202 | Histology of Basic Tissues | 2 | C | 15 | 45 |
| BCH 204 | Biorisk Management and Biochemical Data Handling | 2 | C | 15 | 45 |
| BIO 201 | Genetics I | 2 | C | 30 | - |
| CHM 210 | Physical Chemistry I | 2 | C | 30 | - |
| CHM 211 | Organic Chemistry I | 2 | C | 30 | - |
| CHM 212 | Inorganic Chemistry I | 2 | C | 30 | - |
| MCB 221 | General Microbiology | 2 | C | 15 | 45 |

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| MCB 231 | Basic Techniques in Microbiology | 2 | C | - | 90 |
| PIO 201 | Introduction to Physiology and Blood | 2 | C | 30 | - |
| | **Total** | **30** | | | |

**300 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST 312 | Peace and conflict Resolution | 2 | C | 30 | - |
| ENT 312 | Venture Creation | 2 | C | 15 | 45 |
| BCH 301 | Enzymology | 2 | C | 30 | - |
| BCH 302 | Metabolism of Carbohydrates | 2 | C | 30 | - |
| BCH 303 | Metabolism of Lipids | 2 | C | 30 | - |
| BCH 304 | Metabolism of Amino Acids & Proteins | 2 | C | 30 | - |
| BCH 305 | Structure and Functions of Nucleic Acids | 2 | C | 30 | - |
| BCH 306 | Analytical Methods in Biochemistry | 3 | C | 30 | 45 |
| BCH 307 | Membrane Biochemistry | 2 | C | 30 | - |
| BCH 308 | Bioenergetics | 1 | C | 15 | - |
| BCH 309 | Inorganic Biochemistry | 1 | C | 15 | - |
| BCH 399* | Industrial Attachment | 3 | C | - | 12 Weeks |

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| BCH 310 | Biochemistry and Molecular Biology of Microorganisms | 2 | C | 30 | - |
| BCH 312 | Food and Nutritional Biochemistry | 2 | C | 30 | - |
| CHM 303 | Organic Chemistry II | 2 | C | 30 | - |
| | **Total** | **30** | | | |

*** To take place during the long vacation between 300 and 400 Levels**

**400 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| BCH 401 | Advanced Enzymology | 2 | C | 30 | - |
| BCH 402 | Molecular Biochemistry | 2 | C | 30 | - |
| BCH 403 | Metabolic Regulations | 2 | C | 30 | - |
| BCH 404 | Biochemical Reasoning | 1 | C | 15 | - |
| BCH 405 | Plant Biochemistry | 2 | C | 30 | - |
| BCH 406 | Research Project | 6 | C | - | 270 |
| BCH 407 | Bioinformatics | 2 | C | 30 | - |
| BCH 408 | Biochemical Entrepreneurship | 2 | C | 30 | - |
| GST 401 | Character Building, Professionalism and Team Work in Healthcare | 2 | R | 30 | - |
| BCH 409 | Industrial Biochemistry | 2 | C | 30 | - |
| BCH 410 | Biochemical Pharmacology and Toxicology | 3 | C | 30 | 45 |
| BCH 411 | Tissue Biochemistry | 1 | C | 15 | - |

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| BCH 412 | Immunology and Immunochemistry | 2 | C | 30 | - |
| BCH 413 | Research Methods in Biochemistry | 1 | C | 15 | - |
| BCH 414 | Forensic Biochemistry | 1 | C | 15 | - |
| BCH 415 | Special Topics and Seminar in Biochemistry | 1 | C | 15 | - |
| | **Total** | **32** | | | |

## Course Contents and Learning Outcomes

### 100 Level

### GST 111: Communication in English
### (2 Units C: LH 15; PH 45)

**Course Contents**

The Course introduces the student to the sound patterns in English language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages and collocations). Sentence in English (types, structural and functional, simple and complex). Grammar and usage (tense, mood, modality, concord and aspects of language use in everyday life). Logical and critical thinking and reasoning methods (logic and syllogism, inductive and deductive argument and reasoning methods, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities: (Pre-writing, writing, post writing, editing and proofreading, brainstorming, outlining, paragraphing, types of writing, summary, essays, letter, curriculum vitae, report writing, note making and mechanics of writing). Comprehension strategies (reading and types of reading, comprehension skills, 3RsQ). Information and communication technology in modern language learning. Language skills for effective communication. Major word formation processes. Writing and reading comprehension strategies. Logical and critical reasoning for meaningful presentations. Art of public speaking and listening. Report writing.

**GST 112: Nigerian Peoples and Culture**
**(2 Units C: LH 30)**

**Course Contents**

This is a premise where Nigerian history, culture, and art up to 1800 (Yoruba, Hausa and Igbo peoples and culture; peoples and culture of the ethnic minority groups) are explained. Nigeria under colonial rule (advent of colonial rule in Nigeria and colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914, formation of political parties in Nigeria, nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics and Nigerian Civil War). Concept of trade and economics of self-reliance (indigenous trade and market system, indigenous apprenticeship system among Nigeria people, trade, skill acquisition and self-reliance). Social justices and national development (law definition and classification. judiciary and fundamental rights. Individual, norms and values (basic Nigeria norms and values, patterns of citizenship acquisition, citizenship and civic responsibilities, indigenous languages, usage and development, negative attitudes and conducts, cultism, kidnapping and other related social vices). Re-orientation, moral and national values (The 3R's – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline (WAI), War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation

Agency (NOA). Current socio-political and cultural developments in Nigeria.

**MTH 101: Elementary Mathematics I (Algebra and Trigonometry)**
**(2 Units C: LH 30)**

**Course Contents**
Elementary set theory, subsets, union, intersection, complements and venn diagrams. Real numbers, integers, rational and irrational numbers, mathematical induction, real sequences and series, theory of quadratic equations and binomial theorem. Complex numbers, algebra of complex numbers and the argand diagram. De-Moivre's theorem, nth roots of unity. circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

**MTH 102: Elementary Mathematics II (Calculus)**
**(2 Units C: LH 30)**

**Course Contents**
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 and definite integrals. Application to areas and volumes.

**COS 101: Introduction to Computing Sciences**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
The course provides a brief history of computing. Description of the basic components of a computer/computing device. Input/Output devices and peripherals. Hardware, software and human ware. Diverse and growing computer/digital applications. Information processing and its roles in society. The Internet, its applications and its impact on the world today. The different areas/programs of the computing discipline. The job specializations for computing professionals. The future of computing.

**Lab Work:** This is essentially, a practical demonstration of the basic parts of a computer. Illustration of different operating systems of different computing devices including desktops, laptops, tablets, smart boards and smart phones. Demonstration of commonly used applications such as word processors, spreadsheets, presentation software and graphics. Illustration of input and output devices including printers, scanners, projectors and smart boards. Practical demonstration of the Internet and its various applications. Illustration of browsers and search engines. How to access online resources.

**BIO 101: General Biology I**
**(2 Units C: LH 30)**

**Course Contents**
The course explain cell structure and organization and the functions of cellular organelles. Characteristics and

classification of living things. Chromosomes, genes; their relationships and importance. General reproduction. interrelationships of organisms (competitions, parasitism, predation, symbiosis, commensalisms, mutualism, saprophytism). Heredity and evolution (introduction to Darwinism and Lamarkism, Mendelian laws, explanation of key genetic terms). Elements of ecology and types of habitat.

**BIO 102: General Biology II (2 Units C: LH 30)**

**Course Contents**
Basic characteristics, identification and classification of viruses, bacteria and fungi.

A generalized survey of the plant and animal kingdoms based mainly on the study of similarities and differences in the external features. Ecological adaptations. Briefs on physiology to include nutrition, respiration, circulatory systems, excretion, reproduction, growth and development.

**BIO 107: General Biology Practical I**
**(1 Unit C: PH 45)**

**Course Contents**
The course is designed to provides the common laboratory hazards. prevention and first aid. measurements in biology. uses and care of microscope. compound and dissecting microscope. Biological drawings and illustration, scaling, accuracy and proportion. use of common laboratory apparatus and laboratory experiments designed to illustrate the topics covered in **BIO 101.**

**BIO 108: General Biology Practical II**
**(1 Unit C: PH 45)**

**Course Contents**

This significant explains Anatomy of flowering plants, primary vegetative body. stem, leaf and root to show the mature tissues namely parenchyma, collenchyma, sclerenchyma, xylem and phloem. Types of fruits and seeds. Care and use of dissecting kits and other biological wares. Dissection and general histology of animal tissues based on vertebrate forms. Morphology and functions of epithelial, muscular, nervous and connective tissues. Examination of various groups of lower invertebrates under microscopes, identification of various groups of organisms in Animal Kingdom and any experiment designed to emphasize the practical aspects of topics in **BIO 102.**

**CHM 101: General Chemistry I (2 Units C: LH 30)**

**Course Contents**

The course involves the details of Atoms, molecules, elements, compounds and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridization and shapes of simple molecules. Valence forces and structure of solids. Chemical equations and stoichiometry, chemical bonding and intermolecular forces and kinetic theory of matter. Elementary thermochemistry, rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases.

Redox reactions and introduction to electrochemistry. Radioactivity.

**CHM 102: General Chemistry II**
**(2 Units C: LH 30)**

**Course Contents**

Historical survey of the development and importance of organic chemistry, fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures and nano chemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds. Determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry. Nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The Chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

**CHM 107: General Chemistry Practical I**
**(1 Unit C: PH 45)**

**Course Contents**

This is a practical course that involves Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

**CHM 108: General Chemistry Practical II**
**(1 Unit C: PH 45)**

**Course Contents**
This is a continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

**PHY 101: General Physics I (Mechanics)**
**(2 Units C: LH 30)**

**Course Contents**
Space and time. units and dimension. vectors and scalars. differentiation of vectors: displacement, velocity and acceleration. Kinematics. Newton laws of motion (Inertial frames, Impulse, force and action at a distance, momentum conservation). relative motion. Application of Newtonian mechanics. equations of motion. conservation principles in physics, conservative forces, conservation of linear momentum, Kinetic energy and work, Potential energy, System of particles, Centre of mass. Rotational motion. torque, vector product, moment, rotation of coordinate axes and angular momentum, polar coordinates. conservation of angular momentum; Circular motion. Moments of inertia, gyroscopes and precession. gravitation: Newton's Law of Gravitation, Kepler's Laws of Planetary Motion, Gravitational

Potential Energy, Escape velocity, Satellites motion and orbits.

**PHY 102: General Physics II (Electricity &Magnetism) (2 Units C: LH 30)**

**Course Contents**

The course explains the forces in nature, electrostatics, electric charge and its properties, methods of charging, Coulomb's law and superposition, electric field and potential, Gauss's law, capacitance, electric dipoles, energy in electric fields, conductors and insulators, current, voltage and resistance, Ohm's law and analysis of DC circuits, magnetic fields, Lorentz force, Biot-Savart and Ampère's laws, magnetic dipoles, dielectrics, energy in magnetic fields, electromotive force, electromagnetic induction, self and mutual inductances, Faraday and Lenz's laws, step up and step down transformers. Maxwell's equations, electromagnetic oscillations and waves, AC voltages and currents applied to inductors, capacitors, resistance and combinations.

**PHY 107: General Practical Physics I (1 Unit C: PH 45)**

**Course Contents**

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

**PHY 108: General Practical Physics II**
**(1 Unit C: PH 45)**

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

**BCH 101: Introductory Biochemistry I (1 Units C: LH 15; PH)**

**Course Contents**
This is an introduction to Biochemistry. History, Scope and Developments in Biochemistry; Philosophy and objectives of Biochemistry; Skills to be acquired as a Biochemist; Significance and relationships of Biochemistry to other life sciences; Carrier opportunities in Biochemistry and related disciplines; Important discoveries in Biochemistry. Elementary thermodynamics and their applications to biological systems. Introduction to kinetics.

**BCH 102: Introductory Biochemistry II**
**(1 Units R: LH 15; PH -)**

**Course Contents**

The course explains the Chemical elements of life; Composition of living matters; Brief introduction to the major biomolecules, enzymes and vitamins; Physical and chemical basis of molecular interactions, covelency and electrovalency; Isomerism of Biological compounds (geometrical, optical, positional and chemical); Oxidation-reduction reactions in biological systems: definitions and examples.

**200 Level**

**GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)**

**Course Contents**

It provides the meaning and the scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding and many more.

**ENT 211: Entrepreneurship and Innovation (2 Units C: LH 15; PH 45)**

**Course Contents**

Concept of entrepreneurship/corporate entrepreneurship. Theories, rationale and relevance of entrepreneurship (schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship and creative destruction). Characteristics of entrepreneurs (opportunity seeker, risk taker, natural and nurtured, problem solver and change agent, innovator and creative thinker). Entrepreneurial thinking (critical thinking, reflective thinking, and creative thinking). Innovation (concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and forming alliances and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office, networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

**BCH 201: General Biochemistry I**
**(2 Units C: LH 30)**

**Course Contents**

The course introduces the chemistry of amino acids, their properties, reactions and biological functions. Classification of amino acids: neutral, basic and acidic; polar and non-polar; essential and non-essential amino acids. Peptides. Introductory chemistry and classification of proteins. Biological functions of proteins. Methods of their isolation, purification and identification. Primary, secondary, tertiary and quaternary structures of proteins. Basic principles of tests for proteins and amino acids. Introductory chemistry of carbohydrates, lipids and nucleic acids. Nomenclature of nucleosides and nucleotides, effects of acid and alkali on hydrolysis of nucleic acids.

**BCH 202: General Biochemistry II**
**(2 Units C: LH 30)**

**Course Contents**

This explains the cell theory. Structures and functions of major cell components. Cell types, constancy and diversity. Cell organelles of prokaryotes and eukaryotes. Chemical composition of cells. Centrifugation and methods of cell fractionation. Structure, function and fractionation of extra-cellular organelles. Water, total body water and its distribution. Regulation of water and electrolyte balance. Disorder of water and electrolyte balance. Acidity and alkalinity, pH and pK values and their effects on cellular activities.

**BCH 203: General Biochemistry Practical**
**(1 Unit C: PH 45)**

**Course Contents**

Laboratory experiments are designed to reflect the topics covered in BCH 201 and BCH 202. Introduction to laboratory methods and procedures employed in studying biochemical processes.

**STA 201: Statistics for Agriculture and Biological Sciences**
**(3 Units C: LH 45)**

**Course Contents**

This provides the scope for statistical method in Biology and Agriculture. Measures of location, partition and dispersion. Elements of probability. Probability distributions: binomial, Poisson, geometric, hyper geometric, negative binomial and normal, Student's t and chi-square distributions. 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.

**ANA 202: Histology of Basic Tissues**
**(2 Units C: LH 15; PH 45)**

**Course Contents**

The course in an introduction to histology; Method of study in histology; Cell Membrane, Cellular organelles; Cell dynamics and cell cycle; Cytogenetics; Histochemistry and cytochemistry; Introduction to recombinant DNA; *In situ* hybridisation histochemistry; Cell dynamics and cycle; Basic tissues of the body, the epithelial, connective tissues, muscle and nervous tissue; The microanatomy of the four basic tissues, namely: epithelial tissue, including glandular tissue, connective tissue, muscular tissue, and nervous tissue; Covering and Lining Epithelia; Glandular Epithelia; Connective tissue. Bone, Bone formation and Joints; Blood. Muscle. Nervous tissue (PNS); Nervous tissue (CNS). Cardiovascular system; Respiratory system; Integumentary system; Liver, Gallbladder and Pancreas; Gastro-intestinal system; Lymphatic tissue and the Immune system; Endocrine system; Urinary system; Female reproductive system. Male reproductive system; Eye

**BCH 204: Biorisk Management and Biochemical Data Handling**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
The course provides definition of common terms: (Risk, hazard, threat, biorisk, biosafety, biosecurity, biorisk management, valuable biological material, risk assessment, risk characterization and risk evaluation); Risks associated with biological work and introduction to biorisk management framework; Definition and explanation of assessment, mitigation and Performance (AMP) model; Basic biosafety and biosecurity risk assessment; Strategies for mitigating biosafety risks; Performance evaluation and its importance; Relevance of biorisk management (BRM) as part of Global Health Security framework.

Introduction to biochemical data and its importance; Data formats and storage; Quality control and data validation; Basic statistical analysis techniques (mean, median, standard deviation, etc.); Basic probability and hypothesis testing; Data visualization techniques (scatter plots, bar graphs, histograms, etc.); Advanced statistical analysis techniques (regression analysis, ANOVA, etc.); Biochemical data interpretation and reporting.

**BIO 201: Genetics I**
**(2 Units C: LH 30; PH -)**

**Course Contents**
The course is an hereditable and non-hereditable characteristics; Probability and tests of goodness of fit;

Quantitative inheritance; Variation in genome structure; Introduction to population genetics.

**CHM 210: Physical Chemistry I**
**(2 Units C: LH 30; PH -)**

**Course Contents**
It provides insight on kinetic theory of gases; Science of real gases; The laws of thermodynamics; 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 I**
**(2 Units C: LH 30; PH -)**

**Course Contents**
The course provides current explanations on the chemistry of aromatic compounds; Structures of simple sugars, starch and cellulose, peptides, and proteins; Chemistry of bifunctional compounds; Energetics, kinetics, and the investigation of reaction mechanisms; Mechanisms of substitution, elimination, addition, and rearrangement reactions; Stereochemistry; Examples of various named organic reactions e.g., Grignard reaction, Aldol and related reactions; Simple alicyclic carbon compounds and their synthesis

**CHM 212: Inorganic Chemistry I**
**(2 Units C: LH 30; PH -)**

**Course Contents**
Chemistry of first row transition metals; Introduction to coordination 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 organometallic chemistry; Role of metals in biochemical systems; Concepts of hard and soft acids and bases; Oxidation and reduction reactions.

**MCB 221: General Microbiology**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
The course provides a detailed history of the Science of Microbiology; Classification of organisms into prokaryotes and eukaryotes; Classification of prokaryotes into Archaea and eubacteria anatomy and cytochemistry of bacteria and fungi; Shapes, groupings and colonial morphology of bacteria and fungi; Structure of viruses; Sterilization and disinfection; Structure, ecology and reproduction of representative microbial genera; Culture of micro-organisms: Isolation of micro-organisms: bacteria, viruses and fungi (yeasts and moulds); Nutrition and biochemical activities of micro-organisms; Antigens and antibodies; Identification and economic importance of selected microbial groups; Microbial variation and heredity; Study of laboratory equipment; Introduction to microbiology of air food, milk, dairy products,

water and soil; Staining techniques, antibiotic sensitivity tests, serological tests and antimicrobial agents

**MCB 231: Basic Techniques in Microbiology**
**(2 Units C: LH -; PH 90)**

**Course Contents**

This is a foundational course that explain culturing of micro-organisms; Preparation of media for microbial growth; Isolation of pure culture: Streaking, Pour plates etc. And it provide details on sub-culturing procedures; Staining techniques for differentiation of micro-organisms; Enumeration of micro-organisms, direct and indirect procedures; Identification of micro-organisms to include colonial and cellular morphology and biochemical procedures; Identification of bacteria should also include the use of serological techniques, antibiotic sensitivity discs and agar-in well methods; The use of anaerobic jar for growth of anaerobic organisms; Methods of preservation (agar slants, frequent sub-culturing, refrigeration and use of deep freezers, lyophilisation, storage in liquid nitrogen) of microbial cultures.

**PIO 201: Introduction to Physiology and Blood**
**(2 Units C: LH 30; PH -)**

**Course Contents**

This is an introductory course gives the Introduction and History of Physiology; Structure and functions of cell membranes; Transport process, special transport mechanism in amphibian bladder. Kidney, Gall bladder, Intestine, Astrocytes and Exocrine glands; Biophysical principles; Homeostasis and control systems including temperature regulation; biological rhythms, composition and functions of blood haemopoiesis; WBC and differential count, plasma proteins, coagulation fibrinolysis and platelet functions; Blood groups –ABO system – Rh system – blood transfusion – indication for collection and storage of blood, hazards of blood transfusions; Reticulo-endothelial system; Immunity and immunodeficiency disease and HIV.

**300 Level**

**Course Contents**

Concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political conflicts; structural conflict theory, realist theory of conflict and frustration-aggression conflict theory. Root causes of conflict and violence in Africa: indigene and settlers phenomenon; boundaries/boarder disputes; political disputes; ethnic disputes and rivalries; economic inequalities; social disputes; nationalist movements and agitations; selected conflict case studies – Tiv-Junkun; Zango Kataf, chieftaincy and land disputes many more. Peace building, management of conflicts and security, peace and human development. Approaches to peace &conflict management-(religious, government, community leaders and many more). Elements of peace studies and conflict resolution: conflict dynamics assessment scales, constructive and destructive. Justice and legal framework: concepts of social justice. The Nigeria legal system. Insurgency and terrorism. Peace mediation and peace keeping. Peace &security council (international, national and local levels). Agents of conflict resolution: conventions, treaties, community policing, evolution and imperatives. Alternative Dispute Resolution (ADR) : a). Dialogue b). Arbitration, c). Negotiation d). Collaboration and many more Roles of International Organisations in conflict resolution: (a). The United Nations, UN and its conflict resolution organs; (b). The African Union & Peace Security Council (c). ECOWAS in peace keeping. Media and traditional institutions in peace building. Managing post-conflict situations/crisis: refugees, internally displaced persons (IDPs). The role of NGOs in post-conflict situations/crisis.

**ENT 312: Venture Creation**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning and market research). Entrepreneurial finance (venture capital, equity finance, micro finance, personal savings, small business investment organisations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition &retention, B2B, C2C and B2C models of e-commerce, first mover advantage, e-commerce business models and successful e-commerce companies). Small business management/family business, leadership &management, basic bookkeeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (the concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - Artificial Intelligence (AI), Virtual/Mixed Reality (VR), Internet of

Things (IoTs), Blockchain, Cloud Computing, Renewable Energy and many more. Digital Business and E-Commerce Strategies).

**BCH 301: Enzymology**
**(2 Units C: LH 30)**

**Course Contents**
Discovery, classification and nomenclature of enzymes. Vitamins: fat and water soluble vitamins and co-enzymes, minerals in enzyme biochemistry. Structures and functions of vitamins and co-enzymes. Kinetics of enzymes. Mechanisms of enzyme-catalysed reactions. Effects of temperature, pH, ions and inhibitors on enzyme catalysed reactions. Enzyme inhibition. Derivation and significance of Michaelis-Menten equation. Allosteric/Regulatory enzymes. Active sites of enzymes. Estimation of kinetic parameters of enzyme activities. Zymogen activation, digestive enzymes and many more Production, isolation, purification and characterization of enzymes. Marker enzymes. Recent advances in enzymology.

**BCH 302: Metabolism of Carbohydrates**
**(2 Units C: LH 30)**

**Course Contents**
Chemistry and function, isolation and purification of polysaccharides. Molecular weight determination and analytical methods for structural determination of polysaccharides. Biochemistry of important disaccharides, oligosaccharides and polysaccharides; degradation and

digestion of carbohydrates - sugars, storage polysaccharides and cell walls. Glycolysis, the tricarboxylic acid cycle, the phosphogluconate pathway, the glycoxylate pathway; the pentose phosphate pathway and the cori cycle, the calvin pathway. Gluconeogenesis and glycogenesis, glycogenolysis, metabolism of fructose, Polyol pathway. Regulation of carbohydrate metabolism. Disorders of carbohydrate metabolism.

**BCH 303: Metabolism of Lipids**
**(2 Units C: LH 30)**

**Course Contents**
The course provides the classification of lipids - fatty acids, triglycerides, glycosylglycerols, phospholipids, waxes, prostaglandins. lipid micelles, monolayers and bilayers. Oxidation of fatty acids. Microsomal peroxidation of polyunsaturated fatty acids. Metabolism of unsaturated fatty acids: essential and non-essential. Metabolism of acylglycerols. Metabolism of phospholipids. Cholesterol biosynthesis and breakdown. Metabolism of ketone bodies. Integration of lipid metabolism. Acetic acid as a central precursor for biosynthesis of lipids. Lipoprotein metabolism and transport of lipids. Adipose tissue metabolism.

**BCH 304: Metabolism of Amino Acids & Proteins**
**(2 Units C: LH 30)**

**Course Contents**
Amino acids as building blocks of proteins and the peptide bond as covalent backbone of proteins. Forces involved in the

stabilization of protein structure. Protein isolation, fractionation, purification and characterization. Amino acid analysis of peptides and proteins. Methods for the determination of the sequence of amino acids in proteins. Protein biosynthesis, molecular weight determination of proteins. Techniques in protein biochemistry. Oxidative degradation of amino acids and metabolism of one carbon units. Ammonia toxicity and urea formation. Ketogenic and glucogenic amino acids. Biosynthesis of amino acids and some derivatives, the urea cycle; metabolism of inorganic nitrogen. Disorders of amino acid metabolism and polyamines.

**BCH 305: Structure and Functions of Nucleic Acids**
**(2 Units C: LH 30)**

**Course Contents**
The course explains the structure and function of nucleic acids. The genetic code and protein synthesis. Metabolism of purines and pyrimidines, nucleosides and nucleotides. Degradation of purine and pyrimidine nucleotides. DNA replication and DNA repairs. Disorders and abnormalities of nucleic acid metabolism-gout, Lesch-Nyhan syndrome, hypouricaemia, orotic aciduria, Reye’s syndrome, Xeroderma pigmentosus and skin cancer.

**BCH 306: Analytical Methods in Biochemistry**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
Tissue and cell culture techniques, immunoassays, blotting and isotopic techniques. Principles, methodologies,

instrumentation and applications of electrophoresis, manometry and centrifugation techniques. Chromatographic techniques including paper, thin layer, column, gas, and high-performance chromatographic techniques. Spectroscopic techniques including uv-visible, infra-red, nuclear magnetic resonance and mass spectrometry. Fluorimetry, polarographic including potentiometric and electrometric measurements. State-of-the-art equipment: gas chromatography-mass spectrometry, thermocycler, high performance liquid chromatography, nuclear magnetic resonance, fourier-transform infrared spectroscopy. This course includes laboratory practical classes, which will provide students the opportunity to practice the various techniques and familiarise themselves with the types of equipment used for the techniques.

**BCH 307: Membrane Biochemistry**
**(2 Units C: LH 30)**

**Course Contents**

Structure, composition and functions of biological membranes. Isolation, characterization and classification of membranes; chemistry and biosynthesis of membranes. Molecular organisation of membrane components. Natural and artificial membrane bilayers - the unit membrane hypothesis and fluid mosaic model. Membrane transport system - active versus passive transport systems. Transport of sugars and amino acids.

**BCH 308: Bioenergetics**
**(1 Unit C: LH 15)**

**Course Contents**
High-energy compounds. Chemical thermodynamics, Oxidations and reductions. Chemical potentials, Electrochemical potentials, Electron transport system and oxidative phosphorylation. Uncouplers of oxidative phosphorylation. Shuttle systems for oxidation of extra-mitochondrial NADH, ATP Cycle, Regulation of ATP production.

**BCH 309: Inorganic Biochemistry**
**(1 Unit C: LH 15)**

**Course Contents**
Relationship between the physicochemical properties and biological functions of inorganic ions. Ligand complexes and their biochemical significance. Trace elements in biological systems. Electrolyte metabolism. Nitrogen cycle and sulphur cycle.

**BCH 399: Industrial Attachment (For 4 year Programme - 12 weeks)**
**(3 Units C: PH 135)**

**Course Contents**
Students should be attached to some relevant industrial organisations for 12 Weeks at the end of 300 Level during the long vacation before commencement of 400 Level.

Assessment to be based on seminar presentation, report and assessment by their industry and university supervisors.

**BCH 310: Biochemistry and Molecular Biology of Microorganisms**
**(2 Units C: LH 30; PH -)**

**Course Contents**
General introduction to genetic materials: DNA, RNA, protein, gene, loci, intron, exons, etc.; Prokaryotic Genomes - Physical organization of bacterial genomes; Structure of the bacterial nucleoid; Replication and partitioning of the bacterial genome; Genome of Archaea: A review of central dogma; DNA replication, supercoiling, transcription, translation; Genetic exchanges in bacteria - Mechanisms of genetic exchange: transformation, conjugation, and transduction; Plasmids – Plasmids and plasmid biology, plasmid replication and conjugation, plasmids as vectors in cloning; DNA damage and repair mechanisms: Molecular mechanism of gene regulation in prokaryotes: Transcriptional regulation in prokaryotes (inducible and repressible system, positive regulation and negative regulation); Operon concept and organization – lac, trp, Ara operons; Transcriptional attenuation; Phages, Bacteriophage Genetics: - Benzer's fine structure of gene in bacteriophage T4: Plaque Formation, and Phage Mutants; Genetic recombination in the lytic cycle, (concept of recon, muton, cistron).

**BCH 312: Food and Nutritional Biochemistry**
**(2 Units C: LH 30; PH -)**

**Course Contents**
It is 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, greens 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; Functional foods, nutraceuticals and supplements.

**CHM 303: Organic Chemistry II**
**(2 Units C: LH 30; PH -)**

**Course Contents**
Aromatic and alicyclic chemistry; Survey of representative polycyclic compounds; Heterocyclic Chemistry (3,4,5 and 6-membered ring O, N, S heterocyclic compounds); Reactive intermediates – carbocations, carbanions, carbenes, nitrenes etc.; Selected rearrangement reactions such as, Beckmann, Baeyer-Villiger, and many others to illustrate various reaction mechanisms and types; Forensic analysis of biological

samples, pharmaceutical samples, organic analytes and macromolecular samples; Forensic analysis of biological samples, pharmaceutical samples, organic analytes and macromolecular samples.

**400 Level**

**Course Contents**

The course describes the chemistry of enzyme catalysis. Steady state enzyme kinetics. Transient kinetic methods. Ligand binding and its application to enzymology. Kinetics of multiple binding sites. Mechanisms of two substrate systems. Molecular models of allosterism. Enzyme models of allosterism. Multi-enzyme complexes. Enzyme assays and techniques in enzymology. Criteria for determining purity of enzymes. Enzyme reconstitution. Regulation of enzyme activity and synthesis.

**BCH 402: Molecular Biochemistry**
**(2 Units C: LH 30)**

**Course Contents**

It explains the gene structure and function. Nucleic acid function and biological function. DNA sequencing and restriction endonucleases. DNA repair mechanisms. Nucleic acid replication. Regulation of nucleic acid synthesis. Genetic code and gene-protein relationship. Eukaryotic transcription. Control of gene expression. Functional analysis of the replicator structure of bacteriophage DNA. Drug-nucleic acid interactions. Initiation factor for viral DNA replication. Genetic control of viral replication. Model systems used for studying embryology at the molecular level. Model systems in differentiation studies. Cell cycle, Control of cell proliferation. Genetic engineering and recombinant DNA Technology. Polymerase chain reaction, human genome project and gene therapy.

**BCH 403: Metabolic Regulations**
**(2 Units C: LH 30)**

**Course Contents**

The course explains the relationship of Krebs' Cycle to protein, carbohydrate, lipid and nucleic acid metabolism. Integration of metabolic pathways. Turn-over rates and metabolic pools. Regulation of enzymes of metabolic pathways-feedback inhibition versus enzyme synthesis. Catabolite repression, end product repression. Identification of different regulatory mechanisms in metabolic pathways.

**BCH 404: Biochemical Reasoning**
**(1 Unit: C LH 15)**

**Course Contents**

It is an evaluation and design of experimental biochemistry from available information and data. Analysis, interpretation and inference: drawing from biochemical research data.

**BCH 405: Plant Biochemistry**
**(2 Units C: LH 30)**

**Course Contents**

The course gives an explanations on the organisation of plant cells. The plant cell wall structure, formation and growth. Biochemistry of plant development. Lignin formation. The biochemistry of important plant processes and metabolic pathways. Photosynthesis. Secondary metabolites. Plant hormones and structure-activity relationship of plant hormones. Biosynthesis of carotenoid pigments. Synthetic growth regulators and herbicides. Indigenous plants of medicinal importance. Recent advances in medicinal plant biochemistry.

**BCH 406 Research Projects**
**(6 Units C: PH 270)**

**Course Contents**
The course prepare student on how to achieve an independent research findings into selected areas/topics of interest to the supervising 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 407: Bioinformatics**
**(2 Units C: LH 30)**

**Course Contents**
An overview of bioinformatics, history of bioinformatics, genome sequencing projects, database searching algorithms (BLAST, FASTA), pairwise and multiple sequence alignments, phylogenetic analysis, data mining in novel genomes, current topics in bioinformatics and use of perl to facilitate biological analysis.

**BCH 408: Biochemical Entrepreneurship**
**(2 Units C: LH 30)**

**Course Contents**
It describes how entrepreneurship skills related to biochemistry, creation of new ventures/business, writing and designing business plans, feasibility studies, financial planning and management, production of local diagnostic kits, soap/detergents, crude commercial enzymes, quality vegetable oils, bread, confectionery, food processing/packaging and preservation, production of ointments and medicinal plant extracts. Students will be grouped in areas of interest.

**GST 401: Character Building, Professionalism and Team Work in Healthcare**
**(2 Units R: LH 30; PH -)**

**Course Contents**
The course provides the technical knowhow on the concept of leadership and meaning of leaders; Theories, principles and styles of leadership; Methods of developing team wisdom; Team work as a personal skill; Creating powerful partnership in mentoring; Mentoring and mentoring skills: Stages of formal mentoring relationships; Introduction to professionalism in healthcare practice; Communication and interpersonal skills; Introduction to general psychology and medical psychology.

Counselling psychology in applied psychology; Definition, principles and application of effective communication skills in healthcare settings; The principles of Character Building and types personality traits; Philosophical concepts of Character Building; Code of ethics and principles for various health professions; Case scenarios in health care and their ethical implications; Introduction to psychoactive substances and their clinical manifestations; Cultural perspectives and management strategies in psychoactive substance abuse

**BCH 409: Industrial Biochemistry**
**(2 Units C: LH 30; PH -)**

**Course Contents**
This is 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; Primary and secondary metabolism as applied to Industrial Biochemistry; Process evaluation and development; Over production of metabolites - amino acids, taste enhancers, vitamins, toxin etc.; Methods for screening 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 410: Biochemical Pharmacology and Toxicology**
**(3 Units C: LH 30; PH 45)**

**Course Contents**

It provides an in-depth analysis on Xenobiotics Types and exposure; Xenobiotics/drug absorption, routes of exposure, metabolism (phase I and II), excretion, biotransformation and toxicity/adverse reactions; Mechanism of drug action; Metabolic factors affecting chemotherapeutic agents; Drug resistances and other factors affecting drug efficacy; The physiological and biochemical action of some selected drugs; Drug abuse and effects; Drug discovery - classic and modern methods, bioprospecting of plant metabolites, *in silico* methods. Traditional/ ethnomedicine of some diseases (fieldwork and seminar).

It explores the basic principles of toxicology, the definition and scope; Absorption and distribution of toxicants; Toxicokinetics, metabolism of toxicants; Comparative toxicology; Elimination of toxicants and their metabolites, toxicant-receptor interactions, genetic poisons, chemical carcinogenesis, trace element toxicity, hepatotoxicity. Biological effects of toxic substances in living organisms; Metabolism, cellular and tissue targets, mechanisms of action, and pathological effects; Resistance and tolerance of toxicants, natural toxicants, chronic testing in animals; Tests for mutagenicity in toxicological evaluation of chemicals; Isolation and structural elucidation of toxicants; Enzymatic detoxification. Biochemistry of drug addiction.

**BCH 411: Tissue Biochemistry**
**(1 Units C: LH 15; PH -)**

**Course Contents**

It defines the 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.

**BCH 412: Immunology and immunochemistry**
**(2 Units C: LH 30; PH -)**

**Course Contents**

Blood chemistry and composition; Preparation of serum and plasma; Protein components of plasma; Basic concept of immunology; Innate and acquired immunity; Structure antigen and antigenic determinants, antibodies, cellular immunity, layered defence; Structure classification of immunoglobulin; Antigen-antibody interactions, genetics of response to antigenic stimulation; Immunological tolerance and suppression; Combining sites of antibodies; The antigen binding site; Domains of antibody molecules-gene duplication and diversification; Generation of diverse antibody specificities, clonal selection theory of antibody formation; Biological significance of clonal selection; Tumour and transplant immunology; Myeloma and hybridoma immunoglobulin; Immunological anomalies (hypersensitivity, autoimmunity) immune evasion; Diagnostic immunology: ELISA, immunochromatographic assays, etc.; Therapeutic immunology: Immuno-prophylaxis and serotherapy, vaccines, anitvenom.

**BCH 413: Research Methods in Biochemistry**
**(1 Units C: LH 15; PH -)**

**Course Contents**

The course discusses among others, the meaning, objectives, types, approaches and significance of research; Research methods versus methodology, research process and criteria of good research; Research designs: The meaning of research designs, need for research designs, features of good designs, important concepts of good designs, differential research designs, and Basic principles of Experimental design and sample size determination; Use of computer in research (Internet Access).

The concepts in Statistics: Terms and Definitions in Statistics; Sampling techniques and sample size determination; Types of variables; Nature of variables: outcome and predictor variables; Data handling and cleaning; Concept of hypothesis formulation and testing; Assumptions of parametric variables; Descriptive statistics (data summary): display of data; Inferential statistics (t-test, ANOVA, chi-square); Use of computer based analytical packages such as Microsoft's Word, Excel, PowerPoint, g-power, SPSS, Instat, etc. Interpretation, discussion and reporting of results.

**BCH 414: Forensic Biochemistry**
**(1 Units C: LH 15; PH -)**

**Course Contents**

Introduction to forensic science: history, scope and relevance; Forensic toxicology (biochemistry of metals, drugs, poisons and toxins); Forensic DNA analysis and fingerprinting (extraction, amplification and genotyping); Forensic biochemistry sample handling: Collection and preservation techniques for materials of forensic interest; Analytical procedures in forensic biochemistry; Law, science and medicine in forensic practices; Case studies in forensic biochemistry (analysis of real world cases and the application of forensic biochemistry in solving crimes).

**BCH 415: Special Topics and Seminar in Biochemistry**
**(1 Units R: LH 15; PH -)**

**Course Contents**
Emerging and contemporary issues in different areas of Biochemistry: Clinical Biochemistry, Biochemical Endocrinology, Macromolecules, Environmental Biochemistry, Climate Change and Biochemistry, Parasite Biochemistry, Biochemical Entomology, etc.

# B.Sc. BIOTECHNOLOGY

**Overview**

Biotechnology is an inter-disciplinary field that encompasses all biological sciences, agricultural sciences, medical and the pharmaceutical sciences as well as some aspects of engineering and computational sciences and business studies. Graduates of the programme will be exposed broad based and multi-disciplinary theoretical and practical knowledge to impart competitive skills that meet the needs of the society and the world at large in industrial, academic, government and private work settings.

**Philosophy**

The Biotechnology programme provides balanced and broad based training in technologies that utilise biological systems for development or creation of different products and for acquisition of skills required of graduates who are qualified to practice as scientists in the industries and in the academia.

**Objectives**

The objectives of the programme are to:

1. impart basic and fundamental scientific knowledge in biotechnology to students;

2. equip students with critical thinking and problem solving abilities in the various multidisciplinary settings of biotechnology;

3. equip students to undertake result-oriented and exploratory research activities for industrial and academic

development;

4. develop and apply biotechnological principles in solving societal problems in agriculture, forestry, fishery, health and environment;

5. develop in the students a range of transferable skills that are of value to the society and relevant for gainful employment; and

6. produce graduates who will be leaders in biotechnological-based industries, government agencies, research institutes, universities and in self-employment.

**Unique Features of the programme**

The unique features of the programme include:

1. development of innovative biotechnological skills for sustainable food production, improved health care delivery and sustainable utilisation of environmental bioresources;

2. Production of graduates with capacity to develop new bioprocesses towards new product formation and generation of biotechnological high value-added products;

3. Production of graduates with high proficiencies for needed impacts in gene technologies, personalised healthcare and green biotechnology; and

4. Production of graduates with proficiencies in biotechnology based modern information and communication technologies and data analyses.

**Employability Skills**

Graduates of this programme shall possess and demonstrate practical, analytical, verbal, writing and problem solving skills for professional delivery of career expectations in various bio-based industries, research outfits, tertiary institutions as well as possess skills for self-employment.

**21st Century Skills**

1. Critical thinking, problem solving, reasoning, analysis, interpretation, synthesizing information.

2. Creativity, imagination, innovation, personal expression.

3. Research skill and practices, interrogative questioning.

4. Oral and written communication, public speaking and presenting, listening.

5. Leadership, teamwork, collaboration, cooperation, capacity for virtual workspaces.

6. ICT literacy, media and internet literacy, data interpretation and analysis.

**Admission and Graduation Requirements**

**Admission Requirements**

The entry requirements for a four-year degree programme shall be senior secondary certificate (SSC) credit passes (WASC; NECO or equivalent) in five subjects at not more than two sittings. Such subjects shall include English language, Mathematics, Biology, Chemistry and Physics. In addition, an acceptable pass in the Unified Tertiary Matriculation Examination (UTME) is required for admission into 100 Level.

Candidates with five SSCE (or equivalent) credit passes with at least two passes in Biology, Chemistry, Mathematics or Physics at the GCE Advanced Level or IJMB or JUPEB may be considered for admission into 200 Level. Expected duration for Direct Entry (DE) candidates shall be three (3) years.

**Graduation Requirements**

To be eligible for the award of a Bachelor's Degree in Biotechnology, a student must obtain a minimum of 120 credit units for UTME and or 90 credits units for direct entry respectively.

## Global Course Structure

### 100 Level

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST 111 | Communication In English | 2 | C | 15 | 45 |
| GST 112 | Nigerian Peoples and Culture | 2 | C | 30 | - |
| COS 101 | Introduction to Computing Sciences | 3 | C | 30 | 45 |
| MTH 101 | Elementary Mathematics I | 2 | C | 30 | - |
| MTH 102 | Elementary Mathematics II | 2 | C | 30 | - |
| BIO 101 | General Biology I | 2 | C | 30 | - |
| BIO 102 | General Biology II | 2 | C | 30 | - |
| BIO 107 | General Biology Practical I | 1 | C | - | 45 |
| BIO 108 | General Biology Practical II | 1 | C | - | 45 |
| CHM 101 | General Chemistry I | 2 | C | 30 | - |
| CHM 102 | General Chemistry II | 2 | C | 30 | - |
| CHM 107 | General Chemistry Practical I | 1 | C | - | 45 |
| CHM 108 | General Chemistry Practical II | 1 | C | - | 45 |
| PHY 101 | General Physics I | 2 | C | 30 | - |

| **Course Code** | **Course Title** | **Unit(s)** | **Status** | **LH** | **PH** |
|---|---|---|---|---|---|
| PHY 102 | General Physics II | 2 | C | 30 | - |
| PHY 107 | General Physics Practical I | 1 | C | - | 45 |
| PHY 108 | General Physics Practical II | 1 | C | - | 45 |
| BTG 106 | Careers in Biotechnology | 2 | C | 15 | 45 |
| | **Total** | **33** | | | |

**200 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST 212 | Philosophy, Logic and Human Existence | 2 | C | 30 | - |
| ENT 211 | Entrepreneurship and Innovation | 2 | C | 15 | 45 |
| BCH 201 | General Biochemistry I | 2 | C | 30 | - |
| MCB 221 | General Microbiology I | 2 | C | 15 | 45 |
| STA 201 | Statistics for Agriculture & Biological Sciences | 3 | C | 45 | - |
| BTG 202 | Introduction to Biotechnology | 2 | C | 30 | - |
| MCB 233 | Biorisk Management | 2 | C | 15 | 45 |
| BIO 201 | Genetics I | 2 | C | 30 | - |
| BIO 203 | General Physiology | 2 | C | 30 | - |
| BIO 204 | Biological Technique | 2 | C | 30 | - |
| CHM 211 | Organic Chemistry | 3 | C | 45 | - |
| CHM 213 | Analytical Chemistry | 3 | C | 45 | - |
| BIO 299 | Industrial Attachment | 3 | C | - | - |
| | **Total** | **30** | | | |

**300 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST 312 | Peace And Conflict Resolution | 2 | C | 30 | - |
| ENT 312 | Venture Creation | 2 | C | 15 | 45 |
| BTG 301 | Molecular Genetics | 2 | C | 30 | - |
| BTG 302 | Molecular Cell Biology | 2 | C | 15 | 45 |
| BTG 304 | Genetic Engineering | 2 | C | 15 | 45 |
| BTG 305 | Techniques in Biotechnology | 2 | C | 15 | 45 |
| BTG 309 | Food Biotechnology | 2 | C | 30 | |
| BTG 311 | Plant and Animal Cells Tissue Culture | 2 | C | 15 | 45 |
| BTG 313 | Biotechnology for Animal Production | 2 | C | 15 | 45 |
| BTG 315 | Bioinformatics | 2 | C | 30 | |
| BTG 399* | Industrial Attachment (12 Weeks)<br>(4 year programme only) | 3 | C | - | |
| BCH 301 | Enzymology | 2 | C | 30 | |

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| BTG 307 | Introduction to Food and Nutrition | 2 | C | | 30 |
| BTG 308 | Development and Conservation of Natural Resources | 2 | C | 30 | - |
| | **Total** | **29** | | | |

*** To take place during the long vacation between 300 and 400 Levels**

**Level 400**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| BTG 401 | Biotechnology Seminar | 2 | C | 30 | - |
| BTG 402 | Bio-safety and Bioethics | 1 | C | 30 | - |
| BTG 403 | Environmental Biotechnology | 2 | C | 15 | 45 |
| BTG 404 | Medical Biotechnology | 2 | C | 30 | |
| BTG 405 | Industrial Biotechnology | 2 | C | 15 | 45 |
| BTG 406 | Plant Biotechnology | 2 | C | 15 | 45 |
| BTG 407 | Research Project in Biotechnology | 6 | C | - | 270 |
| BTG 433 | Biotechnology Entrepreneurship | 2 | C | 30 | - |
| BTG 499* | Industrial Attachment (5year Programme only) | 6* | C | - | 24 Weeks |
| BOT 406 | Plant Pathology | 3 | C | 30 | 45 |
| BTG 408 | Metabolic Engineering | 2 | C | 30 | - |
| BTG 409 | Intellectual Property Rights | 2 | C | 30 | - |
| BTG 410 | Analytical Methods in Microbiology | 2 | C | 15 | 45 |

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| BTG 411 | Process Biotechnology | 2 | C | 30 | - |
| | **Total** | **32** | | | |

*Not added to total of 4 year programme; to take place during second semester of 400 Level and Long vacation between 400 and 500 Levels for 5 year programme

## Course Contents and Learning Outcomes

### 100 Level

### GST 111: Communication in English
**(2 Units C: LH 15; PH 45)**

#### Course Contents

This course avails students with the knowledge of sound patterns in English Language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). Sentence in English (types: structural and functional, simple and complex). Grammar and Usage (tense, mood, modality and concord, aspects of language use in everyday life). Logical and Critical Thinking and Reasoning Methods (Logic and Syllogism, Inductive and Deductive Argument and Reasoning Methods, Analogy, Generalisation and Explanations). Ethical considerations, Copyright Rules and Infringements. Writing Activities: (Pre-writing , Writing, Post writing, Editing and Proofreading; Brainstorming, outlining, Paragraphing, Types of writing, Summary, Essays, Letter, Curriculum Vitae, Report writing, Note making and Mechanics of writing). Comprehension Strategies: (Reading and types of Reading, Comprehension Skills, 3RsQ). Information and Communication Technology in modern Language Learning. Language skills for effective communication. Major word formation processes. Writing and reading comprehension strategies. Logical and critical reasoning for meaningful presentations. Art of public speaking and listening. Report writing.

**GST 112: Nigerian Peoples and Culture**
**(2 Units C: LH 30)**

**Course Contents**

This course provides the science students with the background on Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and culture; peoples and culture of the ethnic minority groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; Colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; Nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concept of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigeria people; trade, skill acquisition and self-reliance). Social justices and national development (law definition and classification. Judiciary and fundamental rights. Individual, norms and values (basic Nigeria norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts. Cultism, kidnapping and other related social vices). Re-orientation, moral and national values (The 3R's – Reconstruction, Rehabilitation and Re-orientation; Re-orientation Strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline (WAI), War Against Indiscipline and Corruption(WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

**COS 101: Introduction to Computing Sciences**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
The course provides a brief history of computing. Description of the basic components of a computer/computing device. Input/Output devices and peripherals. Hardware, software and human ware. Diverse and growing computer/digital applications. Information processing and its roles in society. The Internet, its applications and its impact on the world today. The different areas/programs of the computing discipline. The job specializations for computing professionals. The future of computing.

**Lab Work:** Practical demonstration of the basic parts of a computer. Illustration of different operating systems of different computing devices including desktops, laptops, tablets, smart boards and smart phones. Demonstration of commonly used applications such as word processors, spreadsheets, presentation software and graphics. Illustration of input and output devices including printers, scanners, projectors and smart boards. Practical demonstration of the Internet and its various applications. Illustration of browsers and search engines. How to access online resources.

**MTH 101: Elementary Mathematics I (Algebra and Trigonometry)**
**(2 Units C: LH 30)**

**Course Contents**

The course is about elementary set theory, subsets, union, intersection, complements, venn diagrams. Real numbers; integers, rational and irrational numbers, mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem. Complex numbers; algebra of complex numbers; the Argand diagram. De-Moivre's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

**MTH 102: Elementary Mathematics II (Calculus)**
**(2 Units C: LH 30)**

**Course Contents**

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.

**BIO 101: General Biology I**
**(2 Units C: LH 30)**

**Course Contents**
Cell structure and organization, functions of cellular organelles. Characteristics and classification of living things. Chromosomes, genes, their relationships and importance. General reproduction. Interrelationships of organisms (competitions, parasitism, predation, symbiosis, commensalisms, mutualism, saprophytism). Heredity and evolution (introduction to Darwinism and Lamarkism, Mendelian laws, explanation of key genetic terms). Elements of ecology and types of habitats.

**BIO 102: General Biology II**
**(2 Units C: LH 30)**

**Course Contents**
Basic characteristics, identification and classification of viruses, bacteria and fungi. A generalized survey of the plant and animal kingdoms based mainly on the study of similarities and differences in the external features. Ecological adaptations. Briefs on physiology to include nutrition, respiration, circulatory systems, excretion, reproduction, growth and development.

**BIO 107: General Biology Practical I**
**(1 Unit C: PH 45)**

**Course Contents**
Common laboratory hazards. prevention and first aid. measurements in biology. uses and care of microscope. compound and dissecting microscope. Biological drawings and illustration, scaling, accuracy and proportion. use of common laboratory apparatus and laboratory experiments designed to illustrate the topics covered in **BIO 101.**

**BIO 108: General Biology Practical II**
**(1 Unit C: PH 45)**

**Course Contents**
It is concerned with the practical aspect that has to do with Anatomy of flowering plants, primary vegetative body. stem, leaf and root to show the mature tissues namely parenchyma, collenchyma, sclerenchyma, xylem and phloem. Types of fruits and seeds. Care and use of dissecting kits and other biological wares. Dissection and general histology of animal tissues based on vertebrate forms. Morphology and functions of epithelial, muscular, nervous and connective tissues. Examination of various groups of lower invertebrates under microscopes, identification of various groups of organisms in Animal Kingdom and any experiment designed to emphasize the practical aspects of topics in **BIO 102.**

**CHM 101: General Chemistry I**
**(2 Units C: LH 30)**

**Course Contents**
The course provides expectations on the workings of Atoms, molecules, elements and compounds and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridization and shapes of simple molecules. Valence Forces; Structure of solids. Chemical equations and stoichiometry; Chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

**CHM 102: General Chemistry II**
**(2 Units C: LH 30)**

**Course Contents**
This is about historical survey of the development and importance of Organic Chemistry; Fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds. Determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry. Nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes,

ketones, carboxylic acids and derivatives. The Chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

**CHM 107: General Chemistry Practical I**
**(1 Unit C: PH 45)**

**Course Contents**
Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

**CHM 108: General Chemistry Practical II**
**(1 Unit C: PH 45)**

**Course Contents**
Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

**PHY 101: General Physics I (Mechanics)**
**(2 Units C: LH 30)**

**Course Contents**
The course is designed to provide details explanations on space and time. units and dimension. vectors and scalars. differentiation of vectors: displacement, velocity and acceleration. Kinematics. Newton laws of motion (Inertial frames, Impulse, force and action at a distance, momentum

conservation). relative motion. Application of Newtonian mechanics. equations of motion. conservation principles in physics, conservative forces, conservation of linear momentum, Kinetic energy and work, Potential energy, System of particles, Centre of mass. Rotational motion. torque, vector product, moment, rotation of coordinate axes and angular momentum, polar coordinates. conservation of angular momentum; Circular motion. Moments of inertia, gyroscopes and precession. gravitation: Newton's Law of Gravitation, Kepler's Laws of Planetary Motion, Gravitational Potential Energy, Escape velocity, Satellites motion and orbits.

**PHY 102: General Physics II (Electricity & Magnetism) (2 Units C: LH 30)**

**Course Contents**

Forces in nature. Electrostatics, electric charge and its properties. methods of charging. The Coulomb's law and superposition. electric field and potential. Gauss's law. Capacitance. Electric dipoles. Energy in electric fields; Conductors and insulators, current, voltage and resistance, Ohm's law and analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère's laws. magnetic dipoles, Dielectrics, Energy in magnetic fields, Electromotive force. Electromagnetic induction, Self and mutual inductances. Faraday and Lenz's laws, Step up and step down transformers: Maxwell's equations; Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, resistance, and combinations.

**PHY 107: General Practical Physics I**
**(1 Unit C: PH 45)**

**Course Contents**
This is an introductory course that emphasizes on the quantitative measurements, the treatment of measurement errors, and graphical analysis. A variety of experimental techniques should be employed. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, and many more covered in PHY 101, 102, 103 and PHY 104. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

**PHY 108: General Practical Physics II**
**(1 Unit C: PH 45)**

**Course Contents**
This is also a practical course, and, it is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

**BTG 106 – Careers in Biotechnology**
**(2 Units Core: LH 15, PH 45)**

**Course contents**

Biotechnology as a course; Applications of Biotechnology; Biotechnology business opportunities in: Bio-pesticides manufacturing; agri-clinic; compost fertilizer production; vermicompost; plant protection; seed processing; animal feed manufacturing; bee keeping (apiculture); bind and hatchery; liquid fertilizers; Specialty medicine and vaccine manufacturing; consultancy services; artificial human part production (artificial limbs); medical transportation services; food supplements and blood bank; Artificial food sweeteners; genetically modified food processing; vegetable processing plants; Waste water treatment plant; soil water quality testing; water extractors; biodegradable plastic production; biodiesel production

**200 Level**

**GST 212: Philosophy, Logic and Human Existence**
**(2 Units C: LH 30)**

**Course Contents**

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding and many more.

**ENT 211: Entrepreneurship and Innovation**
**(2 Units C: LH 15; PH 45)**

**Course Contents**

Concept of Entrepreneurship (Entrepreneurship, Intrapreneurship/Corporate Entrepreneurship,). Theories, Rationale and relevance of Entrepreneurship (Schumpeterian and other perspectives, Risk-Taking, Necessity and opportunity-based entrepreneurship and Creative destruction). Characteristics of Entrepreneurs (Opportunity seeker, Risk taker, Natural and Nurtured, Problem solver and change agent, Innovator and creative thinker). Entrepreneurial thinking (Critical thinking, Reflective thinking, and Creative thinking). Innovation (Concept of innovation, Dimensions of innovation, Change and innovation, Knowledge and innovation). Enterprise formation, partnership and networking (Basics of Business Plan, Forms of business ownership, Business registration and Forming alliances and joint ventures). Contemporary Entrepreneurship Issues (Knowledge, Skills and Technology, Intellectual property, Virtual office, Networking). Entrepreneurship in Nigeria (Biography of inspirational Entrepreneurs, Youth and women entrepreneurship, Entrepreneurship support institutions, Youth enterprise networks and Environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

**BCH 201: General Biochemistry I**
**(2 Units C: LH 30)**

**Course Contents**

This is an introductory course in the chemistry of amino acids; their properties, reactions and biological functions. Classification of amino acids: neutral, basic and acidic; polar and non-polar; essential and non-essential amino acids. Peptides. Introductory chemistry and classification of proteins. Biological functions of proteins. Methods of their isolation, purification and identification. Primary, secondary, tertiary and quaternary structures of proteins. Basic principles of tests for proteins and amino acids. Introductory chemistry of carbohydrates, lipids and nucleic acids. Nomenclature of nucleosides, and nucleotides; effects of acid and alkali on hydrolysis of nucleic acids.

**MCB 221: General Microbiology**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
History of the Science of Microbiology. Classification of organisms into prokaryotes and eukaryotes; Classification of prokaryotes into Archaea and eubacteria Anatomy and cytochemistry of bacteria and fungi. Shapes, groupings and colonial morphology of bacteria and fungi. Structure of viruses. Sterilization and disinfection; Structure, ecology and reproduction of representative microbial genera. Culture of micro-organisms. Isolation of micro-organisms; isolation of bacteria, viruses, fungi (yeasts and moulds. Nutrition and biochemical activities of micro-organisms. Antigens and antibodies. Identification and economic importance of selected microbial groups. Microbial variation and heredity. Study of laboratory Equipment. Introduction to microbiology of air food, milk, dairy products, water and soil. Staining techniques, antibiotic sensitivity tests, serological tests, antimicrobial agents

**STA 201: Statistics for Agriculture and Biological Sciences**
**(3 Units C: LH 45)**

**Course Contents**
Scope for statistical method in Biology and Agriculture. Measures of location, partition and dispersion. Elements of probability. Probability distributions: binomial, Poisson, geometric, hypergeometric, negative binomial and normal, Student’s t and chi-square distributions. 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.

**BTG 202**: **Introduction to Biotechnology**
**(2 Units C: LH 30)**

**Course Contents**
Historical developments. Principles and applications of biotechnology. Implications of molecular biology in the modern world, including ethical and social controversies. Introductory aspects of microbial biotechnology, medical biotechnology, environmental biotechnology, pharmaceutical biotechnology, agricultural biotechnology and industrial biotechnology. Biotechnological production of industrial materials: biofuels and antibiotics. DNA cloning, DNA fingerprinting and the use of DNA in forensics. Practical would include measurement of cell size using micrometer, measurement of cell concentrations (microscopic enumeration, fresh weight, dry weight, packed cell volume); microtome sectioning and microscopy; aseptic techniques and autoclaving; different DNA extraction methods, gel electrophoresis, polymerase chain reaction techniques, primer design, overview of DNA cloning.

**MCB 233 – Biorisk Management**
**(2 Units Core; LH 15; PH 45)**

**Course contents**
Definition of common terms (risk, hazard, threat, biorisk, biosafety, biosecurity, biorisk management, valuable

biological materials, risk assessment, risk characterization and risk mitigation). Risk associated with biological work, Biorisk management framework. Assessment, mitigation and performance (AMP) model. Basic Biosafety and Biosecurity risk assessment. Performance evaluation and its importance. Relevance of Biorisk management in global health security framework. Biological Waste and Waste Management. Record and Record Keeping, etc. Identifying Biological risk spectrum and Biological Safety and Security tools using case studies. Biosafety in Microbiology and Molecular Biology. Introduction to agents of bioterrorism. Assessment of biological hazards and risks. Biorisk Mitigation via personal protective equipment and biosafety cabinets.

**BIO 201 – Genetics**
**(2 Units Core: LH 30, PH)**

**Course contents**

Genetics is concerned with Molecular basis of heredity; chromosome structure; patterns of Mendelian and non-Mendelian inheritance; evolution; biotechnological applications; Hereditable and non-hereditable characteristics; Probability and tests of goodness of fit; Quantitative inheritance; variation in genome structure; introduction to population genetics.

**BIO 203: General Physiology**
**(2 Units C: LH 30)**

**Course Contents**
Chemicals of life: the chemistry of carbohydrates, lipids, proteins and nucleic acids and their biological importance. General characteristics of enzymes. Nutrition. digestion and absorption in plants and animals. Biosynthesis, photosynthesis and protein synthesis. Cell membrane structure and function. A general study of osmoregulation, excretion, transport. growth hormones and enzymology. homeostasis and their co-ordination in animals. Plant water relation. growth and growth regulation.

**BIO 204: Biological Techniques**
**(2 Unit C: LH 15; PH 45)**

**Course Contents**
The course is about the technics of Microscopy handling of microscopes. preparation of microscope slides (microtomy) for microscopic examinations. use of hand lens. biological drawings and diagrams. Spectrophotometry. Colorimetry. Photometry. Polarimetry. Chromatography. Refractometry. melting points and colligative properties. Herbarium and museum techniques. Experimental designs, report writing and presentations.

**CHM 211: Organic Chemistry I**
**(2 Units C: LH 30)**

**Course Contents**
Chemistry of aromatic compounds. Structures of simple sugars, starch and cellulose, peptides, and proteins. Chemistry of bifunctional compounds. Energetics, kinetics, and the investigation of reaction mechanisms. Mechanisms of substitution, elimination, addition, and rearrangement reactions. Stereochemistry. Examples of various named organic reactions e.g., Grignard reaction, Aldol and related reactions. Simple alicyclic carbon compounds and their synthesis.

**CHM 213: Analytical Chemistry I**
**(2 Units C: LH 30)**

**Course Contents**
Theory of errors; and statistical treatment of data: Theory of sampling. Chemical methods of analysis including volumetric, gravimetric, data analysis and presentation; Physicochemical methods, Optical methods of analysis; separation methods. The Analytical Process; Chemical Measurements; Experimental Error; Chemical Equilibrium; Activity and the Systematic Treatment of Equilibrium; Monoprotic Acid-Base Equilibria; Polyprotic Acid-Base Equilbria; Acid-Base Titrations; Fundamentals of Electrochemistry; Electrodes and Potentiometry; Redox Titrations; Electroanalytical Techniques; EDTA Titrations; Gravimetric Analysis; Precipitation Titrations; Combustion Analysis; Advanced Topics in Equilibrium.

**BTG 299: Industrial Attachment (12 Weeks)**
**(3 Units C: PH 135)**

**Course Contents**

Students should be attached to relevant industrial organizations for 12 Weeks preferably during the long vacation for appropriate experience. Students should be assessed based on seminar presentations, written reports and supervisors' assessments.

**300 Level**

**GST 312: Peace and Conflict Resolution**
**(2 Units C: LH 30)**

**Course Contents**

Concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic and geo-political conflicts. Structural conflict theory, realist theory of conflict and frustration-aggression conflict theory. Root causes of conflict and violence in Africa: indigene and settlers' phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations, selected conflict case studies – Tiv-Junkun, Zango Kartaf, chieftaincy and land disputes and many more. peace building, management of conflicts and security, peace & human development. Approaches to peace & conflict management: (religious, government, community leaders and many more.). Elements of peace studies and conflict resolution, conflict dynamics assessment scales: constructive & destructive. Justice and legal framework and concepts of social justice. The Nigeria legal system. Insurgency and terrorism. Peace Mediation and Peace Keeping. Peace and security council (international, national and local levels). Agents of conflict resolution: conventions, treaties, community policing, evolution and imperatives. Alternative dispute resolution (ADR): a). dialogue b). arbitration c). negotiation d). collaboration and many more Roles of international organizations in conflict resolution: (a). The United Nations (UN) and its conflict resolution organs. (b).

The African Union & Peace Security Council (c). ECOWAS in peace keeping. Media and traditional institutions in peace building. Managing post-conflict situations/crisis: refugees. internally displaced persons (IDPs). The role of NGOs in post-conflict situations/crisis.

**ENT 312: Venture Creation**
**(2 Units C: LH 15; PH 45)**

**Course Contents**

Opportunity Identification (Sources of business opportunities in Nigeria, Environmental scanning, Demand and supply gap/unmet needs/market gaps/Market Research, Unutilised resources, Social and climate conditions and Technology adoption gap). New business development (business planning, market research). Entrepreneurial Finance (Venture capital, Equity finance, Micro finance, Personal savings, Small business investment organizations and Business plan competition). Entrepreneurial marketing and e-commerce (Principles of marketing, Customer Acquisition & Retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and Successful E-Commerce Companies,). Small Business Management/Family Business: Leadership & Management, Basic book keeping, Nature of family business and Family Business Growth Model. Negotiation and Business communication (Strategy and tactics of negotiation/bargaining, Traditional and modern business communication methods). Opportunity Discovery Demonstrations (Business idea generation presentations, Business idea Contest, Brainstorming sessions, Idea pitching). Technological Solutions (The Concept of Market/Customer

Solution, Customer Solution and Emerging Technologies, Business Applications of New Technologies - Artificial Intelligence (AI), Virtual/Mixed Reality (VR), Internet of Things (IoTs), Blockchain, Cloud Computing, Renewable Energy and more more. Digital Business and E-Commerce Strategies).

**BTG 301**: **Molecular Genetics**
**(2 Units C: LH 30)**

**Course Contents**
Fundamental 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. Molecular genetics at the level of DNA sequence: point mutation, frame-shift mutation, depurination, deamination. The roles of genes in the control of hereditary, cell development, cellular metabolism, and functions of the organisms. Transposons and insertion sequences. Gene expression in prokaryotic and eukaryotic organisms; regulation of gene expression. Transcription, translation, regulation, promoters, other regulatory sequences, replication, repair, eukaryote genomes, introns and exons.

**BTG 302: Molecular Cell Biology**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
The structure and ultrastructure of cells. Differences and similarities between prokaryotic and eukaryotic cells. Microscopy methods for structural analysis of the prokaryotic

and eukaryotic cells. Organelles and membrane systems; their structure and function. Cell division: mitosis, meiosis. Intracellular protein sorting and secretion, endocytosis and exocytosis. Cytoskeleton and cell motility. Apoptosis, cancer and processes that regulate the development of multicellular organisms. Extra- and intracellular signal transduction. The gene concept, gene structure and function, DNA replication and repair, DNA fingerprinting and DNA typing, DNA sequencing, mapping and quantifying of transcripts. Genomics: Structural, Functional and Comparative; genomics of genes, proteomics, metabolomics, transcriptomics, DNA Micro-arrays. The relationship between DNA, RNA and protein. Assaying DNA-protein interactions, knock-outs; determination of three dimensional protein structures using experimental techniques and computer simulation.

**BTG 304: Genetic Engineering**
**(2 Units C: LH 15; PH 45)**

**Course Contents**

Isolation of DNA and RNA from plant, animal and microbial cells (extraction of pure samples of DNA). Introduction to genetic engineering, fundamentals of gene cloning and genetic engineering principles. Fragmentation of DNA, restriction endonuclease digestion, enrichment for specific DNA sequences. Analysis of DNA fragment sizes, joining DNA molecules together, cloning vectors.

Types and characteristics. Selection of host cells, introduction of DNA into the host cells(transformation, transduction, conjugation, transfection, electroporation, microinjection, gene gun). Detection and analysis of successful clones, stability of cloned genes, manipulation of cloned genes in vitro. Gene amplification, gene knockout and disruption, gene targeting, genome editing and Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) technology. Genetically modified organisms, genetic modification of industrial microorganisms. Insulin, antibodies, vaccines and hormone production technologies. Hormone replacement therapy. Genetic diagnosis and gene therapy. Transgenic animals, transgenic plants, transformation of plants using Agrobacterium tumefaciencs. Organic insecticide, Bacillus thuringiensis, FLAVR SAVR Tomato. The Human Genome Project, prospects and consequences.

**BTG 305: Techniques in Biotechnology**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
Principles of instrumentation. Principles and techniques of radioisotope techniques, chromatographic methods, electrophoresis, centrifugation techniques, Ultracentrifugation. Dialysis and Ultra-filtration, spectroscopic techniques, polymerase chain reaction (PCR), DNA hybridization, DNA sequencing techniques, Enzyme linked Immunosorbent assays (ELISA). Random Amplified Polymorphic DNAs (RAPDs); Restriction fragment length polymorphisms (RFLPs); Simple Sequence Repeats (SSR); DNA Micro array, Ribotyping. Southern, Northern, and Western blot methods of protein and DNA and identifications. SDS-PADE, DGGE. Physical methods of gene transfer. Optical microscopy; Review of modern analytical techniques

(radiochemical methods). Fluorimetric instrumentation types- GLC, NMR, X-ray diffraction.

**BTG 309: Food Biotechnology**
**(2 Units C: LH 30)**

**Course Contents**
Food Classes – carbohydrates, fats, proteins, vitamins, minerals, water, fibre. Food Groups – tubers, cereals, fruits, legumes, meat, fish, leafy vegetables and many more. Fermented African foods and beverages (traditional processing techniques) – palm wine, garri, burukutu, ogi and many more. Food pigments; confectioneries – configuration and conformation of sugar. Food contaminants – toxic substances in foods, food poisoning and intoxication – prevention and cure. Biotechnology of food processing, preservation and storage. Deterioration and spoilage agents of foods. Biotechnological methods to increase shelf lives of food crops, food produce and ready to eat foods. Biotechnological production of natural ingredients for food industry. New applications of biotechnology in food industry - genetically engineered α-amylase, lipase and condiments. Genetically engineered crops and animals, ethical, biosafety and socio-cultural challenges. Promoting local food production and processing for global acceptability. World food problems, hunger eradication/elimination. Novel sources of proteins, neglected and underutilized animal and plant protein sources. Laboratory cultured meat, plant based meat production.

**BTG 311: Plant and Animal Cells Tissue Culture**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
Microscopic structure of organisms, introductory microtechniques. Plant tissue culture and animal cell culture techniques. Media used for tissue cultures, media composition (phyto-hormones, vitamins, growth factors etc); sterility. Procedures for micro propagation of plants (callus culture, meristem culture, organ culture), germ-plasm storage, morphogenesis, concept of totipotency, micropropagation through organogenesis, somatic embryogenesis, protoplast culture and fusion, embryogenesis, isolation and maintenance of various animal/insect cell lines. Culture methods for animal cells/tissues, measurement of animal and plant cell growth. Microalgal biotechnology: microbial photosynthesis, photoautotrophic, heterotrophic and photoheterophic cultivation of photosynthetic cells.

**BTG 313: Biotechnology for Animal Production**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
Principles of animal breeding, marker assisted selection and breeding, artificial insemination, embryo transfer, embryo splitting and embryosexing. Cloning, in-vitro fertilization and embryo rescue, multiple ovulation embryo techniques for farm animals. Applications of animal tissue cultures in livestock breeding. Conservation of genetic resources, 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. Biotechnology in animal health and survival, biotechnology in animal nutrition. Emerging issues: ethical concerns, industry and public concerns, management of issues of concern.

**BTG 315: Bioinformatics**
**(2 Units C: LH 30)**

**Course Contents**
Definitions and scope of bioinformatics for biotechnology. Computer science and biotechnology, computational biology. Use of computer for data analysis and processing, process optimization. Databases: searching, construction and retrieving information from database. Biological information systems: Gene Database (GenBank), Molecular Databases, Literature Databases, Annotated sequence database, genome and organism-specific database, miscellaneous database, Data retrieval with ENTREZ and DBGET/LinkDB, Data retrieval with sequence similarity searches (SRS), Transcription Regulatory Regions Database (TRRD). Applications of Bioinformatics: study of phylogenetics, building phylogenetic trees, molecular phylogeny, pharmainformatics, cheminformatics, protein interaction informatics. Biological macromolecular structures and structure prediction methods. Introduction of various software used in biotechnology research and development.

**BTG 399: Industrial Attachment (12 Weeks)**
**3 Units C: PH 135)**

**Course Contents**
Students should be attached to relevant industrial organizations for 12 Weeks preferably during the long vacation for appropriate experience. Students should be assessed based on seminar presentations, written reports and supervisors' assessments.

**BTG 301 – Enzymology**
**(2 Units Core: LH 30**)

**Course contents**
Discovery, classification and nomenclature of enzymes; Vitamins and co-enzymes; minerals in enzyme biochemistry; Fat and water soluble vitamins; Structures and functions of vitamins and co-enzymes; Genetics of enzymes; Enzyme inhibition; Mechanisms of enzyme-catalysed reactions; Effects of temperature, pH, ions and inhibitors on enzyme catalysed reactions; Derivation and significance of Michaelis-Menten equation; Allosteric/Regulatory enzymes; Active sites of enzymes; Estimation of kinetic parameters of enzyme activities; Zymogen activation, digestive enzymes etc.; Production, isolation, purification and characterization of enzymes; Recent advances in enzymology.

**BTG 307: Introduction to Food and Nutrition (2 Units Core: LH 30)**

**Course contents**

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, greens 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.

**BTG 308: Development and Conservation of Natural Resources**
**(2 Units Core: LH 30)**

**Course contents**

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 co-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, germplasm appropriation and privatization for crop improvement. Patents and plant breeders' rights, production of improved plants and animals.

## 400 Level

**BTG 401: Biotechnology Seminar**
**(2 Units C: LH 30)**

**Course Contents**
Development of communication skills needed by professionals in the field of biotechnology through students' oral presentations. Topics should address contemporary issues in biotechnology. They may be topics taught in the class or seminar topics given by academic staff. Topics are to be presented orally in a centre of guided studies made of departmental academic staff, students and the interested populace. Three copies of such well-articulated work should be bound and presented to the department.

**BTG 402: Bio-safety and Bioethics**
**(1 Unit C: LH 15)**

**Course Contents**
**Biosafety**: History, evolution and concept of biosafety. Application of biosafety in laboratories and industries. Biosafety guidelines and regulations. National and international standards of biosafety. Implementation of biosafety standards and guidelines. Biosafety levels, design of clean rooms, biosafety cabinets, risk assessment and containment levels. Biohazard and hazardous wastes. Biosafety protocol to protect nature. Good laboratory practice, good manufacturing practice, use of genetically modified organisms and their release, risks of GMOs for human and the environment.

**Bioethics**: Introduction and need of bioethics, its relation with other branches. Risk assessment and management in bio-industries, safety guideline in biotechnology laboratories and industries. Types of risks associated with genetically modified organisms, ethical issues in GMOs, ethics related to human cloning, human genome project, prenatal diagnosis, animal rights, data privacy of citizens' health. Ethical issues in various biotechnology products and services, sperm bank; sperm/ovule donation (sales), designer babies, organ donation/sale. Social economic impact of biotechnology.

**BTG 403: Environmental Biotechnology**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
Air pollution, sources of air pollution. Geen house gases, sources and properties. Biofixation of atmospheric carbon dioxide, NOx, SOx, and other air pollutants. Air filtration systems. Consequences of air pollution: global warming-meaning, mechanisms and consequences. Water pollution, sources, effects and consequences. Pollution of underground water. Biodetoxification of polluted water. Plastic pollution of the environment, impacts and consequences on the aquatic biodiversity and ecosystems. Wastewater treatment systems (trickling filters, oxidation pounds, anaerobic sludge digestion, activation processes and many more). Soil pollution: types and sources of soil pollutants. Bio-degradation, bio-detoxification, bio-adsorption, and bio-accumulation of contaminants. Bioremediation of contaminated soils (bio-stimulation, bio-augmentation),

phyto-remediation, mycoremediation. Solid wastes: disposal, composting and recycling. Green biotechnology: concepts and definition, zero emission systems, closed life support systems, waste recycling, production of bio-degradable plastics, bio-insecticides, bio-fertilizers. Prevention of erosion and desertification through breeding for tolerance to abiotic factors. Contemporary issues in environmental biotechnology. Biotechnological control of green house gases and emissions. Biotechnology in combating and mitigating climate change.

**BTG 404: Medical Biotechnology**
**(2 Units C: LH 30)**

**Course Contents**

Industrial production of monoclonal antibodies. Vaccine production. ELISA and PCR – based diagnostic kits; other molecular biology-based medical diagnosis. Bioengineering of drugs, drug delivery systems, tissue culture and grafting. Stem cell culture and transplanting, bone marrow cell culture and transplanting, cartilage cell culture and transplanting. Production of artificial cells and artificial organs, biocompatible polymer production. Gene and diseases, gene therapy. Reproduction biotechnology: sperm and ovule preservation, in-vitro fertilization and embryo transplanting, artificial womb.

**BTG 405: Industrial Biotechnology**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
Micro-organisms 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. An overview of bio-industries; production of various classes of useful metabolites (health care products, food and beverage products (distilled and non-distilled alcoholic beverages; fermented milk products such as cheese and yoghurt), industrial chemicals and bio-chemicals (amino acids, organic acids, vitamins, antibiotics, colouring agents), single cell proteins, bio-insecticides, biofertilisers. Fermentation economics. Development and prospects of enzyme technology. Bioconversion of waste into useful industrial products.

**BTG 406: Plant Biotechnology**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
Organization of plant cells. Photosynthesis: light and dark phases of photosynthesis; the C3 and C4 plants and their pathways. Phyto-hormones and other plant regulators. Plants tissue culture, techniques for rapid multiplication of planting materials, clonal propagation. Plant breeding objectives, traits of interest for field crops, traits of interest for fruits and vegetable crops, traits of interest for ornamentals and medicinal. Feasibility of trait, choice of cultivar type. The

cycle of selection, gains from selection, development of inbred cultivars, development of commercial hybrids. Engineering of crops for improved yield, improve seedlings, diseases, pest and herbicide resistance, improved resistance to abiotic factors (droughts, salt, soil acidity, nutritional deficiency). Non-regulated commercial transgenics**,** FlavrSavr tomato history, roundup-ready soybeans**,** BT cotton and corn, virus-resistant papaya**,** other deregulated products. Commercial transgenics, herbicide resistant crops, trends and future direction. Regulatory considerations for transgenics: laboratory and commercial, State and federal regulations for transgenics, intellectual property, public perception of genetically modified plants, horizontal gene transfer and transgene escape, registration and commercialization – procedures and costs.

**BTG 407: Research Project in Biotechnology**
**(6 Units C: PH 270)**

**Course Contents**

Students are required to carry out an independent research into selected areas of biotechnology. Students will be required to survey on the topics, perform experiments and produce a written reports at the end of the semester. Students will be examined on the project undertaken orally. Projects embarked upon should emphasis biochemical principles and mechanics.

**BTG 433: Biotechnology Entrepreneurship**
**(2 Units C: LH 30)**

**Course Contents**

This course provides definitions and concepts in biotechnology entrepreneurship. Going from biotech bench to marketplace. Compilation of the different products of biotechnological origin with applications in agriculture, pharmaceuticals, medicine and the environment. How to write a biotechnological specific business plan. Market surveys, turning community specific problem to business opportunity. Raising funds for start-ups. Procurement processes. Industrial production of biotechnological products and scale up steps. Role and functions of scientists in the biotechnology industry. Entrepreneurship: role of universities in supporting academic entrepreneurship, limiting factors on biotechnology entrepreneur. Firm development instruments. Biotechnology intellectual property, models and technology transfer. Marketing biotechnological patents, pitching and investor wooing strategies. The biotechnological value chain of a model business (biopharmaceutical). Business strategy models of biotechnological firms, strategic alliances, and acquisitions of biotechnology firms, strategic decision making. Financing aspects of biotechnology entrepreneurship, equity, shares and options, raising money, going public, networking. Inventory and stock taking; media & public relations; risk management and Insurance.

**BOT406: Plant Pathology**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
Principles and concepts in plant pathology. The concept of disease, infection, pathogenesis, host- pathogen relationship. Methods and theory of biological therapy and chemotherapy. Disease inciting organisms. Symptoms of plant diseases. Defense mechanisms. Principles of plant disease control. Methods of studying plant diseases. Biopesticides in deceases management. The method of studying nematodes diseases of plants.

**BTG 408: Metabolic Engineering**
**(2 Units Core: LH 30)**

**Course contents**
Regulation of metabolism, induction, nutritional repression, feedback regulation, metabolic control mechanisms; regulatory mechanism of carbohydrates metabolism; regulation of protein and amino acid synthesis; Regulation of biosynthetic pathways in prokaryotes and eukaryotes, feedback resistance mutation.

**BTG 409: Intellectual Property Rights**
**(2 Units Core: LH 30)**

**Course contents**
Description of Intellectual property (IP) rights; Goals, objectives and scope of IP policy in Khairun; Coverage of the IP policy; Ownership of IP assets; Rights and obligations of

inventor/innovator/author/ researcher; Disclosure and reporting of research activities with IP potentials/ value; Confidentiality; Management of IP; Research collaboration; Commercialization of intellectual property; Distribution of Income derived from the commercialization of IP assets; Ownership of innovations and/or inventions; Appropriate methods of dispute resolution on issues of IP rights.

**BTG 410: Analytical Method in Microbiology**
**(2 Units Core: LH 15, PH 45)**

**Course contents**
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 411: Process Biotechnology**
**(2 Units Core: LH 30)**

**Course contents**
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 downstream separation and purification protocols employed.

# B.Sc. Forensic Science

**Overview**

Forensic science is defined as the application of scientific methods and processes in solving crime, both civil and criminal. During the course of an investigation, forensic scientists collect, preserve, and analyze scientific evidence. Physical evidence is collected from an object, person or crime scene, analyzed in a forensic laboratory and then the results presented in court. Each crime scene is unique and each case presents its own challenges.

The study of forensic science is grounded in fundamental concepts and techniques gathered from the natural sciences. The study involves a multi-disciplinary approach, largely covering biological methods and analytical chemistry techniques. Forensic science is, indeed, a multi-disciplinary and broad field, covering an array of sub-disciplines.

**Philosophy**

The Philosophy of Forensic Science Programme is to programme is to prepare graduates with necessary skills and knowledge to examine and analyse evidence from crime scenes, and/or suspects to develop findings that can assist crime investigation and prosecution.

**Objectives**

The principal objectives of the programme are:

1. students will develop a thorough understanding of modern scientific principles of crime scene investigation, particularly evidence collection and preservation;

2. students will receive intensive training in forensic laboratory methodology so as to examine and analyse evidences.

3. students will develop effective written and oral communication skills for presentation of their findings in the court of law;

4. students will develop and appreciate the importance of interaction between law and enforcement agents, scientists and legal professionals;

5. students will develop and appreciate the importance of a high sense of professionalism and ethical behaviour; and

6. students will acquire advanced knowledge through research studies.

**Unique Features of the Programme**
Forensic Science is unique in the following respects: 1. applies the methods and techniques of all the established sciences to legal matters; 2. uses unique investigative techniques in the evaluation of samples taken at crime scenes; and 3. addresses issues associated with the law.

**Employability Skills**
1. Analytical Chemist
2. Arson & Fire Investigator
3. Ballistics Expert

4. Blood Spatter Analyst
5. Biomedical Scientist
6. Crime Scene Investigator
7. Crime Lab Analyst
8. Crime Scene Photographer
9. Computer Forensic Investigator
10. Detective
11. Digital Forensic Analyst/Officer
12. Fingerprint Analyst
13. Forensic Accountant
14. Forensic Anthropologist
15. Forensic Artist
16. Forensic Ballistics Analyst
17. Forensic Hypnotist
18. Forensic Investigator
19. Forensic Odontologist
20. Forensic Pathologist
21. Forensic Serologist
22. Forensic Scientist
23. Forensic Psychologist
24. Forensic Toxicologist

25. Latent Print Examiner

26. Mobile Forensic Analyst

**21st Century Skills**

1. Critical thinking (quantitative reasoning and problem solving)
2. Computer proficiency
3. Observation and attention to details
4. Interpersonal skills
5. Public speaking
6. Oral and written presentation

## Admission and Graduation Requirements

### Admission Requirements

Candidates can be admitted into the B. Sc. Forensic Science degree programme by one of the following two ways:

1. Indirect Entry
2. Direct Entry (DE)

**Indirect Entry Mode (JAMP – UTME)**

The minimum academic requirement is a credit level passes at Senior Secondary Certificate (SSC) in English Language, Mathematics, Biology, Chemistry and Physics at not more than two sittings. In addition, an acceptable pass in the following Unified Tertiary Matriculation Examination (UTME) subjects is also required for admission into 100 Level: English, Biology, Chemistry and Physics.

**Direct Entry Mode**

Candidates seeking admission into B. Sc. Forensic Science programme through Direct Entry must have two passes at GCE 'A' Level/IJMB or its equivalent in Biology, Chemistry or Physics to be considered for admission into 200 Level.

**Graduation Requirements**

To qualify for the award of B.Sc. Forensic Science degree, a student must satisfy the following requirements:

- pass a minimum of 120 Units (for UTME candidates) and 90 Units (for DE candidates) including all compulsory courses.

## Global Course Structure

### 100 Level

| Course Code | Course Title | Units | Status | LH | PH |
|---|---|---|---|---|---|
| GST 111 | Communication in English | 2 | C | 15 | 45 |
| GST 112 | Nigerian Peoples and Culture | 2 | C | 30 | |
| COS 101 | Introduction to Computing Sciences | 3 | C | 30 | 45 |
| MTH 101 | Elementary Mathematics I | 2 | C | 30 | - |
| MTH 102 | Elementary Mathematics II | 2 | C | 30 | - |
| FRS 102 | Introductory Forensic Science | 2 | C | 30 | - |
| CHM 101 | General Chemistry I | 2 | C | 30 | - |
| CHM 102 | General Chemistry II | 2 | C | 30 | - |
| CHM 107 | General Chemistry Practical I | 1 | C | - | 45 |
| CHM 108 | General Chemistry Practical II | 1 | C | - | 45 |
| BIO 101 | General Biology I | 2 | C | 30 | - |
| BIO 102 | General Biology II | 2 | C | 30 | - |
| BIO 107 | General Biology Practical I | 1 | C | - | 45 |
| BIO 108 | General Biology Practical II | 1 | C | - | 45 |
| PHY 101 | General Physics I | 2 | C | 30 | - |

| **Course Code** | **Course Title** | **Units** | **Status** | **LH** | **PH** |
|---|---|---|---|---|---|
| PHY 102 | General Physics II | 2 | C | 30 | - |
| PHY 107 | General Physics Practical I | 1 | C | - | 45 |
| PHY 108 | General Physics Practical II | 1 | C | - | 45 |
| | **Total** | **31** | | | |

**200 Level**

| Course Code | Course Title | Units | Status | LH | PH |
|---|---|---|---|---|---|
| GST 212 | Philosophy, Logic and Human Existence | 2 | C | 30 | - |
| ENT 211 | Entrepreneurship and Innovation | 2 | C | 15 | 45 |
| CYB 201 | Fundamentals of Cyber Security I | 1 | C | 15 | - |
| FRS 201 | Footwear and Tire Track Examination | 2 | C | 30 | - |
| FRS 203 | Forensic Audio and Video Analysis | 2 | C | 30 | - |
| FRS 205 | Forensic Entomology | 2 | C | 30 | - |
| LAW 211 | Criminal Law for Forensic Scientists | 2 | C | 30 | - |
| PSY 215 | Forensic Psychology | 2 | C | 30 | - |
| CYB 202 | Fundamentals of Cyber Security II | 2 | C | 30 | - |
| FRS 202 | Crime Scene Investigation | 2 | C | 30 | - |
| FRS 204 | Trace Evidence | 2 | C | 30 | - |
| FRS 206 | Forensic Microbiology | 2 | C | 30 | - |

| **Course Code** | **Course Title** | **Units** | **Status** | **LH** | **PH** |
|---|---|---|---|---|---|
| LAW 212 | Introduction to Criminal Justice Administration | 2 | C | 30 | - |
| BCH 201 | General Biochemistry I | 2 | C | 45 | - |
| BCH 202 | General Biochemistry II | 2 | C | 45 | - |
| CHM 211 | Organic Chemistry I | 2 | E | 30 | |
| CHM 213 | Analytical Chemistry I | 2 | E | 30 | |
| CHM 212 | Inorganic Chemistry I | 2 | E | 30 | |
| CHM 207 | General Chemistry Practical III | 1 | E | - | 45 |
| CHM 208 | General Chemistry Practical IV | 1 | E | - | 45 |
| BIO 201 | Genetics I | 2 | E | 30 | - |
| BIO 208 | Biostatistics | 2 | E | 30 | - |
| MCB 221 | General Microbiology | 2 | E | 15 | 45 |
| | **Total** | **41** | | | |

**300 Level**

| Course Code | Course Title | Units | Status | LH | PH |
|---|---|---|---|---|---|
| GST 312 | Peace and Conflict Resolution | 2 | C | 30 | - |
| ENT 312 | Venture Creation | 2 | C | 15 | 45 |
| FRS 301 | Introduction to Forensic Serology | 2 | C | 30 | - |
| FRS 303 | Forensic Practical I | 1 | C | - | 45 |
| FRS 307 | Research Methodology | 3 | C | 45 | - |
| FRS 308 | Forensic Practical II | 1 | C | - | 45 |
| FRS 302 | Fingerprint | 2 | C | 30 | - |
| FRS 305 | Forensic Odontology | 2 | C | 30 | - |
| FRS 306 | Forensic Toxicology | 2 | C | 30 | - |
| FRS 399 | SIWES | 3 | C | - | 12 weeks |
| CHM 302 | Inorganic Chemistry II | 2 | E | 30 | - |
| CHM 303 | Organic Chemistry II | 2 | E | 30 | - |

| Course Code | Course Title | Units | Status | LH | PH |
|---|---|---|---|---|---|
| CHM 312 | Analytical Atomic Spectroscopy | 2 | E | 30 | - |
| CHM 316 | Applied Spectroscopy | 2 | E | 30 | - |
| BCH 310 | Biochemistry and Molecular Biology of microorganism | 2 | E | 30 | - |
| BIO 301 | Genetics II | 2 | E | 30 | 45 |
| MCB307 | Immunology | 2 | E | 30 | - |
| CYB 305 | Digital Forensics and Investigation Methods | 2 | E | 15 | 45 |
| SEN 301 | Object-Oriented Programming | 2 | E | 15 | 45 |
| | **Total** | **38** | | | |

**400 Level**

| Course Code | Course Title | Units | Status | LH | PH |
|---|---|---|---|---|---|
| FRS 401 | Introduction to Questioned Documents | 2 | C | 30 | - |
| FRS 402 | Forensic Pathology | 2 | C | 30 | - |
| FRS403 | Forensic Ballistics | 3 | C | 45 | - |
| FRS 404 | DNA Fingerprinting | 2 | C | 30 | - |
| FRS 405 | Forensic Practical III | 2 | C | - | 90 |
| FRS 406 | Forensic Practical IV | 2 | C | - | 90 |
| FRS 404 | Forensic Anthropology | 2 | C | 30 | - |
| FRS409 | Applied Forensic Physics | 2 | C | 30 | - |
| FRS 410 | Entrepreneurship for Forensic Scientists | 2 | C | 30 | - |
| FRS 499 | Final Year Research Project | 6 | C | - | 270 |
| CHM 410 | Analytical Chemistry II | 2 | C | 30 | |
| FRS 401 | Explosive Chemistry | 2 | C | 30 | |
| FRS 402 | Microscopy | 2 | C | 30 | |

| Course Code | Course Title | Units | Status | LH | PH |
|---|---|---|---|---|---|
| FRS 403 | Chemical Pathology | 2 | C | 30 | |
| FRS404 | Applied Forensic Biology | 2 | E | 30 | |
| FRS405 | Applied Forensic Chemistry | 2 | E | 30 | |
| | **Total** | **37** | | | |

## Course Contents and Learning Outcomes

### 100 Level

### GST 111: Communication in English
**(2 Units C: LH 15; PH 45)**

**Course Contents**

This course introduces the students to the sound patterns in English Language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). Sentence in English (types: structural and functional, simple and complex). Grammar and usage (tense, mood, modality and concord, aspects of language use in everyday life). Logical and critical thinking and reasoning methods (logic and syllogism, inductive and deductive argument and reasoning methods, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities: (pre-writing , writing, post writing, editing and proofreading; brainstorming, outlining, paragraphing. Types of writing: summary, essays, letter, curriculum vitae, report writing, note making etc. Mechanics of writing). Comprehension strategies: (reading and types of reading, comprehension skills, 3RsQ). Information and Communication Technology in modern language learning. Language skills for effective communication. Major word formation processes. Writing and reading comprehension strategies. Logical and critical reasoning for meaningful presentations. Art of public speaking and listening. Report writing.

**GST 112- Nigerian Peoples and Culture**
**(2 Units C: LH 30)**

**Course Contents**

To gives a background of Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and culture; peoples and culture of the ethnic minority groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; Colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; Nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concept of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigeria people; trade, skill acquisition and self-reliance). Social justices and national development (law definition and classification. Judiciary and fundamental rights. Individual, norms and values (basic Nigeria norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts. Cultism, kidnapping and other related social vices). Re-orientation, moral and national values (The 3R's – Reconstruction, Rehabilitation and Re-orientation; Re-orientation Strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline (WAI), War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation

Agency (NOA). Current socio-political and cultural developments in Nigeria.

**COS 101: Introduction to Computing Sciences**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
The course gives a brief history of computing. Description of the basic components of a computer/computing device. Input/output devices and peripherals. Hardware, software and human ware. Diverse and growing computer/digital applications. Information processing and its roles in society. The Internet, its applications and its impact on the world today. The different areas/programs of the computing discipline. The job specializations for computing professionals. The future of computing.

**Lab Work:** It is a lab based practical demonstration of the basic parts of a computer. Illustration of different operating systems of different computing devices including desktops, laptops, tablets, smart boards and smart phones. Demonstration of commonly used applications such as word processors, spreadsheets, presentation software and graphics. Illustration of input and output devices including printers, scanners, projectors and smart boards. Practical demonstration of the Internet and its various applications. Illustration of browsers and search engines. How to access online resources.

**MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)**

**Course Contents**

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

**MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)**

**Course Contents**

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

**FRS 102: Introductory Forensic Science (2 Units C: LH 30)**

**Course Contents**

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

**CHM 101: General Chemistry I**
**(2 Units C: LH 30)**

**Course Contents**
Atoms, molecules, elements and compounds and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridization and shapes of simple molecules. Valence Forces. Structure of solids. Chemical equations and stoichiometry; Chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry. Rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

**CHM 102: General Chemistry II**
**(2 Units C: LH 30)**

**Course Contents**
Historical survey of the development and importance of Organic Chemistry. Fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds. Determination of

structures of organic compounds including qualitative and quantitative analysis in organic chemistry. Nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The Chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

**CHM 107: General Chemistry Practical I**
**(1 Unit C: PH 45)**

**Course Contents**
The course is an expectation of laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

**CHM 108: General Chemistry Practical II**
**(1 Unit C: PH 45)**

**Course Contents**
Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

**BIO 101: General Biology I**
**(2 Units C: LH 30)**

**Course Contents**
Cell structure and organisation, functions of cellular organelles. Characteristics and classification of living things. Chromosomes, genes; their relationships and importance. General reproduction. interrelationships of organisms (competitions, parasitism, predation, symbiosis, commensalisms, mutualism, saprophytism). Heredity and evolution (introduction to Darwinism and Lamarkism, Mendelian laws, explanation of key genetic terms). Elements of ecology and types of habitat.

**BIO 102: General Biology II**
**(2 Units C: LH 30)**

**Course Contents**
This is a course that exposes the basic characteristics, identification and classification of viruses, bacteria and fungi.

A generalized survey of the plant and animal kingdoms based mainly on the study of similarities and differences in the external features. Ecological adaptations. Briefs on physiology to include nutrition, respiration, circulatory systems, excretion, reproduction, growth and development.

**BIO 107: General Biology Practical I**
**(1 Unit C: PH 45)**

**Course Contents**
It treat topic that have to do with the common laboratory hazards: prevention and first aid; measurements in biology. Uses and care of microscope: compound and dissecting microscope. Biological drawings and illustration, scaling, accuracy and proportion. Use of common laboratory apparatus and laboratory experiments designed to illustrate the topics covered in **BIO 101.**

**KHAIRUN-BIO 108: General Biology Practical II**
**(1 Unit C: PH 45)**

**Course Contents**
The course unit is on the Anatomy of flowering plants, primary vegetative body: stem, leaf and root to show the mature tissues namely parenchyma, collenchyma, sclerenchyma, xylem and phloem. Types of fruits and seeds. Care and use of dissecting kits and other biological wares. Dissection and general histology of animal tissues based on vertebrate forms. Morphology and functions of epithelial, muscular, nervous and connective tissues. Examination of various groups of lower invertebrates under microscopes, identification of various groups of organisms in Animal Kingdom and any experiment designed to emphasize the practical aspects of topics in BIO 102.

**PHY 101: General Physics I (Mechanics)**
**(2 Units C: LH 30)**

**Courses Contents**

Space and time. Units and dimension, Vectors and Scalars. Differentiation of vectors: displacement, velocity and acceleration. Kinematics. Newton laws of motion (Inertial frames, Impulse, force and action at a distance, momentum conservation). Relative motion. Application of Newtonian mechanics. Equations of motion. Conservation principles in physics. Conservative forces. Conservation of linear momentum. Kinetic energy and work. Potential energy. System of particles. Centre of mass. Rotational motion: Torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates. Conservation of angular momentum. Circular motion. Moments of inertia. gyroscopes and precession. Gravitation: Newton's Law of Gravitation. Kepler's Laws of Planetary Motion. Gravitational Potential Energy. Escape velocity. Satellites motion and orbits.

**PHY 102: General Physics II (Electricity & Magnetism)**
**(2 Units C: LH 30)**

**Course Contents**

This units provides details on the Forces in nature. Electrostatics; electric charge and its properties, methods of charging. Coulomb's law and superposition. electric field and potential. Gauss's law. Capacitance. Electric dipoles. Energy in electric fields. Conductors and insulators, current, voltage and resistance. Ohm's law and analysis of DC circuits.

Magnetic fields. Lorentz force. Biot-Savart and Ampère's laws. magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz's laws. Step up and step-down transformers: Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, resistance, and combinations.

**PHY 107: General Practical Physics I**
**(1 Unit C: PH 45)**

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

**PHY 108: General Practical Physics II**
**(1 Unit C: PH 45)**

**Course Contents**
This is a practical course that is basically, a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on

quantitative measurements. The treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

## 200 Level

### GST 212: Philosophy, Logic and Human Existence
**(2 Units C: LH 30)**

**Course Contents**

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

### ENT 211: Entrepreneurship and Innovation
**(2 Units C: LH 15; PH 45)**

**Course Contents**

Concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship,). Theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship and creative destruction). Characteristics of entrepreneurs (opportunity seeker, risk taker, natural and nurtured, problem solver and change agent, innovator and creative thinker). Entrepreneurial thinking (critical thinking, reflective thinking, and creative thinking).

Innovation (concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business Plan, forms of business ownership, business registration and forming alliances and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office, networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce

**CYB 201: Fundamentals of Cyber Security I**
**(1 Unit C: LH 15)**

**Course Contents**

The topics in this unit include basic concepts on CIA (Confidentiality, Integrity, and Availability). methodologies for implementing security policies. best current practices, testing security, and incident response. risk management. disaster recovery. access control. basic cryptography and software application vulnerabilities.

**FRS 201: Footwear and Tire Track Examination**
**(2 Units C: LH 30)**

**Course Contents**

This course unit describes the types of footwear and tire track evidence examined in forensics. Procedure of sample collection (adhesive lifter, gelatin lifter, electrostatic dust printing, etc.). Evidence detection, recovery, and handling procedure. Laboratory and photography procedure. Courtroom testimony and legal issues, casework. Comparison of collected evidence to known impressions, impressions connected to other crimes and evidence stored in databases' Imprints and impression characteristics (class, individual and wear characteristics). Uses of footwear and tire track examination

**FRS 203: Forensic Audio and Video Analysis**
**(2 Units C: LH 30)**

**Course Contents**
Meaning of forensic audio analysis and forensic video analysis. Types of audio and video evidence. Collection of audio and video evidence for forensic analysis. Repair and recovery of audio and video evidence for forensic investigations. Audio and video evidence enhancement techniques used to assist investigators, jurors and attorneys. Analysis, interpretation and identification of audio and video recordings (authentication of recordings, Identifying people and objects on recordings). Uses of audio and video recordings in legal matters

**FRS 205: Forensic Entomology**
**(2 Units C: LH 30)**

**Course Contents**
Meaning and historical development of forensic entomology. Stages in the decomposition of a carrion. Arthropods involved with post-mortem changes of the human body. Collecting,

preserving and packaging specimens. Estimating post-mortem index (PMI). DNA analysis for species identification. Scanning electron microscopy and potassium permanganate staining. Applications of forensic entomology. Limitations of forensic entomology.

**LAW 211: Criminal Law for Forensic Scientists**
**(2 Units C: LH 30)**

**Course Contents**
The course provides students with the basic introduction to the elements of evidence law. Expert Witness Testimony. Ingredients of establishing offences. Specific offenses relating to homicide and non-fatal offenses. Police: history and structure. Police administration. Juvenile delinquency. Drug abuse. Relevant provisions of Motor Vehicle Act, 1 (offenses and penalties). Relevant provisions of Nigerian Penal Code.

**PSY 215: Forensic Psychology**
**(2 Units C: LH 30)**

**Course Contents**
This is to do with the concept and scope of forensic psychology, techniques and processes of forensic investigations, art of identification of incidence, psychological approaches to interrogations and confessions using psychological skills; crime and delinquency, psychopathic behaviours and society, juvenile offender, social and psychological implications of legal judgements; crime culture and prevention, the reliability of eye witness testimony, construction of the personality profile of criminals; role of

psychologists in the criminal justice system (court room), the mental health of the offender and mental health legislation.

**CYB 202: Fundamental of Cyber Security II**
**(2 Units C: LH 30)**

**Course Contents**
Operating system protection mechanisms. Intrusion detection systems. Formal models of security. Cryptography. Steganography. Network and distributed system security. Denial of service (and other) attack strategies, worms, viruses. Transfer of funds/value across networks. Electronic voting. Secure applications. Homeland cyber security policy, and government regulation of information technology.

**FRS 202: Crime Scene Investigation**
**(3 Units C: LH 45)**

**Course Contents**
The course describes Crime Scene: definition and types of crime scenes (primary and secondary crime scenes); general crime scene, procedures: crime scene management; role of forensic scientists, forensic doctors, fire brigade and judiciary, maintaining the chain of custody; securing, protecting and recording the crime scene: forensic photography, sketching and field notes; definition, importance and types of physical evidences; collection and preservation of physical evidences, and forwarding to the forensic laboratory in crimes like murder, theft, extortion, explosion etc.; investigation and sketching of indoor and outdoor scenes of crime using triangulation method and baseline method; collection and

packaging of different types of evidences; collection and handling of toxicological, hit and run crime scene and fire crime scene samples; analysis of different types fibres; examination of soil and paints samples

**FRS 204: Trace Evidence**
**(3 Units C: LH 45)**

**Course Contents**
Physical properties of evidence (temperature, weight, density and refractive index). Physical evidence like soil, glass, fiber, hair and liquids. Forensic examination of glass: composition of glass, measuring and comparing physical properties of glass. Classification of glass samples. Comparison of glass fragments and fractures. Collection and preservation of glass evidence. Forensic analysis and examination of soil–colour, density, size distribution of particles, mineral and chemical analysis of soil. Variations in soil, collection and preservation of soil evidence. Types of paints and their composition, macroscopic and microscopic studies, pigment distribution, micro-chemical analysis- solubility test and other necessary analytical techniques helping in the interpretation of paint evidence. Fibers: classification of fibers and preliminary examination. Identification and comparison of manufactured fibres, significance of match. Collection and preservation of fiber evidence. Antigen-antibody reaction (blood groupings). Studying the morphology of different plant parts. Study of conducting tissue- Xylem and phloem elements in angiosperms and gymnosperms as seen in L.S. and R.L.S.. Study of fungal colonies by using PDA culture. Separation of dyes by TLC and paper chromatographic techniques.

**FRS 206: Forensic Microbiology**
**(2 Units C: LH 30)**

**Course Contents**
The course describes what is Forensic Microbiology and all its relevant components. Definition and scope of forensic microbiology. Bioterrorism, agro-terrorism and biological warfare. Types of samples collected. Sample collection. Sample matrix analysis. Water sample analysis. DNA profiling. Techniques used in elucidating causative biological agents. Investigating a suspected bioterrorist attack. Postmortem microbiology (PMM) analysis. Applications of forensic microbiology.

**LAW 212: Introduction to Criminal Justice Administration**
**(2 Units C: LH 30)**

**Course Contents**
What is criminal Justice and its theories aspects? Definition of criminal justice. Aspects of the procedure and practice of the criminal process. Concepts and principles underlying criminal law; The crime picture; causes of crime; Criminal law; the legal environment; the court: the courtroom workgroup; Sentencing; Probation and parole; Prisons; The future of criminal justice

**BCH 201: General Biochemistry I**
**(2 Units C: LH 30)**

**Course Contents**
Introductory chemistry of amino acids, their properties, reactions and biological functions. Classification of amino acids: neutral, basic and acidic; polar and non-polar; essential and non-essential amino acids. Peptides. Introductory chemistry and classification of proteins. Biological functions of proteins. Methods of their isolation, purification and identification. Primary, secondary, tertiary and quaternary structures of proteins. Basic principles of tests for proteins and amino acids. Introductory chemistry of carbohydrates, lipids and nucleic acids. Nomenclature of nucleosides and nucleotides, effects of acid and alkali on hydrolysis of nucleic acids.

**BCH 202: General Biochemistry II**
**(2 Units C: LH 30)**

**Course Contents**
This is on the cell theory: Structures and functions of major cell components. Cell types, constancy and diversity. Cell organelles of prokaryotes and eukaryotes. Chemical composition of cells. Centrifugation and methods of cell fractionation. Structure, function and fractionation of extra-cellular organelles. Water, total body water and its distribution. Regulation of water and electrolyte balance. Disorder of water and electrolyte balance. Acidity and alkalinity, pH and pK values and their effects on cellular activities.

**CHM 211: Organic Chemistry I**
**(2 Units E: LH 30)**

**Course Contents**
The course contents of Organic Chemistry is about the Chemistry of aromatic compounds. Structures of simple sugars, starch and cellulose, peptides, and proteins. Chemistry of bifunctional compounds. Energetics, kinetics, and the investigation of reaction mechanisms. Mechanisms of substitution, elimination, addition, and rearrangement reactions. Stereochemistry. Examples of various named organic reactions e.g., Grignard reaction, Aldol and related reactions. Simple alicyclic carbon compounds and their synthesis.

**CHM 212: Inorganic Chemistry I**
**(2 Units E: LH 30)**

**Course Contents**
It contains the Chemistry of first row transition metals. Introduction to coordination 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 organometallic chemistry. Role of metals in biochemical systems. Concepts of hard and soft acids and bases. Oxidation and reduction reactions. Sciences 310 New.

**CHM 213: Analytical Chemistry I**
**(2 Units E: LH 30)**

**Course Contents**
This is about the theory of errors; and statistical treatment of data: Theory of sampling. Chemical methods of analysis including volumetric, gravimetric, data analysis. Presentation and physicochemical methods. Optical methods of analysis; separation methods.

**CHM 207: General Chemistry Practical III**
**(1 Unit E: PH 45)**

**Course Contents**
The course aims to describe the Ph measurement determination of relative molar mass from colligative properties. The demonstration of partition coefficient in two immiscible solvents. Temperature measurement and heat of dissolution. Heat of neutralisation. Determination of critical solution temperature of water- phenol system ideal gas law: measuring the molar volume of a gas and the universal gas constant.

**CHM 208: General Chemistry Practical IV**
**(1 Unit E: PH 45)**

**Course Contents**
This is about the preparation of esters. Preparation of aldehydes and ketones. Vinegar analysis, chromatography. Thin layer chromatography. Dehydration of alcohol groups. Qualitative analysis of common functional groups.

**BIO 201 – Genetics**
**(2 Units E: LH 30, PH)**

**Course contents**

It contains the molecular basis of heredity; chromosome structure; patterns of Mendelian and non-Mendelian inheritance; evolution; biotechnological applications; Hereditable and non-hereditable characteristics; Probability and tests of goodness of fit; Quantitative inheritance; variation in genome structure; introduction to population genetics.

**BIO 208: Biostatistics**
**(2 Units E: LH 30)**

**Course Contents**

Variability in biological data: continuous and discontinuous variables. Statistical sampling procedures. Observations and problems of estimation. Representation and summarization of biological data. Frequency distribution. Measures of central tendency and dispersion. Probability theory. Normal, binomial and Poisson distribution. T-test, f-test and chi-square test. Analysis of variance (ANOVA) and covariance. Principles of experimental design. Correlation, linear and curvilinear regression and transformation.

**MCB 221: General Microbiology**
**(2 Units E: LH 15; PH 45)**

**Course Contents**

The General Biology is about the History of the Science of Microbiology. Classification of organisms into prokaryotes and eukaryotes. Classification of prokaryotes into archaea and eubacteria. Anatomy and cytochemistry of bacteria and fungi; shapes, groupings and colonial morphology of bacteria and fungi. Structure of viruses. Sterilization and disinfection. Structure, ecology and reproduction of representative microbial genera. Culture of micro-organisms. Isolation of micro-organisms. Isolation of bacteria, viruses fungi (yeasts and moulds, nutrition and biochemical activities of micro-organisms. Antigens and antibodies. Identification and economic importance of selected microbial groups. Microbial variation and heredity. Study of laboratory equipment. Introduction to microbiology of air food, milk, dairy products, water and soil. Staining techniques, antibiotic sensitivity tests, serological tests, antimicrobial agents.

## 300 Level

### GST 312: Peace and Conflict Resolution
### (2 Units C: LH 30)

**Course Contents**

Introduces the students of the level 300 to the basic Peace and Conflict Resolution; concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic and geo-political conflicts. Structural conflict theory, realist theory of conflict and frustration-aggression conflict theory. Root causes of conflict and violence in Africa: indigene and settlers' phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes, religious disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations, selected conflict case studies – Tiv-Junkun, Zango Kataf, Aguleri/Omuleri; Ife/Modakake; Native Borom/Fulani settlers in Plateau, chieftaincy and land disputes and many more. peace building, management of conflicts and security, peace & human development. Approaches to peace & conflict management: (religious, government, community leaders and many more.). Elements of peace studies and conflict resolution, conflict dynamics assessment scales: constructive & destructive. Justice and legal framework and concepts of social justice. The Nigeria legal system. Insurgency and terrorism. Peace Mediation and Peace Keeping. Peace and security council (international, national and local levels). Agents of conflict resolution: conventions, treaties, community policing, evolution and imperatives. Alternative dispute resolution (ADR): a). dialogue b). arbitration c).

negotiation d). collaboration and many more Roles of international organizations in conflict resolution: (a). The United Nations (UN) and its conflict resolution organs. (b). The African Union & Peace Security Council (c). ECOWAS in peace keeping. Media and traditional institutions in peace building. Managing post-conflict situations/crisis: refugees. internally displaced persons (IDPs). The role of NGOs in post-conflict situations/crisis.

**ENT 312: Venture Creation**
**(2 Units C: LH 15; PH 45)**

**Course Contents**

This is meant to address the students of Entrepreneur and skill acquisition. To provides Opportunity Identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (Venture capital, equity finance, micro finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, first mover advantage, E-commerce business models and successful E-Commerce companies,). Small business management/family business: leadership & management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (the concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - Artificial Intelligence (AI), Virtual/Mixed Reality (VR), Internet of Things (IoTs), Blockchain, Cloud Computing, Renewable Energy etc. Digital Business and E-Commerce Strategies).

**FRS 301: Introduction to Forensic Serology**
**(2 Units C: LH 30)**

**Course Contents**

The course introduces the students to among others, Blood: The nature of blood, blood components and their functions, identification of bloodstains by microscopic methods. Tests used in blood analysis: catalytic and crystal tests. ABO, Rh and MN systems. Use of spectrophotometric, chromatographic and immunological methods in blood analysis. Determination of species of origin, Ring test, single diffusion, double diffusion, crossed-over electrophoresis. Grouping of blood stains: techniques for the determination of blood groups from bloodstains. Composition and examination of biological fluids such as saliva, semen, vaginal fluid, urine and sweat. Protection, packaging and transportation of biological evidences. Bloodstain pattern interpretation: Properties of human blood, target surface considerations, size, shape and directionality of bloodstains, spattered blood, other bloodstain patterns, interpretation of bloodstain on clothing and footwear. Documentation and photography for bloodstain pattern analysis. Preservation of blood evidence; procedures and precautions

**FRS 303: Forensic Practical I**
**(1 Unit C: PH 45)**

**Course Contents**
This is about Blood Group analysis from fresh and old blood stains. Catalytic and crystal tests for blood. Determination of species of origin; Blood stain pattern analysis. Analysis of biological fluids (semen, saliva, sweat, urine). Photography of bite marks and skid marks. Preparation of permanent slides by using maceration technique of various forensic materials of plant origin. Study of pollen grains and spores of forensic significance. Identification of pollen grains and diatoms. Study of life cycle of blowflies. Study of structure of hair; Finding results of different logic gates and their combinations; Working with Windows – File (creation, modification, deletion, attributes), Folder (creation, nesting, attributes). Working with Linux – File (creation, modification, deletion, attributes), Various commands on Linux (basic utility commands e.g. Date Viva-Voce, Cal etc.). Obtaining the system and process information (Windows)

**FRS 304 - Forensic Anthropology**
**(2 Units C: LH 30)**

**Course Contents**
It foregrounds what is the meaning and historical overview of forensic anthropology; Types of evidence examined (single bone or bone fragment and complete or nearly complete

skeleton); Modern uses of Forensic Anthropology; Determination of sex; Determination of stature; Determination of age; Determination of ancestry; Determination of time of death; Recent advances in forensic anthropology: molecular analysis of skeletal evidence, biomechanics of bone trauma; Bone microscopy; isotope analysis; facial imaging and forensic facial reconstruction

**FRS 308: Forensic Practical II**
**(1 Units C: PH 45)**

**Course Contents**
It is the second aspects of forensic analysis, that explains the making of fingerprints on fingerprint cards and identifying the pattern. Development of fingerprints using powder and chemical methods. Classification of fingerprints. Lifting and identification of latent fingerprints. Lifting and identification of footprints and shoe prints. Analysis of metallic poisons; Analysis of volatile and non-volatile poisons. TLC of insecticides, Barbiturates and other drugs. Analysis of vegetable poisons. Estimation of height and weight using long bones. Determination of age from skull sutures and teeth. Determination of sex from skull and pelvis.

**FRS 302: Fingerprint**
**(2 Units C: LH 30)**

**Course Contents**
This is the study of Fingerprinting: History and Development of fingerprints. Classification of fingerprints by the Henry System. Extension of Henry system, Single digit

classification, Fingerprint Bureau. Principles of fingerprints, importance, nature and location. Fingerprints as evidence: its recognition, collection and preservation. Biological significance of skin pattern, ridge formation, counting and tracing. Important figures in the field of fingerprints, fingerprint patterns, general and individual characteristics of fingerprints. Fingerprints and other impressions: taking fingerprints from living and dead persons. Other Impressions: Tyre marks, tool marks (compression marks, striated marks, combination of compression and striated marks, repeated marks), lip prints and foot print examinations. Latent fingerprints and chance fingerprints in criminal investigation. Investigating the latent fingerprints, Various methods of development of fingerprints and other impression marks: conventional, physical and chemical, fluorescent, magnetic powder, fuming, laser methods. Lifting of latent fingerprints. Restoration of erased/obliterated marks: Method of making cast, punch, engrave, obliteration, restoration, etching (etchings for different metals), magnetic, electrolytic etc. Recording of restored marks – restoration of marks on wood, leather and polymer. Presentation of fingerprints and other impressions as evidences in court.

**FRS 305 - Forensic Odontology**
**(2 Units C: LH 30)**

**Course Contents**
This is about the definition and history of forensic odontology. Uses of forensic odontology. Methods and applications of forensic odontology. Identification of unknown remains: positive identification, possible identification, insufficient

evidence, and exclusion. Determination of species by DNA analysis: collection of specimens, reference samples, saliva, teeth and storage. Age estimation by examination of developmental and degenerative changes. Sex determination by craniofacial morphology and dimensions, sex differences in tooth dimension, tooth morphology and DNA analysis. Bite mark analysis: classification of bite marks – haemorrhage, abrasion, contusion, laceration, incision, avulsion and artefact. Drawbacks of bite mark analysis; lip print analysis (cheiloscopy).

**FRS 306: Forensic Toxicology**
**(2 Units C: LH 30)**

**Course Contents**
It is a detail on Metallic Poisons:- arsenic, mercury, bismuth, lead (nature, administration, symptoms, post-mortem findings, detection and medico-legal aspects). Insecticides:- organophosphorus compounds, organochlorine compounds and carbamates (nature, administration, symptoms, post-mortem findings, isolation, detection, estimation and medico-legal aspects). Volatile poisons:- methyl alcohol, ethyl alcohol, chloroform, and acetone (nature, administration, symptoms, post-mortem findings, isolation, detection, and estimation, medico-legal aspects). Toxicology of alcohol:- introduction, definition of alcohol and illicit liquor. Proof spirit, absorption, detoxication and excretions of alcohol. Problems in alcohol cases and difficulties in diagnosis. Breath test instruments, field sobriety testing, analysis of blood for alcohol. Cases of drunken driving. Analytical techniques in the analysis of alcohol. Miscellaneous Poisons:- animal poisons:

snake, scorpions and other insects. Vegetable Poisons: opium, datura, oleander, madar, abrus precarious, castor, cannabis, nux vomica, cyanide, etc. (nature, administration, symptoms, post-mortem findings, isolation, detection and medico-legal aspects).

**FRS 399: Industrial Training**
**(12 weeks) (3 Units C: PH 135)**

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

**CHM 302: Inorganic Chemistry II**
**(2 Units E: LH 30)**

**Course Contents**
The second party inorganic chemistry discusses the noble gases. Hydrogen. Electronic structure and general properties and comparative study of Group IA and Group IIA elements. Chemistry of boron, carbon, silicon, nitrogen, phosphorus, oxygen and sulphur. The halogens. Transition elements. Separation of metals. Introduction to co-ordination chemistry. Introductory organo-metallic chemistry. Ligand and Crystal field theories. Introduction to radiochemistry. Radioactivity and the periodic table. Role of metals in living systems.

**CHM 303: Organic Chemistry II**
**(2 Units E: LH 30)**

**Course Contents**
But the organic chemistry II is about the Aromatic and Alicyclic chemistry. Survey of representative polycyclic compounds. Heterocyclic Chemistry (3,4,5 and 6-membered ring of O, N, S heterocyclic compounds). Reactive intermediates – carbocations, carbanions, carbenes, nitrenes etc. Selected rearrangement reactions such as, Beckmann, Baeyer-Villiger, and many others to illustrate various reaction mechanisms and types. Forensic analysis of biological samples, pharmaceutical samples, organic analytes and macromolecular samples.

**CHM 312: Analytical Atomic Spectroscopy**
**(2 Units C: LH 30)**

**Course Contents**
Introduction of concept of interaction of atoms with electromagnetic radiation. Atomic absorption spectrometry. Atomic emission spectrometry. Atomic fluorescence spectrometry and X-ray fluorescence spectrometry.

**CHM 316: Applied Spectroscopy**
**(2 Units C: LH 30)**

**Course Contents**
Principles and applications of UV, IR, NMR and mass spectroscopy in the determination and elucidation of structures of organic compounds. Brief mention of hyphenated systems:

GC-MS, LC-MS and LC-NMR, and diagnostic use of NMR in medicine.

**BCH 310: Biochemistry and Molecular Biology of Microorganisms**
**(2 Units E: LH 30; PH -)**

**Course Contents**

General introduction to genetic materials: DNA, RNA, protein, gene, loci, intron, exons, etc.; Prokaryotic Genomes - Physical organization of bacterial genomes; Structure of the bacterial nucleoid; Replication and partitioning of the bacterial genome; Genome of Archaea: A review of central dogma; DNA replication, supercoiling, transcription, translation; Genetic exchanges in bacteria - Mechanisms of genetic exchange: transformation, conjugation, and transduction; Plasmids – Plasmids and plasmid biology, plasmid replication and conjugation, plasmids as vectors in cloning; DNA damage and repair mechanisms: Molecular mechanism of gene regulation in prokaryotes: Transcriptional regulation in prokaryotes (inducible and repressible system, positive regulation and negative regulation); Operon concept and organization – lac, trp, Ara operons; Transcriptional attenuation; Phages, Bacteriophage Genetics: - Benzer's fine structure of gene in bacteriophage T4: Plaque Formation, and Phage Mutants; Genetic recombination in the lytic cycle, (concept of recon, muton, cistron).

**BIO 301: Genetics II**
**(2 Units E: LH 30; PH 45)**

**Course Contents**
Aspects of human genetics; pedigree analysis. Further consideration of various deviations from basic principles. Gene interactions, including biochemical mutants, nucleic acids and nucleotides, DNA replication, mutation of DNA, proteins and regulation of gene expression. DNA technology and genetic engineering.

**MCB 307: Immunology**
**(3 Units: E LH 30; PH 45)**

**Course Contents**
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, effect or systems of parasite killing and nature of resistance in plants. Animal and human vaccine production.

**CYB 305: Digital Forensics and Investigation Methods**
**(2 Units E: LH 15; PH 45)**

**Course Contents**
Introduction to digital forensics, digital evidence, and increasing awareness of digital evidence. Challenging aspects of digital evidence. Best practices in securing, processing, acquiring, examining and reporting on digital evidence. Cyber

trail and challenging aspects of the cyber trail. Brief history of computer crime and cybercrime investigation. Cyber auditing. Evolution of investigative tools. Language of computer crime investigation. The role of computers in crime, technology and law, jurisdiction, pornography and obscenity, child pornography, privacy, copyrights and the “theft” of digital intellectual property. The investigative process and investigative reconstruction, with digital evidence. Examining the techniques and tools used by computer forensics investigations such as acquisition, preservation, recovery, and analysis of evidence obtained from portable and stationary computer storage devices, personal digital assistants (PDAs), and cell phones. Current technologies and methods as well as leading edge techniques with practical based exercises/projects and research opportunities.

**Lab work**: this course is basically a practical one,it is a Practical exercises on how to make use of various techniques and tools for computer forensics investigations and cyber trail during cybercrime investigations. Practice cyber auditing skills. Work on applying the best practices in securing, processing, acquiring, examining and reporting on digital evidence with current technologies and methods in forensics investigation.

**SEN 301 Object-Oriented Programming**
**(2 Unit, E, 15 LH, 45 PH)**

**Course contents**
This is about the Object-oriented approach to information system development, particularly in. reference to the earlier

stages of analysis and design. Importance of modelling.. Principles of modelling.. Object-oriented modelling.. Conceptual model of the Unified Modelling Language (UML).. Architecture.. Software development life cycle. The principles and basic concepts of object orientation and the different aspects of object-oriented modelling as represented by the UML technique. Case study of a typical UML-based CASE tool.

**Lab Work:, this is essentially a** Practical exercises on different requirements specification and design activities; developing problem statements, SRS documents and Use Case Diagrams; designing UML Activity diagrams, UML Class diagrams and State Chart diagrams; drawing partial layered, logical architecture diagram with UML package diagram notation; Designing Component and Deployment diagrams.

**400 Level**
**FRS 401: Introduction to Questioned Documents**
**(2 Units C: LH 30)**

**Course Contents**

The course introduces the student to the Questioned Documents: definition, types, importance, nature and problems. Location, collection, handling and presentation of documents. Adequacy of examples and standards. Examination of alterations, erasures, overwriting, additions and obliterations. Methods of Detection: detection and deciphering of indented writing, charred documents, invisible/secret writing. Ink examination: composition of major types (carbon ink, fountain pen ink, ballpoint pen ink, rolling ball marker inks, fibre or porous tips pen ink). Analysis of writing inks and ink dating; Analysis of documents: pencil lead examination and age of the documents. Identification and comparison of typescripts. Paper analysis: physical characteristic, water mark examination, fibre analysis, chemical and trace elemental analysis. Equipment required: camera, microscope, reference standards, TLC and HPLC. Handwriting and signature: identification, principle of handwriting, individual and class handwriting characteristics. External, internal and physical characteristics affecting the handwriting; Signatures: authentic, forged, disguised and traced signatures and their characteristics. Factors affecting the signature of individuals.

**FRS 402: Forensic Pathology**
**(2 Units C: LH 30)**

**Course Contents**

The course is designed to introduces the students the contents of forensic pathology Introduction: global medical jurisprudence, legal procedure in Nigeria: -police, magistrate's and coroner's inquests. Oath and affirmation. Documentary evidence: -medical certificates, medical reports, death declaration. Understanding laws and ethics of medical practice. Death: - medico-legal aspects of death. Diagnosis of death-somatic and molecular. Early and intermediate changes following death. Late changes after death-putrefaction, autolysis, bacterial action, factors affecting these changes. Determination of time since death, including histopathological methods. Post-mortem examination: - ante- and post – mortem examinations; external and internal examination; collection, preservation and packaging of viscera. Role of a Forensic pathologist. Wounds: definition, types and identification. Medico–legal aspects of wounds. Determining the age of the injury, ante–mortem, post–mortem injuries; abrasions, grazes, lacerations, Bruises and contusion. Punctured wounds and incised wounds – causes, dimensions, ante – mortem, post – mortem analysis and its medico-legal aspects. Difference between suicidal, homicidal and accidental wounds. Wound/Terminal Ballistics: - introduction, injuries and the quantity of energy of projectiles. Shock wave and cavitation effect. Wounding mechanism, Elements of wound Ballistics. Nature of target, velocity of projectile, constructional features of projectile. Contact, point blank, near, chips and distant ranges. Penetration of shots in different regions of the body. Personal Identification: importance and need for personal identification, cases that will require personal identification. Documents proof: scars, professional marks, personal articles, finger printings, dentures, sketches and photographs, skeletal remains. Identification in mass disasters, mutilated remains and decomposed bodies.

**FRS 403: Forensic Ballistics**
**(3 Units C: LH 45)**

**Course Contents**
Forensic ballistics is about the the knowledge of Firearms: introduction, brief history of fire arms, weapon types and their operations, proof marks. Ammunition: a brief history, components, non-toxic shots, propellants, priming compounds and primers, head stamp marking on ammunition. Bullet comparisons, cartridge case examination, class and individual characteristics of identification. Firearms: nature, parts and classification. Uses of standard firearms data bases and automated search systems (DRUGFIRE and IBIS). Ballistics: definition and forensic importance. Types of ballistics: internal, external and terminal ballistics. velocity and theory of recoil, barrel pressure measurement, ballistic coefficient, angle of elevation of the barrel. Range of fire. Muzzle pattern, scorching, blackening, tattooing, wad distribution, pellet patterns, GSR analysis, and primer residues. Reconstruction of the sequence of events in a shooting case. Presentation of evidence in the court. Ricochet: critical angle for ricochet for the bullet and the surface, relationship between the angle of

incidence and ricochet, stability in flight after ricochet, and Lethal effects of ricochet bullet.

**FRS 404: DNA Fingerprinting**
**(2 Units C: LH 30)**

**Course Contents**
The student shall know the DNA fingerprinting, definition, importance in Forensic Science. Collection and types of evidences for DNA fingerprinting. Genetic basis of DNA Fingerprinting. Chromosomes, DNA, Nuclear DNA and Mitochondrial DNA. Techniques of DNA fingerprinting; Isolation, performing southern blots, making radioactive probe, Hybridization reaction, visualization, VNTR, HLA-DQα, STRs, RFLP. Types of DNA fingerprinting: Single locus DNA and multi–locus DNA fingerprinting. Mini satellite, micro-satellite, FTA cards for isolation of DNA. Polymerase chain reaction: instrumentation, principle, significance in forensic case samples. Denaturation, annealing and extension. Detection of PCR products. Practical application of DNA fingerprinting: Paternity and maternity testing, personal identification, criminal identification etc.. DNA databank; limitations of DNA fingerprinting; legality of DNA fingerprinting in Nigeria.

**FRS 405: Forensic Practical III**
**(2 Units C: PH 90)**

**Course Contents**
This a practical course on the Examination and detection of fraudulent documents; Scientific report writing. Identification

of indented writing, invisible writing, class and individual characteristics in handwriting. TLC of different ink samples. Photography of documents. Quantitative analysis using Colorimeter and Spectrophotometer. Immuno-diffusion technique. Electrophoretic separation of proteins

**FRS 406: Forensic Practical IV**
**(2 Units C: PH 90)**

**Course Contents**
The course teaches how to Spot test for explosives. Comparison of bullets. Chemical analysis of explosive materials (e.g., gun powder)-Colour test and microscopic examination. Study of various parts of the firearms: - barrel, stock, calibre, choke etc. Electrophoresis of blood, blood proteins and enzymes. Isolation of DNA. Examination of personal identification marks. Visit for autopsy. Identification of bite marks.

**FRS 407: Research Methodology**
**(3 Units C: LH 45)**

**Course Contents**
It is about how to write a research at the conclusion of the program. Introduction to Research Methodology: definition, concept and research in science and forensic science; Scientific, social science and behaviour science methods. Experimental research and non– experimental research design. Tools of data collection; observation, questionnaires, interview schedules and case study methods. Introduction to statistics: parametric and non-parametric statistics.

Descriptive Statistics: measures of central tendency and dispersion. Graphical representation of the data and simple correlation methods.

**FRS 409: Applied Forensic Physics**
**(2 Units C: LH 30)**

**Course Contents**

This is an application course that requires the student to know Physics of Speech: generation of sound, amplitude vibration, simple harmonic motion, sine waves, physical properties of vibrating systems. Propagation of sound and standing waves, modes of vibration and its significance in voice identification. Causes and investigation of vehicular accidents: automobile accidents-introduction, sources of information, eyewitnesses, tire and other marks, pedestrian impacts and vehicle condition, speed and damage. Curved scuffmarks, time and distance, reaction time. Photography and plans. Forensic photography: introduction, types of cameras and films, digital photo imaging, ISO number, exposure index, photo imaging evidence. Angle, scale, depth of field, light, ambient light, colour, temperature, flash/ strobe. Surveillance photography and aerial photography and accessories. Methods for developing photographs: high-speed photography, legal aspects of visual evidence; image magnification, photography of fingerprints, impressions, tool marks and restored latent prints and impressions.

**FRS 410: Entrepreneurship for Forensic Scientists**
**(2 Units C: LH 30)**

**Course Contents**

Definitions, nature and concepts of management (meaning of management; Scope of management; Purpose of management; who is a manager? Concepts of management in profit and non-profit organisations). Foundation of entrepreneurship; who is an entrepreneur? How can a forensic scientist become an entrepreneur The corporate innovation on entrepreneurs; discovering business opportunity.

**FRS 499: Final Year Student's Research Project**
**(6 Units C: PH 270)**

Each final year B. Sc. Forensic Science student must carry out an independent research project on selected areas of interest under the supervision of an academic staff and present findings before internal and external examiners.

**CHM 410: Analytical Chemistry II**
**(2 Units C: LH 15; PH 45)**

**Course Contents**

Potentiometric and pH methods. Conductometric, electroanalytical, amperometric, colorimetric methods of analysis. Coupled methods of analysis e.g. GC-MS, LC-MS. Radio-chemical methods, chromatography.

**FRS 401: Explosive Chemistry**
**(2 Unit C: LH 30)**

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

**FRS 402: Microscopy**
**(2 Unit C: LH 30)**

**Course Contents**
This introduces student to what is Microscopy: Definition, different types of microscopes: Simple microscope, Compound microscope, Comparison microscope, Stereomicroscope, Polarizing Microscope, SEM and TEM microscopes, and Fluorescence microscope (Components, performance criteria and uses); Scope of microscopy in Forensic Science and elementary theory of microscope; light and lenses; Fiber Optics: Optical fibers, Propagation of light through optical fiber, Angle of acceptance and numerical aperture, losses and Solar cells;

**FRS 403: Chemical Pathology**
**(2 Unit E: LH 30)**

**Course Contents**

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

**FRS 405: Applied Forensic Biology**
**(2 Unit E: LH 30)**

**Course Contents**

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

## B.Sc. Industrial Chemistry

### Overview

This course is designed to introduce the student to 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. The programme is designed to equip students for employment in virtually all types of industries. Consequently, a lot emphasis is placed on practical work and industrial training during the course of the programme which may be run as a 4-year programme or a 5-year programme. For institutions opting for the 4-year programme, students are to undertake two industrial attachments of 12 weeks duration each, the first at 200-level and the second at 300-level. Institutions wishing to expose their students to more intensive industrial training should adopt the 5-year programme in which case the students will spend the entire 400-level (36 weeks) on industrial attachment. The programme is also planned to arouse entrepreneurial spirits needed for self-employment and economic emancipation.

**Philosophy**

The philosophy of the programme is to train graduates who will apply scientific approach through verifiable and reproducible methodologies to solving developmental needs of the society.

**Objectives**

The Objectives of the Industrial Chemistry programme include:

1. provide students with scientific knowledge and skills from which they can proceed to further studies in specialized and/or multi- disciplinary areas;

2. provide students with a broad and balanced foundation of scientific knowledge and practical skills as may be applicable in their different programmes;

3. develop in students the ability to apply scientific knowledge and skills to solving theoretical and practical problems;

4. develop in students, a range of transferable skills that are of value in any employment and society they might find themselves;

5. provide, through training and orientation, an appreciation of the rewards inherent in inter- and multi- disciplinary approach to the solution of complex life problems, and

6. engender in students an appreciation of the fact that no nation can develop without science and its application.

**The specific objectives of the Industrial Chemistry Programme are as follows:**

1. provide students with a thorough grounding in principles and sound knowledge of scientific methods of the chemical sciences;

2.arouse a sense of curiosity and enquiring mind, in order to encourage and develop creative thinking and research aptitudes;

1. 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;

4. 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; and
5. inculcate in students appropriate skills and abilities to manage and administer technological operations within the field of chemistry and allied areas.

**Unique Features of the Programme**

The unique features of the programme include:

1. the programme is rich through a combination of various subjects for a better understanding of industrial chemistry;
2. cognitive abilities and skills relating to solution of problems in industrial chemistry and other allied chemical industries;

3. practical skills relating to the conduct of laboratory work in chemical industries. mastering industrial processes that take place in pharmaceutical, food and beverages, petroleum and petrochemical, paints and textile industries and metallurgical and ceramic industries;

1. general skills relating to non-subject specific competencies, communication, interpersonal, organization skills; and

5. graduate of industrial chemistry will be equipped for graduate self-employment.

**Employability Skills**

Industrial chemistry graduates are specially equipped for employment in various industries in such areas as production supervision, quality control, research and development, technical marketing etc. Some typical industries where industrial chemistry graduates can be employed include chemical, food and beverage, pharmaceuticals, petroleum and petrochemicals, metallurgical and ceramic industries, textile, paper and wood, paint, and environmental agencies as well as several other regulatory agencies. The programme is also designed to equip students for self – employment.

**21st Century Skills**

1. Creativity
2. Computer Literacy
3. Organization Skills
4. Communication and IT Skills
5. Teamwork

6. Innovation
7. Problem Solving Skills
8. Critical Thinking

**Admission and Graduation Requirements**

**Admission Requirements**

There are two different pathways by which candidates can be admitted into the programmes in the discipline: the Indirect Entry and the Direct Entry.

**Indirect Entry**

Admission through indirect entry shall take the student to 100 level. The candidate must have Senior Secondary Certificate (SSC) credit passes in five subjects at not more than two sittings in SSCE, NECO or GCE (ordinary level). The credit passes are required in the following subjects: English language, Mathematics, Chemistry, Physics and Biology. The UTME subjects are: English Language, Physics, Biology and Chemistry.

**Direct Entry**

Admission by direct entry is into second year (200 level) of the programme. Candidates for direct entry should possess passes at GCE (advanced level) at one sitting in at least two of the following subjects: Physics, Mathematics, Biology and Chemistry or National Diploma (ND) at a minimum of Upper Credit level in Lab technology (chemistry option) and any other related course from any recognized institution.

**Graduation Requirements**

To be eligible for the award of a Bachelor's Degree in Industrial chemistry, a student must pass a minimum of 120 credit units for those admitted through UTME and 90 units for the Direct Entry, admission including all the compulsory courses of the Department, the Faculty courses, namely A student admitted through UTME must complete the programme in 4 years (8 semesters), while a student admitted through Direct Entry must complete the programme in 3 years (6 semesters); both can be given extra two years (4 semesters) to complete their programme provided their CGPA is not below 1.0.the extra 2 years in come in form of spell over 1x2.

**level 100**

**Global Course Structure;**

| **Course Code** | **Course Title** | **Unit(s)** | **Status** | **LH** | **PH** |
|---|---|---|---|---|---|
| GST 111 | Communication in English | 2 | C | 15 | 45 |
| GST 112 | Nigerian Peoples and Culture | 2 | C | 30 | |
| MTH 101 | Elementary Mathematics I | 2 | C | 45 | - |
| MTH 102 | Elementary Mathematics II | 2 | C | 45 | - |
| COS 101 | Introduction to Computing Sciences | 3 | C | 30 | 45 |
| CHM 101 | General Chemistry I | 2 | C | 45 | - |
| CHM 107 | General Practical Chemistry I | 1 | C | - | 45 |
| CHM 108 | General Practical Chemistry 11 | 1 | C | | 45 |
| CHM 102 | General Chemistry11 | 2 | C | 30 | |
| PHY 101 | General Physics I | 2 | C | 30 | - |
| PHY 102 | General Physics II | 2 | C | 30 | - |

| **Course Code** | **Course Title** | **Unit(s)** | **Status** | **LH** | **PH** |
|---|---|---|---|---|---|
| PHY 107 | General Practical Physics I | 1 | C | - | 45 |
| PHY 108 | General Practical Physics II | 1 | C | - | 45 |
| GET 102 | Engineering Graphics and Solid Modelling | 2 | C | 30 | 45 |
| BIO101 | General Biology I | 2 | C | 30 | - |
| BIO102 | General Biology II | 2 | C | 30 | - |
| BIO107 | General Biology Practical I | 1 | C | - | 45 |
| BIO108 | General Biology Practical II | 1 | C | - | 45 |
| STA112 | Probability I | 3 | C | 45 | - |
| MTH103 | Elementary Mathematics III | 2 | C | 30 | - |
| **Total** | | | **36** | | |

**200 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST 212 | Philosophy, Logic and Human Existence | 2 | C | 30 | |
| ENT 211 | Entrepreneurship and Innovation | 2 | C | 30 | |
| CHM 210 | Physical Chemistry I | 2 | C | 30 | |
| CHM 211 | Organic Chemistry I | 2 | C | 30 | |
| CHM 212 | Inorganic Chemistry I | 2 | C | 30 | |
| CHM 207 | General Practical Chemistry 1 | 1 | C | 45 | |
| CHM 208 | General Practical Chemistry 11 | 1 | C | 45 | |
| ICH 213 | Analytical Chemistry I | 2 | C | 30 | |
| ICH 251 | Process Science I | 3 | C | 45 | - |
| ICH 252 | Process Science II | 3 | C | 45 | - |
| COS 201 | Computer programming 1 | 2 | C | 30 | 45 |
| CHM 214 | Structure and Bonding | 2 | C | 30 | - |
| CHM213 | Macromolecular Chemistry I | 2 | E | 30 | - |

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| PHY205 | Thermal Physics | 3 | E | 45 | - |
| PHY211 | Workshop Practice | 2 | E | 15 | 45 |
| MTH201 | Mathematical Methods I | 2 | E | 30 | - |
| MTH202 | Elementary Differential Equation | 2 | E | 30 | - |
| MTH204 | Linear Algebra I | 2 | E | 30 | - |
| **Total** | | | **37** | | |

**300 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST 312 | Peace and Conflict resolution | 2 | C | 30 | |
| ENT 312 | Venture Creation | 2 | C | 15 | 45 |
| ICH 314 | Entrepreneurial Skills in Industrial Chemistry | 3 | C | 30 | 45 |
| CHM 301 | Physical Chemistry II | 2 | C | 30 | |
| CHM 302 | Inorganic Chemistry II | 2 | C | 30 | |
| CHM 303 | Organic Chemistry II | 2 | C | 30 | |
| ICH 305 | Petroleum Chemistry | 2 | C | 30 | - |
| ICH 306 | Polymer Chemistry | 2 | C | | 30 |
| ICH 317 | Industrial Raw Materials Resource Inventory | 1 | C | 15 | - |
| ICH 318 | Management and Chemical Industry I | 2 | C | 30 | - |
| ICH 319 | Glass blowing Practical | 1 | C | 45 | |
| *ICH 399 | Industrial Attachment (12 Weeks)Industrial Attachment II (12 Weeks) | 3 | | | |

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| ICH 301 | Separation Method of Analysis | 3 | C | 30 | 45 |
| CHM 316 | Applied Spectroscopy | 2 | E | 30 | - |
| CHM 319 | Environmental Chemistry | 2 | E | 30 | - |
| ICH 302 | Introductory Material Science | 2 | E | 30 | - |
| ICH 303 | Colour and Textile Chemistry | 3 | E | 30 | 45 |
| **Total** | | | **36** | | |

***CHM 399 is only for students in institutions running a 4-year industrial chemistry programme**

**400 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| ICH 422 | Entrepreneurship for Industrial chemistry | 2 | C | 30 | |
| ICH 400 | Seminar in Industrial Chemistry | 2 | C | | |
| ICH 401 | Research Project | 6 | C | - | 270 |
| ICH 453 | Chemistry of Industrial Processes | 3 | C | 45 | - |
| ICH 454 | Chemical Processes Technology | 3 | C | 45 | - |
| ICH 455 | Macromolecular Chemistry II | 3 | C | 45 | - |
| *ICH 499 | Industrial Attachment (36 Weeks) | 6 | C | | |
| CHM 406 | Reaction Kinetics | 2 | C | 30 | - |
| ICH 407 | Electrochemistry | 2 | C | 15 | 45 |
| CHM 410 | Analytical Chemistry II | 2 | C | 30 | - |
| ICH 404 | Group Theory and Symmetry | 2 | E | 30 | - |
| CHM 424 | Coordination Chemistry | 2 | C | 30 | - |
| ICH 415 | Polymer Technology | 2 | E | 30 | - |
| ICH 408 | Organic Synthesis | 2 | E | 30 | - |
| ICH 409 | Food Chemistry | 2 | E | 30 | - |

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| ICH 411 | Agrochemical & Chemotherapeutic Agents | 3 | E | 45 | - |
| **Total** | | | **44** | | |

*ICH 499 is only for students in institutions running Industrial Chemistry as a 5-year programme. In such a case the 4th year will be spent entirely on Industrial Attachment and all the other indicated 400-Level will be taken in the 5th year as 500-Level courses.
There are institutions running B.Sc. Industrial and Environmental Chemistry, Industrial Attachment I (12 Weeks) is usually a whole semester of the third session'

## Course Contents

### 100 Level

**GST 111: Communication in English**
**(2 Units C: LH 15; PH 45)**

**Course Contents**

The course introduced the science to the basic of communication in English right from the Sound patterns in English Language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). Sentence in English (types: structural and functional, simple and complex). Grammar and Usage (tense, mood, modality and concord, aspects of language use in everyday life). Logical and Critical Thinking and Reasoning Methods (Logic and Syllogism, Inductive and Deductive Argument and Reasoning Methods, Analogy, Generalization and Explanations). Ethical considerations, Copyright Rules and Infringements. Writing Activities: (Pre-writing , Writing, Post writing, Editing and Proofreading; Brainstorming, outlining, Paragraphing, Types of writing, Summary, Essays, Letter, Curriculum Vitae, Report writing, Note making etc. Mechanics of writing). Comprehension Strategies: (Reading and types of Reading, Comprehension Skills, 3RsQ). Information and Communication Technology in modern Language Learning. Language skills for effective communication. Major word formation processes. Writing and reading comprehension strategies. Logical and critical reasoning for meaningful presentations. Art of public speaking and listening. Report writing.

**GST 112: Nigerian Peoples and Culture**
**(2units C: LH 30)**

**Course Contents**

It is designed to introduce the science students the basic knowledge of Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and culture; peoples and culture of the ethnic minority groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; Colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; Nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concept of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigeria people; trade, skill acquisition and self-reliance). Social justices and national development (law definition and classification. Judiciary and fundamental rights. Individual, norms and values (basic Nigeria norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts. Cultism, kidnapping and other related social vices). Re-orientation, moral and national values (The 3R's – Reconstruction, Rehabilitation and Re-orientation; Re-orientation Strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against

Indiscipline (WAI), War Against Indiscipline and Corruption(WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.(the next level, renewed hope agenda etc.)

**MTH 101: Elementary Mathematics I (Algebra and Trigonometry)**
**(2 Units C: LH 30)**

**Course Contents**

It is an introductory course on Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series. Theory of quadratic equations. Binomial theorem. Complex numbers. Algebra of complex numbers. The Argand diagram. De-Moivre’s theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

**MTH 102: Elementary Mathematics II (Calculus)**
**(2 Units C: LH 30)**

**Course Contents**

The elementary mathematics II ,gives the 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.

**COS 101: Introduction to Computing Sciences**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
Brief history of computing. Description of the basic components of a computer/computing device. Input/output devices and peripherals. Hardware, software and human ware. Diverse and growing computer/digital applications. Information processing and its roles in society. The Internet, its applications and its impact on the world today. The different areas/programs of the computing discipline. The job specializations for computing professionals. The future of computing.

**Lab Work: this is a laboratory base course.** Practical demonstration of the basic parts of a computer. Illustration of different operating systems of different computing devices including desktops, laptops, tablets, smart boards and smart phones. Demonstration of commonly used applications such as word processors, spreadsheets, presentation software and graphics. Illustration of input and output devices including printers, scanners, projectors and smart boards. Practical demonstration of the Internet and its various applications. Illustration of browsers and search engines. How to access online resources.

**CHM 101: General Chemistry I**
**(2 Units C: LH 30)**

**Course Contents**
This exposes student to Atoms, molecules, elements and compounds and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridization and shapes of simple molecules. Valence Forces. Structure of solids. Chemical equations and stoichiometry; Chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry. Rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

**CHM 102: General Chemistry II**
**(2 Unit C: LH 30)**

**Course Contents**
It is about the Historical survey of the development and importance of Organic Chemistry. Fullerenes as fourth allotrope of carbon, uses as nanotubes, nanostructures, Nano chemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds. Determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry. Nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic

acids and derivatives. The Chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

**CHM 107: General Chemistry Practical I**
**(1 Unit C: PH 45)**

**Course Contents**
The course is a practical course that is mainly laboratory based, it introduces students to Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

**CHM 108: General Chemistry Practical II**
**(1 Unit C: PH 45)**

**Course Contents**
It is a continuation of practical I of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

**PHY 101: General Physics I (Mechanics)**
**(2 Units C: LH 30)**

**Courses Contents**
Space and time. Units and dimension, Vectors and Scalars. Differentiation of vectors: displacement, velocity and acceleration. Kinematics. Newton laws of motion (Inertial frames, Impulse, force and action at a distance, momentum

conservation). Relative motion. Application of Newtonian mechanics. Equations of motion. Conservation principles in physics. Conservative forces. Conservation of linear momentum. Kinetic energy and work. Potential energy. System of particles. Centre of mass. Rotational motion:Torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates. Conservation of angular momentum. Circular motion. Moments of inertia. gyroscopes and precession. Gravitation: Newton's Law of Gravitation. Kepler's Laws of Planetary Motion. Gravitational Potential Energy. Escape velocity. Satellites motion and orbits.

**PHY 102: General Physics II (Electricity & Magnetism) (2 Units C: LH 30)**

**Course Contents**

Forces in nature. Electrostatics; electric charge and its properties, methods of charging. Coulomb's law and superposition. electric field and potential. Gauss's law. Capacitance. Electric dipoles. Energy in electric fields. Conductors and insulators, current, voltage and resistance. Ohm's law and analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère's laws. magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz's laws. Step up and step-down transformers: Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, resistance, and combinations.

**PHY 107: General Practical Physics I**
**(1 Unit C: PH 45)**

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

**PHY 108: General Practical Physics II**
**(1 Unit C: PH 45)**

**Course Contents**
This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements. The treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

**GET 102: Engineering Graphics and Solid Modeling I**
**(2 Units C: LH 15; PH 45)**

**Course Contents**

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; Sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualization and Solid modelling in design, prototyping and product-making. User Interfaces in concrete terms. Design, Drawing, Animation, Rendering and Simulation Workspaces. Sketching of 3D objects. Viewports and sectioning to Shop drawings in Orthographic projections and perspectives. Automated viewports. Sheet Metal and surface modeling. Material selection and rendering. This course will use latest professional design tools such as Fusion 360, Solid Works, Solid Edge or equivalent.

**BIO 101: General Biology I**
**(2 units C: LH 30)**

**Course Contents**

The following are the course content: Cell structure and organization, functions of cellular organelles. Characteristics and classification of living things. Chromosomes, genes; their relationships and importance. General reproduction. Interrelationships of organisms (competitions, parasitism, predation, symbiosis, commensalisms, mutualism, saprophytism). Heredity and evolution (introduction to Darwinism and Lamarkism, Mendelian laws, explanation of key genetic terms). Elements of ecology and types of habitat.

**BIO 102: General Biology II**
**(2 Units C: LH 30)**

**Course Contents**
This involves the Basic characteristics, identification and classification of viruses, bacteria and fungi. A generalized survey of the plant and animal kingdoms based mainly on the study of similarities and differences in the external features. Ecological adaptations. Briefs on physiology to include nutrition, respiration, circulatory systems, excretion, reproduction, growth and development.

**BIO 107: General Biology Practical I**
**(1 Unit C: PH 45)**

**Course Contents**
The course explains the Common laboratory hazards. prevention and first aid. measurements in biology. uses and care of microscope. compound and dissecting microscope. Biological drawings and illustration, scaling, accuracy and proportion. use of common laboratory apparatus and laboratory experiments designed to illustrate the topics covered in **BIO 101.**

**BIO 108: General Biology Practical II**
**(1 Unit C: PH 45)**

**Learning Outcomes**
The course is a practical based, and at the end of this course, students should be able to:

1. describe the anatomy of flowering plants;
2. differentiate types of fruits and seeds;
3. state ways of handling and caring for biological wares;
4. describe the basic histology of animal tissues; and
5. identify various groups in the animal kingdom.

**MTH 103: Elementary Mathematics III (Vectors, Geometry and Dynamics)**
**(2 Units C: LH 30)**

**Course Contents**

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. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

**STA 112: Probability I**
**(3 Units C: LH 45)**

**Course Contents**

Permutation and combination. Concepts and principles of probability. Random variables. Probability and distribution functions. Basic distributions: Binomial, geometric, Poisson, normal and sampling distributions; exploratory data analysis.

**200 Level**

**GST 212: Philosophy, Logic and Human Existence**
**(2 Units C: LH 30)**

**Course Contents**

This is a general studies course, it is designed to introduce the students to the Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

**ENT 211: Entrepreneurship and Innovation**
**(2 Units C: LH 15; PH 45)**

**Course Contents**

It is an Entrepreneur course meant to avail the student of the Concept of Entrepreneurship (Entrepreneurship, Entrepreneurship/Corporate Entrepreneurship,). Theories, Rationale and relevance of Entrepreneurship (Schumpeterian and other perspectives, Risk-Taking, Necessity and opportunity-based entrepreneurship and Creative destruction). Characteristics of Entrepreneurs (Opportunity seeker, Risk taker, Natural and Nurtured, Problem solver and change agent, Innovator and creative thinker). Entrepreneurial thinking (Critical thinking, Reflective thinking, and Creative thinking). Innovation (Concept of innovation, Dimensions of innovation, Change and innovation, Knowledge and innovation). Enterprise formation, partnership and networking (Basics of Business Plan, Forms of business ownership, Business registration and Forming alliances and join ventures). Contemporary Entrepreneurship Issues (Knowledge, Skills and Technology, Intellectual property, Virtual office, Networking). Entrepreneurship in Nigeria (Biography of inspirational Entrepreneurs, Youth and women entrepreneurship, Entrepreneurship support institutions, Youth enterprise networks and Environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

**CHM 210: Physical Chemistry I**
**(2 Units C: LH 30)**

**Course Contents**

It deals with Kinetic theory of gases; science of real gases; the laws of thermodynamics; entropy and free energy; reactions and phase equilibrium; reaction rates; rate laws; mechanism and theories of elementary processes; photochemical reactions; basic electrochemistry.

**CHM 211: Organic Chemistry I**
**(2 Units C: LH 30)**

**Course Contents**

This is about Chemistry of aromatic compounds. Structures of simple sugars, starch and cellulose, peptides, and proteins.

Chemistry of by functional compounds. Energetics, kinetics, and the investigation of reaction mechanisms. Mechanisms of substitution, elimination, addition, and rearrangement reactions. Stereochemistry. Examples of various named organic reactions e.g., Grignard reaction, Aldol and related reactions. Simple alicyclic carbon compounds and their synthesis.

**CHM 212: Inorganic Chemistry I**
**(2 Units C: LH 30)**

**Course Contents**
The course describes the Chemistry of first row transition metals. Introduction to coordination 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 organometallic chemistry. Role of metals in biochemical systems. Concepts of hard and soft acids and bases. Oxidation and reduction reactions. Sciences **310** New

**ICH 213: Analytical Chemistry I**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
This is about the Theory of errors; and statistical treatment of data: Theory of sampling. Chemical methods of analysis including volumetric, gravimetric, data analysis and

presentation and Physicochemical methods, Optical methods of analysis; separation methods.

**CHM 207: General Chemistry Practical III**
**(1 Unit C: PH 45)**

**Course Contents**

This course is the third practical aspects of level 200 chemistry, in describes the pH Measurement. Determination of relative molar mass from colligative properties. Demonstration of partition coefficient in two immiscible solvents. Temperature measurement and heat of dissolution heat of neutralization. Determination of critical solution temperature of water- phenol system. Ideal gas law. Measuring the molar volume of a gas and the universal gas constant.

**CHM 208: General Chemistry Practical IV**
**(1 Unit C: PH 45)**

**Course Contents**

The course is a practical based that prepares the students on to Preparation of Esters. The preparation of Aldehydes and Ketones. Vinegar Analysis. Chromatography. Thin Layer Chromatography. Dehydration of Alcohol. Qualitative Analysis of Common Functional Groups

**ICH 251: Process Science I**
**(3 Units C: LH 45)**

**Course Contents**
Commercial process, problems of scale and cost. Process flow sheet and stoichiometry.

Handling of fluids; conservation laws and dimensional analysis applied to a moving fluid.

Process heat transfer, mechanisms of heat transfer coefficients in batch and continuous processes. Use of mean temperature difference. Change of phase correlation of heat transfer data. Distillation differential, batch, fractional and continuous fractional distillation; number of stages; effects of operating variables.

**ICH 252: Process Science II**
**(3 Units C: LH 45)**

**Course Contents**
The course deals with Mass transfer processes; single phase and inter-phase, mass transfer drying as a heat-mass transfer process. Extraction and Absorption; solvent extraction in mixer settlers and columns; number of ideal stages; number of stages in gas absorption by HTU method; gas film and liquid film rate determining steps. Solid-liquid separation by filtration and sedimentation. Stoichiometry for systems involving recycles.

**COS 201: Computer Programming I**
**(3 Units C: LH 30; PH 45)**

**Course Contents**

This is an Introduction to computer programming. Functional programming; Declarative programming; Logic programming; Scripting languages. Introduction to object-orientation as a technique for modeling computation. structured, and even some level of functional programming principles; Introduction of a typical object-oriented language, such as Java; Basic data types, variables, expressions, assignment statements and operators; Basic object-oriented concepts: abstraction; objects; classes; methods; parameter passing; encapsulation. Class hierarchies and programme organization using packages/namespaces; Use of API – use of iterators/enumerators, List, Stack, Queue from API; Searching; sorting; Recursive algorithms; Event-driven programming: event-handling methods; event propagation; exception handling. Introduction to Strings and string processing; Simple I/O; control structures; Arrays; Simple recursive algorithms; inheritance; polymorphism.

**Lab work**: Programming assignments; design and implementation of simple algorithms, e.g., average, standard deviation, searching and sorting; Developing and tracing simple recursive algorithms. Inheritance and polymorphism.

**CHM213: Macromolecular Chemistry**
**(2 units, E: LH 30)**

**Course Contents**
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 214: Structure and Bonding**
**(2 Units C: LH 30)**

**Course Contents**
Idea of quantum states, orbitals, shape; and energy. Simple valence theory, electron repulsion theory, atomic spectra. Symmetry, molecular geometry and structure, molecular orbital theory of bonding. Methods of determining molecular shape, bond lengths and angles. The structure and chemistry of some representative main group element compounds.

**PHY 205: Thermal Physics**
**(3 Units C: LH 45)**

**Course Contents**
The foundations of classical thermodynamics including the definition of temperature. The first law. Work, heat and

internal energy. The second law. Carnot cycles and Carnot engines. Zeroth law. Entropy and irreversibility. Thermodynamic potentials and the Maxwell relations. Ideal gas equation. Internal energy and internal molecular modes. Qualitative discussion of phase transitions. Gibbs free energy. Clausius-Clapeyron equation. Examples of phase transitions. Van der Waals gas. Kinetic theory. Mean free path. Equi-partition of energy. Heat transfer. Diffusion rate.

**PHY 211: Workshop Practice**
**(2 Units C: LH 15; PH 45)**

**Course Contents**

This course is mainly on a Workshop layout and safety. Basic hand tools and bench work practices. Measurement and gauging. Sheet metal operations. Casting. Cutting, drilling, turning, and milling. Metal joining devices and adhesives in common use. Soldering techniques and wrap joints. Plain and cylindrical generation of smooth surface using power operated machines. Criteria for selection of materials used for construction (metallic and non-metallic). Instrumentation and measuring techniques. Multi-meters and oscilloscopes. Extension of instrument range. A survey of the use of electronic circuit devices (e.g., diodes, transistors including FET, integrated circuits). Photocells. Basic circuit development and analysis. Wood logging. Wood types and processing. Plastic types and working. Plastic moulding, bending, and encapsulation.

**MTH 201: Mathematical Methods 1**
**(2 Units C: LH 30)**

**Course Contents**

This is the first aspect of mathematical method that reveals the 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 and three variables. Partial derivatives chain rule, extrema, lagrangian multipliers. Increments, differentials and linear approximations. Evaluation of line integrals. Multiple integrals.

**MTH 202: Elementary Differential Equations (2 Units C: LH 30)**

**Course Contents**

This is an elementary of differential envation that harps on 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 differential equations. Application to geometry and physics.

**MTH 204: Linear Algebra I**
**(2 Units C: LH 30)**

**Course Contents**

A course on linear algebra that discourses Vector space over the real field. Sub-spaces, linear independence, basis and dimension. Linear transformations and their representation by matrices – rings, null space, rank. Singular and non-singular transformation and matrices. Algebra of matrices.

**300 Level**

**GST 312: Peace and Conflict Resolution (2 Units C: LH 30)**

**Course Contents**

This is level 300GST course meant to prepare the students on the Concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic and geo-political conflicts. Structural conflict theory, realist theory of conflict and frustration-aggression conflict theory. Root causes of conflict and violence in Africa: indigene and settlers' phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations, selected conflict case studies – Tiv-Junkun, Zango Kartaf, Ife/Modakeke, Ogulere/Omuteri Native Burum/Fulani settlers in Plateau, chieftaincy and land disputes and many more. peace building, management of conflicts and security, peace & human development. Approaches to peace & conflict management: (religious, government, community leaders and many more.). Elements of peace studies and conflict resolution, conflict dynamics assessment scales: constructive & destructive. Justice and legal framework and concepts of social justice. The Nigeria legal system. Insurgency and terrorism. Peace Mediation and Peace Keeping. Peace and security council (international, national and local levels). Agents of conflict resolution: conventions, treaties, community policing, evolution and imperatives. Alternative dispute resolution (ADR): a). dialogue b). arbitration c). negotiation d). collaboration and many more

Roles of international organizations in conflict resolution: (a). The United Nations (UN) and its conflict resolution organs. (b). The African Union & Peace Security Council (c). ECOWAS in peace keeping. Media and traditional institutions in peace building. Managing post-conflict situations/crisis: refugees. internally displaced persons (IDPs). The role of NGOs in post-conflict situations/crisis.

**ENT 312: Venture Creation**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
The teaches the student on Opportunity Identification (Sources of business opportunities in Nigeria, Environmental scanning, Demand and supply gap/unmet needs/market gaps/Market Research, Unutilized resources, Social and climate conditions and Technology adoption gap). New business development (business planning, market research). Entrepreneurial Finance (Venture capital, Equity finance, Micro finance, Personal savings, Small business investment organizations and Business plan competition). Entrepreneurial marketing and e-commerce (Principles of marketing, Customer Acquisition & Retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and Successful E-Commerce Companies,). Small Business Management/Family Business: Leadership & Management, Basic book keeping, Nature of family business and Family Business Growth Model. Negotiation and Business communication (Strategy and tactics of negotiation/bargaining, Traditional and modern business communication methods). Opportunity Discovery

Demonstrations (Business idea generation presentations, Business idea Contest, Brainstorming sessions, Idea pitching). Technological Solutions (The Concept of Market/Customer Solution, Customer Solution and Emerging Technologies, Business Applications of New Technologies - Artificial Intelligence (AI), Virtual/Mixed Reality (VR), Internet of Things (IoTs), Blockchain, Cloud Computing, Renewable Energy etc. Digital Business and E-Commerce Strategies).

**ICH 314: Entrepreneurship Skills in Industrial Chemistry (3 Unit C: LH 30; PH 45)**

**Course Contents**

This is about the different Entrepreneur perspectives and strategies. International entrepreneurship opportunities, identification, pursuit of new ventures (Water treatment, production of bio -renewable plastics such as polylactic acids PLA, textile and clothing: medical textiles, military and industrial textiles, electronics: semiconductors, food and drinks, packaging, drug designs, soap and hand sanitizers etc), marketing strategies in business ventures, creativities and the business ideas, legal issues and business environment, and cost accounting. Field trips.

**CHM 301: Physical Chemistry II (2 Units C: LH 30)**

**Course Contents**

A review of Gibbs Function. Chemical thermodynamics. Introduction to statistical thermodynamics. Ideal solutions and non-Ideal solutions. Properties of electrolytes. Colligative Properties. Studies on biochemical systems.

**CHM 302: Inorganic Chemistry II**
**(2 Units C: LH 30)**

**Course Contents**
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. Introduction to co-ordination chemistry. Introductory organo-metallic chemistry. Ligand and Crystal field theories. Introduction to radiochemistry. Radioactivity and the periodic table. Role of metals in living systems.

**CHM 303: Organic Chemistry II**
**(2 Units C: LH 30)**

**Course Contents**
**Pre –requisite: CHM 211**
Aromatic and Alicyclic chemistry. Survey of representative polycyclic compounds. Heterocyclic Chemistry (3,4,5 and 6-membered ring of O, N, S heterocyclic compounds). Reactive intermediates – carbocations, carbanions, carbenes, nitrenes etc. Selected rearrangement reactions such as, Beckmann, Baeyer-Villiger, and many others to illustrate various reaction mechanisms and types. Forensic analysis of biological samples, pharmaceutical samples, organic analytes and macromolecular samples.

**ICH 305: Petroleum Chemistry**
**(2 Units C: LH 30)**

**Course Contents**
The course introduces the student to many facts of of petroleum chemistry, such as Petroleum in the contemporary energy scene. Nature, classification and composition of crude petroleum and natural gases. Natural product chemical markers of petroleum and geological sediments. Distribution of petroleum and natural gas 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. Aviation fuels; present and future Formulation of Lubricants. Theory of Hydraulics, as applied to fuels in pump-pipeline systems. Fundamentals of electricity with emphases on electrical safety in petroleum Lubrication and wear, with importance attached to the physical and chemical properties of lubricants.

**ICH 306: Polymer Chemistry**
**(2 Units C: LH 30)**

**Course Contents**
It describes The nature of polymer nomenclature. Outline of sources of raw materials for polymers. Polymerisation process, condensation polymerisation in details. Solubility and solution properties of polymers. Structure and properties of polymers.

Electrical conducting organic wires, smart/sim cards, flat screen televisions. Fibre forming polymers. Bullet proof vests and vehicle bodies from polymers. Polymerisation mechanisms; detailed treatment of addition processes. Stereospecific reactions, copolymerisation reactions. Phase systems for reactions. Industrially important thermoplastic and thermosetting polymers: Polyurethanes. Rubber elasticity. Mechanical properties of polymers. Analysis and testing of polymers. Degradation of polymers.

**ICH 317: Industrial Raw Materials Resource Inventory (1 Unit C: LH 15)**

**Course Contents**
Survey of Nigeria's industries and their raw material requirements. Mineral chemistry. Fossils and their uses. Plant and animal products. Nuclear, solar, aerodynamic/wind and hydrodynamic sources of energy. Potentials and applications of locally available raw materials as industrial feed stocks.

**ICH 318: Management and Chemical Industry II (2 Units C: LH 30)**

**Course Contents**
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.

**ICH 319: Glassblowing Practical**
**(1 Unit C: PH 45)**

**Course Contents**

Properties of glass in general use. Manufacturers' symbols and what they represent. Types of glass used for laboratory wares. Identification methods, working temperatures. Coefficient of expansion, annealing, thermal resistance and 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.

**ICH 399: Industrial Attachment II (12 Weeks)**
**(3 Units C: PH 135)**

**Course Contents**

This course involves field work. The Students should be attached to some industrial organizations for additional 12 Weeks at the 300 Level preferably during the long vacation for more real-time relevant industrial experience. Students to be assessed based on seminar presentations, their reports and assessment by supervisors. This only applies to institutions that operate a 4-year industrial chemistry programme.

**ICH 301: Separation Methods and Analysis (3 Units: LH 30: P 45)**

**Course Contents**

Intermediate theory and laboratory techniques in analytical and physical chemistry. Advanced data analysis methods and goodness-of-fit criteria Spectroscopic methods and instrumentation. Separation methods: ion exchange, gas, paper, liquid and column chromatography; electrophoresis. Atomic and molecular absorption, emission and fluorescence spectrophotometry. Electroanalytical techniques. Quantitative analysis. X-ray methods. Refractometry, Interferometry, Polarimetry, Polarography & Calorimetry.

**ICH 302: Introductory Material Science**
**(2 Units: LH 30)**

**Course Contents**

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.

**ICH 303: Color and Textile Chemistry (3 Units: LH 30; PH 45)**

**Course contents**

The course introduces the student to the basic Classification of dyes and textile fibers. Natural regenerated and synthetic fibers. Physical and structural properties of fibers. Preparatory processes: Singeing, desiring, scouring, bleaching, mercerization and optical brightening. Colour and constitution. Theory of dyeing. Dyeing preparation, structure, and application of dyes. After treatments and quality control: Colour fastness.

**CHM 316: Applied Spectroscopy (2 Units C: LH 30)**

**Course Contents**

There is a 2 credit units course on the Principles and applications of UV, IR, NMR and mass spectroscopy in the determination and elucidation of structures of organic compounds. Brief mention of hyphenated systems: GC-MS, LC-MS and LC-NMR, and diagnostic use of NMR in medicine.

## KHAIRUN-CHM 319: Environmental Chemistry
## (2 Units C: LH 30)

**Course Content**

**400 Level**

**ICH 400: Seminar in Industrial Chemistry**
**(2 Units C: PH 90)**

**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. Pertaining 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; and
8. Writing Research Proposals**:** Methodology and Process

*Topics may be chosen from any three of the above in addition to (8) above.

**ICH 401: Research Project**
**(6 Units C: PH 270)**

**Course Content**
Research projects into selected topics in industrial chemistry. Students are expected to carry out literature survey on chosen topics, perform experiments and produce reports. Students will be subjected to both seminar and oral examinations on their projects.

**ICH 453: Chemistry of Industrial Processes**
**(3 Units C: LH 45)**

**Course Contents**
The course provides an 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.

**ICH 454: Chemical Process Technology**
**(3 Units C LH 45)**

**Course Contents**
Chemical process technology involves the Mixing and agitation; liquid-liquid, solid-liquid and gas-liquid systems. Scale up. Residence distribution functions for continuous flow systems. Correlation of heat transfer data. Use of effectiveness number of transfer units applied to heat exchangers. Solvent extraction with partially mixable liquids, selection of suitable extracting agents. Column height and cross section in gas washing. Multi-component vapour-liquid equilibria, bubble points and dew points; key components partial material balances.

The approximate design of Multi-component distillation columns. Minimum reflux ration, minimum number of theoretical stages; feed point location. Rigorous simulation procedure; multi-component composition profiles. Small refinery configurations. Optimization. Case studies covering fluid mechanics, heat and mass transfer processes. Linear Programming. The need for process control. Types of control; open loop, feed forward, feed-back, cascade feedback and adaptive control. Primary elements, final elements. Nature of offset; one, two and three term algorithms. Response to disturbances. Controller optimization. Control of systems with non-linear response characteristics. Direct digital control. Programmed control regimes.

**ICH 455: Macromolecular Chemistry**
**(3 Units C: LH 45)**

**Course Contents**
Macromolecular is about 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 499: Industrial Attachment (6 months)**
**(6 Units C: PH 270)**

**Course Contents**
The industrial chemistry requires that All candidates enrolled in a 5-year 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. A student enrolled in this course would be required to submit a report and give presentation at the end of the period of industrial attachment. The grading will normally be based on the reports, seminars and assessment of supervisors. For 4-year Industrial chemistry programme, students should be attached to some industrial organizations for additional 12 Weeks at the 300 Level preferably during the long vacation for more industrial experience. Students to be assessed based on seminar presentation, their reports and assessment by supervisors.

**CHM 406: Reaction Kinetics**
**(2 Units C: LH 30)**

**Course Contents**
Review of first, second and third order rate equations. Rate constants and equilibrium constants. Collision theory. Transition state theory. Reaction co-ordinates. Unimolecular reaction mechanisms. Bimolecular reaction mechanisms.

Chain reaction mechanisms. Chemical warfare, catalysis and heterogeneous reactions. Photochemical reaction mechanisms.

**ICH 404: Group Theory and Symmetry**
**(2 Units: LH 30)**

**Course Contents**
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, and full rotation group. Applications. General symmetry applications. Symmetry of crystal lattices, Block orbitals for infinite system. $C_{v\infty}$

**ICH 407: Electrochemistry**
**(2 Units: LH 15; PH 45)**

**Course Contents**
Chemical Equilibrium: Ionic equilibrium, 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.

**ICH 408: Organic Synthesis**
**(2 Units: LH 30)**

**Course Contents**
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 compounds. Construction of synthetic routes (disconnection approach); molecular self-assembly in synthesis. 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 iminium salts with nucleophile. Synthesis of complex molecules. Pericyclic reactions. Methodology for the construction synthetic routes. Applications for synthesis of important and complex organic compounds.

**ICH 409: Food Chemistry**
**(2 Units: LH 30)**

**Course Contents**
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 410: Analytical Chemistry II**
**(2 Units C: LH 30)**

**Course Contents**
Potentiometric and pH methods. Conduct metric, electro analytical, aerometric, colorimetric methods of analysis. Coupled methods of analysis e.g. GC-MS, LC-MS. Radio-chemical methods, chromatography.

**ICH 411: Agrochemical & Chemotherapeutic Agents**
**(3 Units: LH 45)**

**Course contents**
Pesticides, fungicides, and insect sex attractants. Survey of modern approaches to pest and fungal growth control. Naturally occurring pesticides – rotenoids, pyrethrenoids. Survey of synthetic chlorinated hydrocarbon insecticides. Insect pheromones – techniques of identification, isolation and structural determination and configuration – some synthetic analogues. Herbicides and growth regulation substances. Review of chemical groups used in growth control. Plant growth regulators. Some nitrogen containing herbicides – a review. Synthesis of selected nitrogen containing herbicides.

*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 prostaglandins. Synthetic approaches.

**ICH 415: Polymer Technology**
**(2 Units: LH 30)**

**Course Contents**
Large scale industrial polymerization processes. 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. Polymer processing, injection, extrusion, compression and transfer moulding of thermoplastics. Polymer additives. Polymeric surface coatings and adhesives. Thermosetting elastomers, plasticizers, resins and extrusion, spinning, vulcanization and reinforcement. Casting, testing and quality control: Chemical analysis. Birefringence measurement physical testing.

**CHM 424: Coordination Chemistry**
**(2 Units C: LH 30)**

**Course Contents**
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 Jahn-Teller distortions. Stabilization of unusual oxidation states by complex formation. Thermodynamic stability of complex compounds, the stability constant, the chelate effect. Preparation and reactions of complexes. Kinetics and mechanisms.

# B.Sc. MATHEMATICS

**Overview**

Mathematics programme develops in students' self-confidence in handling problems with minimal or no supervision. Graduates of the programme will acquire sufficient knowledge to develop confidence in appreciating and solving problems in general.

**Philosophy**

The philosophy of the mathematics programme is to train students to acquire academic excellence and competence in Mathematical reasoning and problem–solving through the use of logic and computational skills with main purpose of meeting our national needs in the area of technological advancement which is currently a global trend.

**Objectives**

1. 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.
2. To provide students a broad and balanced foundation in mathematics knowledge and practical skills in statistics and computer science.
3. To develop in students the ability to apply their mathematics knowledge and skills to the solution of theoretical and practical problems in mathematics.
4. To develop in students, through an education in mathematics, a range of transferable skills of value in

mathematical related and non-mathematical related employment.
5. To provide students with knowledge and skills base from which they can proceed to further studies in specialised areas of mathematics or multi-disciplinary areas involving mathematics.
6. To generate in students an appreciation of the importance of mathematics in an industrial, economic, environmental and social context.

**Employability Skills**

Mathematics is embodiment of employability skills and the graduates will be equipped with skills that include the following:
1. Learning and innovation skills
2. Life and career skills
3. Information, media and technology skills
4. quantitative reasoning;
5. ability to manipulate precise and intricate ideas;
6. numeracy.

**21st Century Skills**

1. creative and critical thinking;.
2. problem solving.
3. analytical thinking.
4. logical thinking.
5. communication;.
6. time management.
7. teamwork.
8. independence.

## Unique Features of the Programme

The unique features of the programme include

1. graduates will certainly possess the needed skills to bring to bear the applications of mathematics to address industrial and societal problems towards improvement of quality of life in both the developed and developing worlds taking advantage of current innovations in technology;
2. they will be well equipped to pursue careers in several other emerging areas that encompasses all the mathematics disciplines as well as many other areas of science, social science, business, etc. Examples include finance and cryptography, artificial intelligence, machine learning, actuarial science, climate change, energy and sustainable development, mathematical modeling, biomathematics; and
3. graduates will be equipped to demonstrate anywhere they find themselves that mathematical skills propel a better world and enable one to excel in every other field

## Admission and Graduation Requirements

### Admission Requirements

The entry requirements shall be at least credit level passes in five subjects including English Language, Mathematics, and Physics to form the core subjects with credit in any other two relevant science subjects at the Senior Secondary Certificate (SSC) or its equivalent. In addition, an acceptable pass in the Unified Tertiary Matriculation Examination (UTME), with appropriate subject combination is required for admission into 100 Level.

Candidates with two A level passes (graded A-E) at the GCE/IJMB Advanced Level in relevant subjects (Mathematics, Further Mathematics, Physics and Chemistry) may be admitted into 200-level.

**Graduation Requirements**

Students are required to pass a minimum of 120 credits and 90 credits for UTME and Direct entry students respectively.

## Global Course Structure
### Level 100

| Course Code | Course Title | Units | Status | LH | PH |
|---|---|---|---|---|---|
| GST 111 | Communication in English I | 2 | C | 15 | 45 |
| GST 112 | Nigerian Peoples and Culture | 2 | C | 30 | - |
| MTH 101 | Elementary Mathematics I | 2 | C | 30 | - |
| MTH 102 | Elementary Mathematics II | 2 | C | 30 | - |
| CSC 101 | Introduction to Computer Sciences | 3 | C | 30 | 45 |
| MTH 103 | Elementary Mathematics III | 2 | C | 30 | - |
| STA 112 | Probability I | 3 | C | 45 | - |
| STA 111 | Descriptive Statistics | 3 | C | 45 | - |
| PHY 101 | General Physics I | 2 | C | 30 | - |
| PHY 102 | General Physics II | 2 | C | 30 | - |
| PHY 103 | General Physics III | 2 | C | 30 | - |
| PHY 104 | General Physics IV | 2 | C | 30 | - |

| Course Code | Course Title | Units | Status | LH | PH |
|---|---|---|---|---|---|
| CHM 101 | General Chemistry I | 2 | E | 30 | - |
| CHM 102 | General Chemistry II | 2 | E | 30 | - |
| BIO 101 | General Biology I | 2 | E | 30 | - |
| BIO 102 | General Biology II | 2 | E | 30 | - |
| **Total** | | | **35** | | |

**200 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST 212 | Philosophy, Logic and Human Existence | 2 | C | 30 | - |
| ENT 211 | Entrepreneurship and Innovation | 2 | C | 30 | - |
| COS 201 | Computer Programming I | 3 | C | 30 | 45 |
| MTH 201 | Mathematical Methods I | 2 | C | 30 | - |
| MTH 202 | Elementary Differential Equations | 2 | C | 30 | - |
| MTH 203 | Sets Logic and Algebra I | 2 | C | 30 | - |
| MTH 204 | Linear Algebra I | 2 | C | 30 | - |
| MTH 205 | Linear Algebra II | 1 | C | 15 | - |
| MTH 207 | Real Analysis I | 2 | C | 30 | - |
| MTH 202 | History and Philosophy of Mathematics | 2 | C | 30 | - |
| MTH 209 | Introduction to Numerical Analysis | 2 | C | 30 | |
| MTH 210 | Vector Analysis | 1 | C | 15 | - |
| STA 211 | Probability II | 3 | C | 45 | - |

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| COS 202 | Computer Programming II | 3 | C | 30 | 45 |
| MTH 201 | Sets, Logic, and Algebra II | 2 | C | 30 | - |
| **Total** | | | **31** | | |

**300 Level**

| Course Code | Course Title | Units | Status | LH | PH |
|---|---|---|---|---|---|
| GST 312 | Peace and Conflicts Resolutions | 2 | C | 30 | - |
| ENT 311 | Enterprise Appreciation | 2 | C | 30 | - |
| MTH 300 | Abstract Algebra I | 2 | C | 30 | - |
| MTH 301 | Metric Space Topology | 2 | C | 30 | - |
| MTH 302 | Ordinary Differential Equations | 2 | C | 30 | - |
| MTH 303 | Vector and Tensor Analysis | 2 | C | 30 | - |
| MTH 304 | Complex Analysis I | 2 | C | 30 | - |
| MTH 305 | Complex Analysis II | 2 | C | 30 | - |
| MTH 306 | Abstract Algebra II | 2 | C | 30 | - |
| MTH 307 | Real Analysis II | 2 | C | 30 | - |
| MTH 308 | Introduction to Mathematical Modeling | 2 | C | 30 | - |
| MTH 310 | Mathematical Methods II | 2 | C | 30 | - |
| MTH 399 | Industrial Attachment II (12 Weeks) | 3 | C | - | |
| MTH 301 | Introduction to Mathematical Computing | 3 | C | 30 | 45 |
| **Total** | | **30** | | | |

**Level 400**

| Course Code | Course Title | Units | Status | LH | PH |
|---|---|---|---|---|---|
| MTH 401 | Theory of Ordinary Differential Equations | 2 | C | 30 | 45 |
| MTH 402 | Theory Of Partial Differential Equations | 2 | C | 30 | - |
| MTH 403 | Functional Analysis | 2 | C | 30 | - |
| MTH 404 | Project | 6 | C | - | - |
| MTH 405 | General Topology | 2 | C | 15 | 45 |
| MTH 406 | Lebesgue Measure and Integrals | 2 | C | 30 | - |
| MTH 407 | Mathematical Methods | 2 | C | 30 | - |
| MTH 408 | Entrepreneurship in Mathematics | 2 | C | 30 | - |
| KHAIRUN-MTH 401 | Research Methodology | 1 | C | 15 | - |
| KHAIRUN-MTH 402 | Discrete Mathematics | 3 | E | 45 | - |
| KHAIRUN-MTH 403 | Operations Research | 3 | E | 45 | - |
| KHAIRUN-MTH 404 | Dynamical Systems | 3 | E | 45 | - |
| KHAIRUN-MTH 405 | Group Theory | 3 | E | 45 | - |
| KHAIRUN-MTH 406 | Classical Theory of Numbers | 3 | E | 45 | - |
| KHAIRUN-MTH 407 | Numerical Linear Algebra | 3 | E | 30 | 45 |

| Course Code | Course Title | Units | Status | LH | PH |
|---|---|---|---|---|---|
| MTH 408 | Unconstrained Optimization Theory | 3 | E | 45 | - |
| MTH 409 | Fluid Dynamics | 3 | E | 45 | - |
| MTH 410 | Biomathematics | 3 | E | 45 | - |
| MTH 411 | Introduction to Data Science | 3 | E | 45 | - |
| **Total** | | **50** | | | |

## Course Contents and Learning Outcomes

### 100 Level

### GST 111: Communication in English
**(2 Units C: LH 30; PH 45)**

#### Course Contents

The course introduces to the basic of English communication like Sound patterns in English language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). Sentence in English (types: structural and functional, simple and complex). Grammar and Usage (tense, mood, modality and concord, aspects of language use in everyday life). Logical and Critical Thinking and Reasoning Methods (Logic and Syllogism, Inductive and Deductive Argument and Reasoning Methods, Analogy, Generalization and Explanations). Ethical considerations, Copyright Rules and Infringements. Writing Activities: (pre-writing, writing, post writing, editing and proofreading; brainstorming, outlining, paragraphing, types of writing, summary, essays, letter, curriculum vitae, report writing, note making etc. mechanics of writing). Comprehension Strategies: (reading and types of reading, comprehension skills, 3RsQ). Information and communication technology in modern language learning. Language skills for effective communication. Major word formation processes. Writing and reading comprehension strategies. Logical and critical reasoning for meaningful presentations. Art of public speaking and listening. Report writing.

**GST 112: Nigerian Peoples and Culture**
**(2 Units C: LH 30)**

**Course Contents**

The course is designed to introduce the science student to Nigerian history; culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and culture, peoples and culture of the ethnic minority groups). Nigeria under colonial rule (advent of colonial rule in Nigeria, colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914, formation of political parties in Nigeria. Nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics, Nigerian Civil War). concept of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigeria people; trade, skill acquisition and self-reliance). Social justices and national development (law definition and classification). Judiciary and fundamental rights. Individual, norms and values (basic Nigeria norms and values. Patterns of citizenship acquisition. Citizenship and civic responsibilities. Indigenous languages, usage and development. Negative attitudes and conducts. Cultism, kidnapping and other related social vices). Re-orientation, moral and national values (The 3R's – reconstruction, rehabilitation and re-orientation). Re-orientation strategies. Operation feed the nation (OFN). Green revolution and austerity measures. War against indiscipline (WAI). War against indiscipline and corruption (WAIC). Mass mobilization for self-reliance, social justice and economic recovery (MAMSER). National orientation agency (NOA). Current socio-political and cultural developments in Nigeria.

**COS 101: Introduction to Computing Sciences**
**(3 Units C: LH 30; PH 45)**

**Course Contents**

The course introduce the student to the Brief history of computing. Description of the basic components of a computer/computing device. Input/output devices and peripherals. Hardware, software and human ware. Diverse and growing computer/digital applications. Information processing and its roles in society. The Internet, its applications and its impact on the world today. The different areas/programs of the computing discipline. The job specializations for computing professionals. The future of computing.

**Lab Work: this is basically** Practical demonstration of the basic parts of a computer. Illustration of different operating systems of different computing devices including desktops, laptops, tablets, smart boards and smart phones. Demonstration of commonly used applications such as word processors, spreadsheets, presentation software and graphics. Illustration of input and output devices including printers, scanners, projectors and smart boards. Practical demonstration of the Internet and its various applications. Illustration of browsers and search engines. How to access online resources.

**MTH 101: Elementary Mathematics I (Algebra and Trigonometry)**
**(2 Units C: LH 30)**

**Course Contents**
Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers, mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem. Complex numbers, algebra of complex numbers, the Argand diagram. De-Moivre’s theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

**MTH 102: Elementary Mathematics II (Calculus)**
**(2 Units C: LH 30)**

**Course Contents**
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 (Vectors, Geometry and Dynamics)**
**(2 Units C: LH 30)**

**Course Contents**
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, normal. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

**STA 112: Probability I**
**(3 Units C: LH 45)**

**Course Contents**
Permutation and combination. Concepts and principles of probability. Random variables. Probability and distribution functions. Basic distributions: Binomial, geometric, Poisson, normal and sampling distributions; exploratory data analysis.

**STA 111: Descriptive Statistics**
**(2 Units C: LH=30)**

**Course Contents**
Statistical data. Types, sources and methods of collection. Presentation of data. Tables chart and
graph. Errors and approximations. Frequency and cumulative distributions. Measures of location, partition, dispersion, skewness and Kurtosis. Rates, ratios and index numbers.

**PHY 101: General Physics I**
**(2 Units C: LH=30)**

**Course Contents**
Space and time. units and dimension. vectors and scalars. differentiation of vectors: displacement, velocity and acceleration. Kinematics. Newton laws of motion (Inertial frames, Impulse, force and action at a distance, momentum conservation). relative motion. Application of Newtonian mechanics. equations of motion. conservation principles in physics, conservative forces, conservation of linear momentum, Kinetic energy and work, Potential energy, System of particles, Centre of mass. Rotational motion. torque, vector product, moment, rotation of coordinate axes and angular momentum, polar coordinates. conservation of angular momentum; Circular motion. Moments of inertia, gyroscopes and precession. gravitation: Newton's Law of Gravitation, Kepler's Laws of Planetary Motion, Gravitational Potential Energy, Escape velocity, Satellites motion and orbits.

**PHY 102: General Physics II**
**(2 Units C: LH=30)**

**Contents**
Forces in nature. Electrostatics, electric charge and its properties. methods of charging. Coulomb’s law and superposition. electric field and potential. Gauss’s law. Capacitance. Electric dipoles. Energy in electric fields; Conductors and insulators, current, voltage and resistance, Ohm’s law and analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savartand Ampère’s laws. magnetic dipoles, Dielectrics, Energy in magnetic fields, Electromotive force. Electromagnetic induction, Self and mutual inductances. Faraday and Lenz’s laws, Step up and step-down transformers: Maxwell's equations; Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, resistance, and combinations.

**PHY 103: General Physics III**
**(2 Units C: LH=30)**

**Course Contents**
Heat and temperature (temperature scales). Gas laws. General gas equation. Thermal conductivity. First Law of thermodynamics (heat, work and internal energy, reversibility). Thermodynamic processes (adiabatic, isothermal, isobaric). Second law of thermodynamics (heat engines and entropy). Zeroth law of thermodynamics. Kinetic theory of gases. Molecular collisions and mean free path. Elasticity (Hooke's law, Young's, shear and bulk moduli). Hydrostatics (Pressure, buoyancy, Archimedes' principles).

Bernoulli's equation and incompressible fluid flow. Surface tension (adhesion, cohesion, viscosity, capillarity, drops and bubbles).

**PHY104: General Physics IV**
**(2 Units C: LH=30)**

**Contents**
Simple harmonic motion (SHM): energy in a vibrating system, Damped SHM, Q values and power response curves, forced SHM, resonance and transients, coupled SHM. Normal modes. Waves: types and properties of waves as applied to sound; Transverse and Longitudinal waves; Superposition, interference, diffraction, dispersion, polarisation. Waves at interfaces, Energy and power of waves, the 1-D wave equation, 2-D and 3-D wave equations, wave energy and power, phase and group velocities, echo, beats, the doppler effect, propagation of sound in gases, solids and liquids and their properties. Optics: Nature and propagation of light; reflection, refraction, and internal reflection, dispersion, scattering of light, reflection and refraction at plane and spherical surfaces, thin lenses and optical instruments, wave nature of light; Huygens's principle, interference and diffraction.

**CHM101: General Chemistry I**
**(2 Units E: LH=30)**

**Contents**
Atoms, molecules, elements and compounds and chemical reactions. Modern electronic theory of atoms. Electronic

configuration, periodicity and building up of the periodic table. Hybridization and shapes of simple molecules. Valence Forces and structure of solids. Chemical equations and stoichiometry, chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

**CHM102: General Chemistry II**
**(2 Units E: LH=30)**

**Contents**
Historical survey of the development and importance of organic chemistry, fullerenes as fourth allotrope of carbon, uses as nanotubes, nanostructures and nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds. Determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry. Nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The Chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

**BIO 101: General Biology I**
**(2 Units E: LH=30)**

**Contents**
Cell structure and organisation, functions of cellular organelles. Characteristics and classification of living things. Chromosomes, genes; their relationships and importance. General reproduction. interrelationships of organisms (competitions, parasitism, predation, symbiosis, commensalisms, mutualism, saprophytism). Heredity and evolution (introduction to Darwinism and Lamarkism, Mendelian laws, explanation of key genetic terms). Elements of ecology and types of habitat.

**BIO 102: General Biology II**
**(2 Units E: LH=30)**

**Contents**
Basic characteristics, identification and classification of viruses, bacteria and fungi. A generalized survey of the plant and animal kingdoms based mainly on the study of similarities and differences in the external features. Ecological adaptations. Briefs on physiology to include nutrition, respiration, circulatory systems, excretion, reproduction, growth and development.

**200 Level**

**GST 212: Philosophy, Logic and Human Existence**
**(2 Units C: LH 30)**

**Course Contents**

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

**ENT 211: Entrepreneurship and Innovation**
**(2 Units C: LH 15; PH 45)**

**Course Contents**

Concept of entrepreneurship (entrepreneurship, entrepreneurship/corporate entrepreneurship,). Theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship and creative destruction). Characteristics of entrepreneurs (opportunity seeker, risk taker, natural and nurtured, problem solver and change agent, innovator and creative thinker). Entrepreneurial thinking (critical thinking, reflective thinking, and creative thinking).

innovation (concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation); enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and forming alliances and join ventures). Contemporary entrepreneurship Issues (knowledge, skills and technology, intellectual property, virtual office, networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship); basic principles of e-commerce.

**COS 201: Computer Programming I**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
Introduction to computer programming. Functional programming; Declarative programming; Logic programming; Scripting languages. Introduction to object-orientation as a technique for modelling computation. structured, and even some level of functional programming principles; Introduction of a typical object-oriented language, such as Java; Basic data types, variables, expressions, assignment statements and operators; Basic object-oriented concepts: abstraction; objects; classes; methods; parameter passing; encapsulation. Class hierarchies and programme organisation using packages/namespaces; Use of API – use of iterators/enumerators, List, Stack, Queue from API; Searching; sorting; Recursive algorithms; Event-driven programming: event-handling methods; event propagation;

exception handling. Introduction to Strings and string processing; Simple I/O; control structures; Arrays; Simple recursive algorithms; inheritance; polymorphism.

**Lab work**: Programming assignments; design and implementation of simple algorithms, e.g., average, standard deviation, searching and sorting; Developing and tracing simple recursive algorithms. Inheritance and polymorphism.

**MTH 201: Mathematical Methods 1**
**(2 Units C: LH 30)**

**Course Contents**
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 and three variables. Partial derivatives chain rule, extrema, lagrangian multipliers. Increments, differentials and linear approximations. Evaluation of line integrals. Multiple integrals.

**MTH 202: Elementary Differential Equations**
**(2 Units C: LH 30)**
**Course Contents**
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 differential equations. Application to geometry and physics.

**MTH 203: Sets, Logic and Algebra I**
**(2 Units C: LH 30)**

**Course Contents**
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, semi-groups, rings, integral domains, fields. Homeomorphism. Number systems; properties of integers, rationals, real and complex numbers.

**MTH 204: Linear Algebra I**
**(2 Units C: LH 30)**

**Course Contents**
Vector space over the real field. Sub-spaces, linear independence, basis and dimension. Linear transformations and their representation by matrices – rings, null space, rank. Singular and non-singular transformation and matrices. Algebra of matrices.

**MTH 205: Linear Algebra II**
**(1 Unit C: LH 15)**

**Course Contents**
Systems of linear equation, change of basis, equivalence and similarity. Eigen values and Eigen vectors. Minimum and characteristic polynomials of a linear transformation (matrix). Cayley-Hamilton theorem. Bi-linear and quadratic forms, orthogonal diagonalisation. Canonical forms.

**MTH 207: Real Analysis I**
**(2 Units C: LH 30)**

**Course Contents**
Bounds of real numbers, convergence of sequence of numbers. Monotone sequences, the theorem of nested intervals. Cauchy sequences, tests for convergence of series. Absolute and conditional convergence of series and re-arrangements. Completeness of reals and incompleteness of rationale. Continuity/and differentiability of functions. Rolles' mean and value theorems for differentiable functions, Taylor series.

**MTH 209: Introduction to Numerical Analysis**
**(2 Units C: LH 30)**

**Course Contents**
Solution of algebraic and transcendental equations. Curve fitting. Error analysis. Interpolation and approximation. Zeros of non-linear equations 'in one variable'. Systems of linear equations. Numerical differentiation and integration. Initial value problems in ordinary differential equation.

**MTH 210: Vector Analysis**
**(1 Unit C: LH 15)**

**Course Contents**
Elementary vector algebra, vector and vector triple, 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; Frenet-Serret formulas; differential definition ofgradients, divergent and simple multiplication)

**STA 211: Probability II**
**(3 Units, LH=45)**

**Course Contents**
Further permutation and combination. probability laws. conditional probability, independence. Bayes' theorem. probability distribution of discrete and continuous random variables: binomial, Poisson, geometric, hypergeometric, rectangular (uniform), negative exponential, binomial. Expectations and moments of random variables. Chebyshev's inequality. joint marginal and conditional distributions and moments. limiting distributions. discrete and continuous random variables, standard distributions, moments and moment-generating functions. laws of large numbers and the central limit theorem.

**COS 202: Computer Programming II**
**(3 Units C: LH=30, LP=45)**

**Course Contents**
This course is a continuation of CSC201. Review and coverage of advanced object-oriented programming - polymorphism, abstract classes and interfaces. Class hierarchies and programme organisation using packages/namespaces. Use of API – use of iterators/enumerators, List, Stack, Queue from API; Searching; sorting; Recursive algorithms; Event-driven

programming: event-handling methods; event propagation; exception handling. Applications in Graphical User Interface (GUI) programming.

**Lab work**: Programming assignments leading to extensive practice in problem-solving and programme development with emphasis on object-orientation. Solving basic problems using static and dynamic data structures. Solving various searching and sorting algorithms using iterative and recursive approaches. GUI programming.

**MTH 201: Sets, Logic, and Algebra II**

**(2 Units C: LH=30)**

**Course Contents**

Further Set Theory, Logic and Algebra: Cardinal numbers, Bernstein Theorem, infinite sets, countability; Propositional logic: Truth tables and logical equivalences, Normal Forms and Simplification of Propositional Formulas, Logical Connectives (conjunction, disjunction, negation, implication, equivalence), validity, satisfiability, and tautologies, logical consequence and deduction rules, applications of propositional logic (circuit design, automated reasoning). Quantification theory; universal and existential quantifiers. Divisibility and unique factorization of integers.

**MTH 202: History and Philosophy of Mathematics**
**(2 Units C: LH=30)**

**Course contents**

Mathematics: Definition of Mathematics based on some founding fathers of Mathematics. Fantastic facts about some founding fathers of Mathematics. Philosophy of Mathematics: The different Philosophies of Mathematics. The contributions of Arabs, Babylonians, Chinese, Egyptians, French and Greeks to Mathematics. The importance of critical thinking in Mathematics. The beauty of Mathematics. Mathematics as a discipline. Branches of Mathematics. The integration of Mathematics with computer as an electronic machine. Mathematics as a tool for human development. Mathematics of the 20th century; Hilbert problems, Poincare conjuncture, Fermat's last theorem, mathematical theory of dynamical systems.

## 300 Level

## GST 312: Peace and Conflict Resolution (2 Unit C: LH 30)

### Course Contents

Concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic and geo-political conflicts. Structural conflict theory, realist theory of conflict and frustration-aggression conflict theory. Root causes of conflict and violence in Africa: indigene and settlers' phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations, selected conflict case studies – Tiv-Junkun, Zango Kartaf, chieftaincy and land disputes and many more. peace building, management of conflicts and security, peace & human development. Approaches to peace & conflict management: (religious, government, community leaders and many more.). Elements of peace studies and conflict resolution, conflict dynamics assessment scales: constructive & destructive. Justice and legal framework and concepts of social justice. The Nigeria legal system. Insurgency and terrorism. Peace Mediation and Peace Keeping. Peace and security council (international, national and local levels). Agents of conflict resolution: conventions, treaties, community policing, evolution and imperatives. Alternative dispute resolution (ADR): a). dialogue b). arbitration c). negotiation d). collaboration and many more Roles of international organizations in conflict resolution: (a). The United Nations (UN) and its conflict resolution organs. (b).

The African Union & Peace Security Council (c). ECOWAS in peace keeping. Media and traditional institutions in peace building. Managing post-conflict situations/crisis: refugees. internally displaced persons (IDPs). The role of NGOs in post-conflict situations/crisis.

**ENT 312: Venture Creation**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
Opportunity Identification (Sources of business opportunities in Nigeria, Environmental scanning, Demand and supply gap/unmet needs/market gaps/Market Research, Unutilised resources, Social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial Finance (Venture capital, Equity finance, Micro finance, Personal savings, small business investment organisations and Business plan competition). Entrepreneurial marketing and e-commerce (Principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First mover advantage, E-commerce business models and successful E-Commerce Companies,). Small business management/family business: Leadership & management, Basic book keeping, Nature of family business and family business growth model. Negotiation and business communication (Strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer

solution, customer solution and emerging technologies, business applications of new technologies - Artificial Intelligence (AI), Virtual/Mixed Reality (VR), Internet of Things (IoTs), Blockchain, Cloud computing, Renewable energy etc. Digital business and E-Commerce strategies).

**MTH 300: Abstract Algebra I**
**(2 Units C: LH 30)**

**Course Contents**
Group definition, examples including permutation groups. Sub-groups, Cosets. Lagrange's theorem and applications. Cyclic groups. Rings: definition and examples including Z, Zn, rings of polynomials and matrices. Integral domains, fields. Polynomial rings, factorisation. Euclidean algorithm for polynomials, H.C.F. and L.C.M. of polynomials.

**MTH 301: Metric Space Topology**
**(2 Units C: LH 30)**

**Course Contents**
Sets, metrics, and examples. Open spheres (or balls). Open sets and neighbourhoods. Closed sets. Interior, exterior, frontier, limit points and closure of a set. Dense sub-sets and separable space. Convergence in metric space homeomorphisms. Continuity and compactness, connectedness.

**MTH 302: Ordinary Differential Equations**
**(2 Units C: LH 30)**

**Course Contents**
Ordinary differential equations: linear dependence, Wronskian, reduction order, variation of parameters, series solution about ordinary and regular points. Special functions: Gamma, Beta, Bessel, Legendre's theorem, hyper geometric. Laplace transform and applications to initial value problems

**MTH 303: Vector and Tensor Analysis**
**(2 Units C: LH 30)**

**Course Contents**
Vector differentiation and applications. Gradient, divergence and curl. Vector integration, line, surface and volume integrals, Greens, Stoke's and divergence theorems. Tensor products of vector spaces. Tensor algebra. Symmetry. Cartesian tensors.

**MTH 304: Complex Analysis**
**(2 Units C: LH 30)**

**Course Contents**
Functions of a complex variable. Limits and continuity of functions of a complex variable. Derivating the Cauchy-Riemann equations. Analytic functions. Bi-linear transformations, conformal mapping, 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**
**(2 Units C: LH 30)**

**Course Contents**
This course is a second phase of conflex analysis of Laurent expansions. Isolated singularities and residues. Residue theorem. Calculus of residue, and application to evaluation of integrals and to summation 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**
**(2 Units C: LH 30)**

**Course Contents**
Normal subgroups and quotient groups. Monomorphism, isomorphism theorems. Cayley's theorems. Direct products. Groups of small order. Group acting on sets. Sylow theorems. Ideal and quotient rings. P.I.D. &, U.F.D's Euclides rings. Irreducibility; Field extensions, degree of an extension, and minimum polynomial. Algebraic and transcendental extensions. Straight edged and compass constructions.

**MTH 307: Real Analysis II**
**(2 Units C: LH 30)**

**Course Contents**
Riemann integral of functions Rn→R, continuous monopositive functions. Functions of bounded variation. The Riemann Stieltjes integral. Pointwise and uniform convergence of sequences and series of functions Rn→R. Effects on limits (sums) when the functions are continuous differentiable or Riemann integrable. Power series.

**MTH 308: Introduction to Mathematical Modelling**
**(2 Units C: LH 30)**

**Course Contents**
This is an introductory course teaching student about 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. Applications of mathematical models to physical, biological, social and behavioral sciences.

**MTH 310: Mathematical Methods II**
**(2 Units C: LH 30)**

**Course Contents**
The course contains, Sturm – Liouville problems. Orthogonal polynomials 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 399: Industrial Attachment II (12 Weeks)**
**(3 Units C: PH 135)**

it is a field work, where are to Students should be attached to some industrial organizations for additional 12 weeks at their 300 Level preferably during the long vacation for more industrial experience. Students to be assessed based on seminar presentation, their reports and assessment by supervisors.

**MTH 301: Introduction to Mathematical Computing**
**(3 Units C: LH=30, PH=45)**

**Course Contents**
**This course involves :MATLAB (15 hours)** Basic MATLAB programming: introduction MATLAB environment and help system, basics of MATLAB interface and syntax, data types and scalar variables, arithmetic and mathematical functions, input and output, selection and iteration statements. Control structures. Functions: user defined functions, function files, passing information to and from functions, function design and program decomposition, recursion. Arrays: vectors, arrays and matrices, array addressing, vector, matrix and element-by element operations. Graphics: 2-D and 3-D plotting. Numerical methods in MATLAB such as root-finding, optimization and differential equations.

**PRACTICALS (45 hours)** MATLAB exercises; working with matrices, mathematical expressions (variables, numbers, operators, functions), vectorization, relational and logical operators, plotting functions, complex and statistical functions, input/output of variables (numbers and strings), flow control, MATLAB Simulink basic.

## 400 Level

### MTH 401: Theory of Ordinary Differential Equations (2 Units C: LH 30)

**Course Contents**

The course explains the Existence and uniqueness theorems, dependence of solutions on initial data and parameters. Properties of solutions. Sturm comparison and Sonin-Polya theorems. Linear and non-linear systems. Floquet's theory and stability theory. Integral equations: classification, Volterra and Fredholm types, Neumann series. Fredholm alternative for degenerate Hilbert – Schmidt kernels. Reduction of ordinary differential equations to integral equations. Symmetric kernels, eigenfunction expansion with application.

### MTH 402: Theory of Partial Differential Equations (2 Units C: LH 30)

**Course Contents**

It is about the Theory and solutions of first-order and second order linear equations. Classification, characteristics and canonical forms. Cauchy problems. Elliptic equations: Laplace's and Poisson's formulas, 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 problems.

**MTH 403: Function Analysis**
**(2 Units C: LH 30)**

**Course Contents**
This provides functional analysis on:Hilbert Spaces bounded linear functional, operators on Banach spaces, topological vector spaces, Banach algebra.

**MTH 404: Project:**
**(6 Units C: PH 270)**
A research project and dissertation to be undertaken on any topic of mathematical interest.

**MTH 405: General Topology**
**(2 Units C: LH 30)**

**Course Contents**
Topological spaces, definition, open and closed sets neighborhoods. Coarser, and finer topologies. Basis and sub-basis. Separation axioms, compactness, local compactness, connectedness. Construction of new topological spaces from given ones. Sub-spaces and quotient spaces. Continuous functions, homeomorphisms and topological invariants. Spaces of continuous functions: Point wise and uniform convergence.

**MTH 406: Lebesgue Measure and Integrals**
**(2 Units C: LH 30)**

**Course Contents**
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**
**(2 Units C: LH 30)**

**Course Contents**
Calculus of variation. Lagrange's functional and associated density. Necessary condition for a weak relative extremum. Hamilton's principles. Lagrange's equations and geodesic problems. The Du Bois-Raymond equation and corner conditions. Variable end-points and related theorems. Sufficient conditions for a minimum. Isoperimetric problems. Variation integral transforms. Laplace, Fourier and Hankel transforms. Complex variable methods, convolution theorems. Application to solution of differential equations.

**MTH 408: Entrepreneurship in Mathematics**
**(2 Units C: LH 30)**

**Course Contents**
Student should be exposed to programming languages and how to write projects using latex, web designing, printing technology and mathematics improvement projects.

**MTH 401: Research Methodology**
**(1 Unit C: LH=15)**

**Course Contents**
This involves Scientific research and literature survey. Finding and solving research problems, role of a supervisor, survey of a research topic, research proposal; basic component of research; introduction to scientific reading and writing, copyright issues, ethics, and plagiarism. major parts of project writing; research tools. Searching google (query modifiers), MathSciNet, ZMATH, Scopus, ISI Web of Science, impact factor, h-index, Google Scholar, ORCID, JStor, online and open access journals, virtual library of various countries, article review and research talk.

**MTH 402: Discrete Mathematics**
**(3 Units E, LH=45)**

**Course Contents**
Combinatory; Permutations and combinations, the pigeonhole principle, inclusion-exclusion principle, and generating functions. Graphs; Directed and un-directed graphs, sub graphs, cycles, connectivity, Eulerian and Hamiltonian graphs, planar graphs, and colouring. Application (flow Charts) and state transition graphs; lattices and Boolean Algebra, Finite fields: Mini polynomials. Irreducible polynomials, polynomial roots, Application (error-correcting codes, sequences generators). Algorithms and Complexity: Algorithm design, analysis of algorithms, asymptotic notation, and NP-completeness.

**MTH 403: Operation Research**
**(3 Units E: LH=45)**

**Course Contents**
This is an Introduction to Operations Research (OR): Overview, scope and applications, and the role of OR in decision-making. Linear Programming: Formulation of linear programming problems, graphical method, simplex method, duality theory, and sensitivity analysis. Network Analysis: Shortest path problems, maximal flow problems, and minimum cost flow problems. Integer Programming: Formulation of integer programming problems, branch and bound method, cutting plane method, and applications. Decision Analysis: Decision-making under uncertainty, decision trees, expected value of perfect information, and risk analysis. Simulation: Simulation modeling, Monte Carlo simulation, and applications.

**MTH 404: Dynamical Systems**
**(3 Units E: LH=45)**

**Course Contents**
The course among others students Introduces to Dynamical Systems: Definition of dynamical systems, examples of dynamical systems, and classification of dynamical systems based on their properties. One-dimensional Dynamical Systems: Iterated functions and periodic points. Linear Systems: Linear algebra review, eigenvalues and eigenvectors, matrix exponentials, and stability analysis of linear systems. Nonlinear Systems: Nonlinear algebra review, fixed points,

limit cycles, bifurcations, and chaos. Applications of Dynamical Systems: Examples from Physics, Engineering, Biology, and Economics.

**MTH 405: Group Theory**
**(3 Units E: LH=45)**

**Course Contents**
Group Actions: Definition and examples of group actions, orbit-stabilizer theorem, Burnside's lemma, Sylow's theorems, applications. Direct product of groups: Definition, examples and properties. Groups of small order. Solvable and nilpotent groups, simple groups, classification of finite simple groups, representation theory, free groups and presentations, finitely generated abelian groups. Group Theory Applications: Symmetry groups, group theory in Physics, Cryptography, coding theory, and combinatory.

**MTH 406: Classical Theory of Numbers**
**(3 Units E: LH=45)**

**Course Contents**
Congruences and residues; linear congruences in one variable (definition, examples, existence of solution and methods of finding solutions). Methods of solving system of linear congruences in one variable. The Chinese Remainder Theorem, and Wilson's Theorem. Diophantine problems (linear Diophantine equation and system of linear Diophantine equations) Pythagorean triples, Fermat's Last Theorem, and the Pell equation. Quadratic residues for prime and composite moduli (Legendre’s symbol, quadratic reciprocity, Gauss’

lemma and Jacobi’s symbol), quadratic reciprocity, and applications. Continued fractions and real numbers. Number-theoretic Functions: Euler's totient function, divisor functions, and Mobius inversion formula. Arithmetic Functions (Multiplicative and Additive functions with their examples). Waring’s Problems; Integer partitions. Cryptography: RSA cryptosystem and its security, discrete logarithm problem, and elliptic curve cryptography.

**MTH 407: Numerical Linear Algebra**
**(3 Units E: LH=30, PH=45)**

**Course Contents**
**Lectures (30 Hours)** Vector and Matrix norms; singular value decomposition; Gram-Schmidt Orthonormalization; Conditioning and stability; least squares problems; LU decomposition; Cholesky decomposition; Jacobi method; Gauss-Seidel method; SOR iteration; convergence of basic iterative methods; Generalized eigenvalue problems; Krylov subspace methods; QR method; power method; Arnoldi, Lanczos Eigenvalue algorithms.

**Practical (45 hours)**
Focused on matrix computations, LU decomposition implementation.

- **Application 1 -** Least squares for polynomial fitting,
- **Application 2 -** Scattered-Data Interpolation (RBF). The power method. QR decomposition. **Application 3 -** Principal component analysis (PCA),
- **Application 4 -** PCA-based feature selection,

- **Application 5-** Eigenfaces for face image recognition with PCA.
- **Application 6-** Image and Signal processing.

**MTH 408: Unconstrained Optimization Methods**
**(3 Units E: LH=45)**

**Course Contents**
This course provides: Definition of unconstrained optimization, examples of unconstrained optimization problems. One-dimensional search methods; Bisection method, Golden section search, Newton's, Secant method. Gradient based methods: Steepest descent, Newton’s method, quasi-Newton methods, conjugate gradient methods. Line search methods; Wolfe condition, Armijo rule, backtracking line search. Stochastic gradient descent; introduction to machine learning and neural networks, stochastic gradient descent for deep learning. Applications of unconstrained optimization; Least squares regression, Maximum likelihood estimation.

**MTH 409: Fluid Dynamics**
**(3 Units E: LH=45)**
**Senate-approved relevance to vision, mission, strategic goals, uniqueness and contextual**

**Course Contents**
Real and Ideal fluids. The notion of fluid particle. Kinematics of the flow field. Dimensional analysis. Equations of motion and continuity for incompressible inviscid fluids. Velocity potentials and Stoke's Stream functions. Bernoulli’s equation,

Cauchy-Bernoulli integral for unsteady flows. Two-dimensional flows. Complex potential limiting streamlines. Images and rigid planes. Lagrangian and Eulerian variables. Streamlines and path lines. Vorticity and circulation. The continuity equation. Stream function and calculation of the mass flux in 2D flows.

**MTH 410: Biomathematics**
**(3 Units E: LH=45)**

**Course Contents**
The course describes The role of Mathematics in Biology and Medicine with some examples. Mathematical models in ecology: Population dynamics (continuous and discrete time), Interactions of species; competition, predation, mutualism and symbiosis. Mathematical Genetics: Hardy-Weinberg law, Genetics matrices. Bayer's theorem and its applications to Genetics. Mathematical theory of epidemics: SI, SIS and SIR epidemic models, fitting data to epidemic models. Introduction to enzyme-Kinetics. An introduction to Agent Based Modeling Concept of agent-based modeling, the modeling environment, building simple models for biological systems/phenomenon.

**MTH 411: Introduction to Data Science**
**(3 Units E: LH=45)**

**Course Contents**
Supervised Learning: First step, learning curves, training-validation and test. Learning models generalities, support vector machines, random forest. Examples. Modeling:

Regression analysis, Regression: linear regression simple linear regression, multiple & Polynomial regression, Sparse model. Unsupervised learning, clustering, similarity and distances, quality measures of clustering, case study. Programming: Introduction, Toolboxes: Python/R, fundamental libraries for data Scientists. Integrated development environment (IDE). Data operations: Reading, selecting, filtering, manipulating, sorting, grouping, rearranging, ranking, and plotting.

# B.Sc. MICROBIOLOGY

**Overview**

The programme has been designed to provide a sound understanding of the concepts of microbiology in relation to mankind and the environment. The programme elaborates the importance of microorganisms and their products in industry (alcoholic beverages, petroleum and petrochemicals), health, food, agriculture, pharmacy and environmental sectors of the society. The Microbiology programmes will also emphasize the linkage between microbiology and biotechnology.

**Philosophy**

The philosophy of the course is to train microbiology graduates who will apply microbiological procedures and techniques to solving developmental needs of the society.

**Objectives**

The objectives of the programme are to:

1. broadly train students for positions in the industry, health sector, research institutes;
2. prepare them for graduate and professional studies in applied areas of microbiology; and
3. develop their business skills in various aspects of Applied Microbiology.

**Unique Features of the Programme**

The programme includes a wider range of modern aspects (food, industrial, medical, systematics, pharmaceutical, environmental, petroleum, waste management, agricultural, biotechnology including genetic engineering and entrepreneurial) of microbiology.

**Employability Skills**

A graduate with degree in microbiology can provide opportunities in sectors such as private and government hospitals, technicians in private laboratories, forensic science laboratories, pharmaceutical industry, environmental management organisations, petroleum and petrochemical companies, agriculture, educational institutions, food processing industry, dairy industry, alcohol production, brewery industry, government regulatory agencies and non-governmental organisations (NGOs).

A degree in microbiology should equip the individual with technical, laboratory, scientific analytical and writing capacities with excellent interpersonal and communication skills. To ensure success the individual should have meticulous attention to detail and display a keen interest in treating and preventing diseases that are harmful to humans, proffer measures to monitor food quality, control food and material biodeterioration and enhance environmental quality.

**21st Century Skills**

1. Critical thinking and problem solving
2. Reasoning, analysis and interpretation
3. Synthesising information
4. Research skills and practices
5. Problem solving,
6. Interrogation and questioning.

Finally other skills emphasized are creativity, artistry, curiosity, imagination, innovation, personal expression perseverance, self-direction, planning, self-discipline, adaptability and initiative.

## Admission and Graduation Requirements

### Admission Requirements

**Indirect entry**

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

**Direct entry**

Candidates with at least two A level passes GCE/IJMB/ JUPEB in two relevant subjects (Biology, Botany, Chemistry, Geography, Mathematics and Physics) may be admitted into 200-level, provided they satisfy the ‘O’ Level requirement.

### Graduation Requirements

To be eligible for the award of a Bachelor’s Degree in Microbiology, a student must pass a minimum 120 units for those admitted through UTME and 90 units for who came through direct entry.

## Global Course Structure

**100 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST 111 | Communication In English | 2 | C | 15 | 45 |
| GST 112 | Nigerian Peoples and Culture | 2 | C | 30 | |
| MTH 101 | Elementary Mathematics I | 2 | C | 30 | - |
| MTH 102 | Elementary Mathematics II | 2 | C | 30 | - |
| COS 101 | Introduction to Computing Sciences | 3 | C | 30 | 45 |
| BIO 101 | General Biology I | 2 | C | 30 | - |
| BIO 107 | General Biology Practical I | 1 | C | 45 | |
| CHM 101 | General Chemistry I | 2 | C | 30 | - |
| CHM 107 | General Chemistry Practical I | 1 | C | 45 | |
| PHY 101 | General Physics I | 2 | C | 30 | - |
| PHY 107 | General Physics Practical I | 1 | C | 45 | |
| BIO 102 | General Biology II | 2 | C | 30 | - |
| BIO 108 | General Biology Practical II | 1 | C | 45 | |
| CHM 102 | General Chemistry II | 2 | C | 30 | - |
| CHM 108 | General Chemistry Practical II | 1 | C | - | 45 |
| PHY 102 | General Physics II | 2 | C | 30 | - |
| PHY 108 | General Physics Practical II | 1 | C | - | 45 |
| MCB 101 | Introductory General Microbiology | 2 | C | 15 | 45 |
| **Total** | | | **31** | | |

**200 Level**

| Course Code | Course Title | Units | Status | LH | PH |
|---|---|---|---|---|---|
| GST 212 | Philosophy, Logic and Human Existence | 2 | C | 30 | |
| ENT 211 | Entrepreneurship and Innovation | 2 | C | 15 | 45 |
| MCB 221 | General Microbiology | 2 | C | 30 | |
| MCB 231 | Basic Techniques in Microbiology | 2 | C | - | 90 |
| MCB 223 | Microbial Biotechnology | 2 | C | 15 | 45 |
| MCB 224 | Medical Parasitology and Entomology | 2 | C | 15 | 45 |
| MCB 232 | Principles of Sterilization & Disinfection | 2 | E | 15 | 45 |
| MCB 233 | Biorisk Management | 2 | C | 15 | 45 |
| BIO 201 | Genetics | 2 | C | 15 | 45 |
| BIO 202 | Introductory Ecology | 2 | E | 15 | 45 |
| BIO 208 | Biostatistics | 2 | C | 15 | 45 |
| ZOO 211 | Invertebrates I | 2 | C | 15 | 45 |
| BCH 201 | General Biochemistry I | 2 | C | 15 | 45 |
| BCH 202 | General Biochemistry II | 2 | C | 15 | 45 |
| CHM 210 | Physical Chemistry I | 2 | C | 15 | 45 |

| Course Code | Course Title | Units | Status | LH | PH |
|---|---|---|---|---|---|
| CHM 211 | Organic Chemistry I | 2 | C | 15 | 45 |
| CHM 212 | Inorganic Chemistry I | 2 | C | 15 | 45 |
| **Total** | | **34** | | | |

**300 Level**

| Course Code | Course Title | Units | Status | LH | PH |
|---|---|---|---|---|---|
| GST 312 | Peace and Conflict Resolutions | 2 | C | 30 | |
| ENT 312 | Venture Creation | 2 | C | 30 | |
| MCB 398 | Entrepreneurship and Microbiology | 1 | C | 15 | |
| MCB 305 | Fungi of Medical, Food and Industrial Importance | 2 | C | 30 | |
| MCB 307 | Immunology | 3 | C | 45 | |
| MCB 399 | Industrial Attachment II (12 Weeks) | 3 | C | | |
| MCB 309 | Food Microbiology | 2 | C | 30 | |
| MCB 322 | Bacterial Diversity | 3 | C | 45 | |
| MCB 324 | Microbial Ecology | 3 | C | 45 | |
| MCB 301 | Food Quality Assessment and Safety | 2 | E | 15 | 45 |
| MCB 302 | Soil Microbiology | 2 | C | 15 | 45 |
| MCB 303 | Biodeterioration | 2 | C | 15 | 45 |
| MCB 303 | Plant Microbiology | 2 | E | 15 | 45 |
| MCB 306 | Field Course | 2 | C | - | 90 |
| MCB 308 | Pharmaceutical Microbiology | 2 | C | 15 | 45 |
| **Total** | | **31** | | | |

**400 Level**

| Course Code | Course Title | Units | Status | LH | PH |
|---|---|---|---|---|---|
| MCB 405 | Principles of Epidemiology and Public Health Management | 2 | C | 30 | |
| MCB 407 | Pathogenic Microbiology | 3 | C | 45 | |
| MCB 431 | Petroleum Microbiology | 2 | C | 30 | |
| MCB 412 | Microbial Genetics | 3 | C | 45 | |
| MCB 423 | Industrial Microbiology | 3 | C | 30 | 45 |
| MCB 424 | Microbial Physiology & Metabolism | 3 | C | 45 | |
| MCB 425 | Environmental Microbiology | 3 | C | 30 | 45 |
| MCB 482 | Virology & Tissue Culture | 2 | C | 30 | |
| MCB 491 | Research Project | 6 | C | | 270 |
| MCB 401 | Aquatic Microbiology | 2 | E | 15 | 45 |
| MCB 403 | Research Methodology | 2 | C | 15 | 45 |
| MCB 404 | Analytical Microbiology and Quality Control | 2 | C | 15 | 45 |
| **Total** | | | **31** | | |

**Course Contents**

**100 Level**

**GST 111: Communication in English**
**(2 Units C: LH 30; PH 45)**

**Course Contents**
This is a GST course that introduces the students to the basic of English Language like Sound patterns in English language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). Sentence in English (types: structural and functional, simple and complex). Grammar and Usage (tense, mood, modality and concord, aspects of language use in everyday life). Logical and Critical Thinking and Reasoning Methods (Logic and Syllogism, Inductive and Deductive Argument and Reasoning Methods, Analogy, Generalisation and Explanations). Ethical considerations, Copyright Rules and Infringements. Writing Activities: (pre-writing, writing, post writing, editing and proofreading; brainstorming, outlining, paragraphing, types of writing, summary, essays, letter, curriculum vitae, report writing, note making etc. mechanics of writing). Comprehension Strategies: (reading and types of reading, comprehension skills, 3RsQ). Information and communication technology in modern language learning. Language skills for effective communication. Major word formation processes. Writing and reading comprehension strategies. Logical and critical reasoning for meaningful presentations. Art of public speaking and listening. Report writing.

**GST 112: Nigeria Peoples and Culture**
**(2 Units C: LH 30)**

**Course Contents**

The course introduces the students to Nigerian history; culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and culture, peoples and culture of the Ethnic Minority Groups). Nigeria under colonial rule (advent of colonial rule in Nigeria, colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914, formation of political parties in Nigeria. Nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics, Nigerian Civil War). Concept of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigeria people; trade, skill acquisition and self-reliance). Social justices and national development (law definition and classification). Judiciary and fundamental rights. Individual, norms and values (basic Nigeria norms and values. Patterns of citizenship acquisition. Citizenship and civic responsibilities. Indigenous languages, usage and development. Negative attitudes and conducts. Cultism, kidnapping and other related social vices). Re-orientation, moral and national values (The 3R's – reconstruction, rehabilitation and re-orientation). Re-orientation strategies. Operation feed the nation (OFN). Green revolution and austerity measures. War against indiscipline (WAI). War against indiscipline and corruption (WAIC). Mass mobilization for self-reliance, social justice and economic recovery (MAMSER). National orientation agency (NOA). Current socio-political and cultural developments in Nigeria.

**MTH 101: Elementary Mathematics I (Algebra and Trigonometry)**
**(2 Units C: LH 30)**

**Course Contents**

This is an Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers, Mathematical Induction, real sequences and series, theory of quadratic equations, binomial theorem. Complex numbers, algebra of complex numbers, the Argand diagram. De-Moivre's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

**MTH 102: Elementary mathematics II (Calculus)**
**(2 Units C: LH 30)**

**Course Contents**

The course is on the 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.

**COS 101: Introduction to Computing Sciences**
**(3 Units C: LH 30; PH 45)**

**Course Contents**

This provides the brief history of computing. Description of the basic components of a computer/computing device. Input/Output devices and peripherals. Hardware, software and human ware. Diverse and growing computer/digital applications. Information processing and its roles in society. The Internet, its applications and its impact on the world today. The different areas/programs of the computing discipline. The job specializations for computing professionals. The future of computing.

**Lab Work:** It is a practical based course that is mainly a practical demonstration of the basic parts of a computer. Illustration of different operating systems of different computing devices including desktops, laptops, tablets, smart boards and smart phones. Demonstration of commonly used applications such as word processors, spreadsheets, presentation software and graphics. Illustration of input and output devices including printers, scanners, projectors and smart boards. Practical demonstration of the Internet and its various applications. Illustration of browsers and search engines. How to access online resources.

**BIO 101: General Biology I**
**(2 Units C: LH 30)**

**Course Contents**
It is an introduction to cell structure and organisation, functions of cellular organelles. Characteristics and classification of living things. Chromosomes, genes; their relationships and importance. General reproduction. interrelationships of organisms (competitions, parasitism, predation, symbiosis, commensalisms, mutualism, saprophytism). Heredity and evolution (introduction to Darwinism and Lamarkism, Mendelian laws, explanation of key genetic terms). Elements of ecology and types of habitat.

**BIO 102: General Biology II**
**(2 Units C: LH 30)**

**Course Contents**
It entails the basic characteristics, identification and classification of viruses, bacteria and fungi. A generalized survey of the plant and animal kingdoms based mainly on the study of similarities and differences in the external features. Ecological adaptations. Briefs on physiology to include nutrition, respiration, circulatory systems, excretion, reproduction, growth and development.

**BIO 107: General biology Practical I**
**(1 Unit C: PH 45)**

**Course Contents**

Common laboratory hazards. Prevention and first aid. Measurements in biology. Uses and care of microscope. Compound and dissecting microscope. Biological drawings and illustration, scaling, accuracy and proportion. Use of common laboratory apparatus and laboratory experiments designed to illustrate the topics covered in **BIO 101.**

**BIO 108: General Biology Practical II**
**(1 Unit C: PH 45)**

**Course Contents**

Anatomy of flowering plants, primary vegetative body Stem, leaf and root to show the mature tissues namely parenchyma, collenchyma, sclerenchyma, xylem and phloem. Types of fruits and seeds. Care and use of dissecting kits and other biological wares. Dissection and general histology of animal tissues based on vertebrate forms. Morphology and functions of epithelial, muscular, nervous and connective tissues. Examination of various groups of lower invertebrates under microscopes, identification of various groups of organisms in Animal Kingdom and any experiment designed to emphasize the practical aspects of topics in BIO 102.

**CHM 101: General Chemistry I**
**(2 Units C: LH 30)**

**Course Contents**
Atoms, molecules and chemical reactions. Modern electronic theory of atoms. Electronic configuration; periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence Forces. Structure of solids. Chemical equations and stoichiometry. Chemical bonding and intermolecular forces. Kinetic theory of matter. Elementary thermochemistry, rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

**CHM 102: General Chemistry II**
**(2 Units C: LH 30)**

**Course Contents**
Historical survey of the development and importance of Organic Chemistry. Fullerenes as fourth allotrope of carbon, uses in nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds. Determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry. Nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The Chemistry of selected metals and

non-metals. Comparative chemistry of group IA, IIA and IVA elements.

**CHM 107: General Chemistry Practical I**
**(1 Unit C: PH 45)**

**Course Contents**
The course is a Laboratory base where Laboratory experiments are designed to reflect the topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation

**CHM 108: General Chemistry Practical II**
**(1 Unit C: PH 45)**

**Course Contents**
Continuation of CHM 107.It require an additional laboratory experiments that include functional group analysis and quantitative analysis by using volumetric methods

**Course Contents**
space and time. units and dimension. vectors and scalars. differentiation of vectors: displacement, velocity and acceleration. Kinematics. Newton laws of motion (Inertial frames, Impulse, force and action at a distance, momentum conservation). relative motion. Application of Newtonian mechanics. equations of motion. conservation principles in physics, conservative forces, Conservation of linear momentum, Kinetic energy and work, Potential energy, System of particles, Centre of mass. Rotational motion. torque,

vector product, moment, rotation of coordinate axes and angular momentum, polar coordinates. conservation of angular momentum; Circular motion. Moments of inertia, gyroscopes and precession. gravitation: Newton's Law of Gravitation, Kepler's Laws of Planetary Motion, Gravitational Potential Energy, Escape velocity, Satellites motion and orbits.

**PHY 102: General Physics II (Electricity & Magnetism) (2 Units C: LH 30)**

**Course Contents**

Forces in nature. Electrostatics (electric charge and its properties, methods of charging). Coulomb's law and superposition. Electric field and potential. Gauss's law. Capacitance. Electric dipoles. Energy in electric fields. Conductors and insulators. DC circuits (current, voltage and resistance. Ohm's law. Resistor combinations. Analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère's laws. Magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz's laws. Step up and step down transformers. Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, and resistance.

**PHY 107: General Practical Physics**
**(1 Unit C: PH 45)**

**Course Contents**

This is an introductory course which emphasizes the quantitative measurements, the treatment of measurement errors, and graphical analysis. A variety of experimental techniques should 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. However, emphasis is placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

**PHY 108: General Practical Physics**
**(1 Unit C: PH 45)**

**Course Contents**

This practical course that is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

**MCB 101 Introductory General Microbiology**
**(2CU C; LH 15; PH 45)**

**Course contents**

The course provides the definition and scope of Microbiology. The types of Microorganisms, ubiquity and importance of microorganisms in food, water, industry, agriculture, environment, medicine, veterinary medicine, pharmacy and biotechnology. Microbial taxonomy. Basic laboratory equipment and wares used in microbiology laboratory including demonstration on their operations. Safety precautions in microbiology laboratory. Culture media and their classifications. Isolation of microorganisms from various sources. Culture maintenance, Culture preservation. Control of microorganisms. Laboratory report writing.

## 200 Level

### GST 212: Philosophy, Logic and Human Existence
### (2 Units C: LH 30)

**Course Contents**

The course introduces the Science Students to the scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

### ENT 211: Entrepreneurship and Innovation
### (2 Units C: LH15; PH 45)

**Course Contents**

It is about the concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship,). Theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship and creative destruction). Characteristics of entrepreneurs (opportunity seeker, risk taker, natural and nurtured, problem solver and change agent, innovator and creative thinker). Entrepreneurial thinking (critical thinking, reflective thinking, and creative thinking).

Innovation (concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation); enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and forming alliances and join ventures). Contemporary entrepreneurship Issues (knowledge, skills and technology, intellectual property, virtual office, networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship); basic principles of e-commerce.

**MCB 221: General Microbiology**
**(2 Units C: LH 15; PH 45)**

**Course Contents**

The course forgrounds students on the History of the Science of Microbiology. Classification of organisms into prokaryotes and eukaryotes. Classification of prokaryotes into archaea and eubacteria. Anatomy and cytochemistry of bacteria and fungi; shapes, groupings and colonial morphology of bacteria and fungi. Structure of viruses. Sterilization and disinfection. Structure, ecology and reproduction of representative microbial genera. Culture of micro-organisms. Isolation of micro-organisms. Isolation of bacteria, viruses fungi (yeasts and moulds, nutrition and biochemical activities of micro-organisms. Antigens and antibodies. Identification and economic importance of selected microbial groups. Microbial variation and heredity. Study of laboratory equipment. Introduction to microbiology of air food, milk, dairy products, water and soil. Staining techniques, antibiotic sensitivity tests, serological tests, antimicrobial agents.

**MCB 231: Basic Techniques in Microbiology**
**(2 Units C: PH 90)**

**Course Contents**

It describes the culturing of micro-organisms. Preparation of media for microbial growth. Isolation of pure culture. Streaking, pour plates etc. Subculturing procedures. Staining techniques for differentiation of micro-organisms. Enumeration of micro-organisms, direct and indirect procedures. Identification of micro-organisms to include colonial and cellular morphology and biochemical procedures. Identification of bacteria should also include the use of serological techniques, antibiotic sensitivity discs and agar-in well methods. The use of anaerobic jar for growth of anaerobic organisms. Methods of preservation (agar slants, frequent subculturing, refrigeration and use of deep freezers, lyophilisation, storage in liquid nitrogen) of microbial cultures.

**MCB 223 Microbial Biotechnology**
**(3CU C; LH 30; PH 45)**

**Course content**

Basic concepts of Molecular Biology (Principal macromolecules and other Biomolecules). Introduction to genes and genomics. Gene expression and regulation. Brief history of recombinant DNA technology. Biotechnological techniques, recombinant DNA techniques in biotechnology.

Polymerase Chain Reaction (PCR). Preparation of recombinant DNA, Cloning and Cloning vectors. Introduction of DNA into bacteria and yeasts. Selection and Preservation of the transformed microorganisms. Production of Metabolites using microorganisms: Bio-insecticides, Amino acids, Antibiotics etc. Applications of Microbial Biotechnology (Medical, Environmental, Agricultural, Industrial e.t.c).

**MCB 224 Medical Parasitology and Entomology**

**(2CU C; LH 15; PH 45)**

**Course contents**

This is an introduction to Parasitism, Host Parasite Relationship, characteristics, morphology, lifecycle, pathogenesis, epidemiology, diagnosis and control of intestinal and luminal protozoa. Amoebae (*Entamoeba* species, *Dientamoeba fragilis, Endolimax nana, Iodamoeba butschili, Chilomatix mesnili*), pathogenic free-living amoebae (*Naegleria fowleri, Acanthamoeba* species). Ciliates: *Balantidium coli*. Blood and tissue flagellates: *Trypanosoma brucei gambiense*, *T. brucei* rhodesiense, *Trypanosoma cruzi* (Chaga's disease), *Leishmania* species. Intestinal and luminal flagellates (*Giardia lamblia* and related species, *Trichomonas vaginalis, T. tenax, T. hominis*). Tissue coccidia (*Toxoplasma gondii, Cryptosporidium parvum, Sarcocystis hominis, Isospora belli, Cyclospora cayetanensis*). Malaria parasites (*Plasmodium* species), *Babesia* species. Study of the following insects; *Glossina species*, *Musca domestica*, Black fly, Mosquitoes, Fleas etc.

**MCB 232 Principles of Sterilization and Disinfection (2CU E; LH 15; PH 45)**

**Course content**

The course provides the general introduction and definition of terms. Methods of Sterilization: Physical (Heat, Radiation, Filtration, etc). Chemical (Gaseous and liquids), Disinfection and Antisepsis. Desirable properties of effective disinfectants and antiseptics. Disinfectants/Antiseptics: Phenols, Alcohols, Quaternary ammonium compounds, Halogens and Dyes. Miscellaneous agents (Chlorhexidine, Dequalinum compounds, Heavy metals and their compounds). Evaluation of Disinfectants: Assessment of bacteriostatic activity. Minimum inhibitory concentration. Minimum bacteriocidal concentration, Time survival technique. Rideal-Walker (Phenol coefficient) test. Chick- Martin test. Kelsey- Sykes test. The in-use test.

**MCB 233 Biorisk Management (2CU C; LH 15; PH 45)**

**Course content**

The content include definition of common terms (risk, hazard, threat, biorisk, biosafety, biosecurity, biorisk management, valuable biological materials, risk assessment, risk characterization and risk mitigation). Risk associated with biological work, Biorisk management framework. Assessment, mitigation and performance (AMP) model. Basic Biosafety and Biosecurity risk assessment. Performance evaluation and its importance. Relevance of Biorisk management in global health security framework. Biological

Waste and Waste Management. Record and Record Keeping, etc. Identifying Biological risk spectrum and Biological Safety and Security tools using case studies. Biosafety in Microbiology and Molecular Biology. Introduction to agents of bioterrorism. Assessment of biological hazards and risks. Biorisk Mitigation via personal protective equipment and biosafety cabinets.

**BIO 201 – Genetics**
**(2 Units Core: LH 30, PH)**

**Course contents**
Molecular basis of heredity; chromosome structure; patterns of Mendelian and non-Mendelian inheritance; evolution; biotechnological applications; Hereditable and non-hereditable characteristics; Probability and tests of goodness of fit; Quantitative inheritance; variation in genome structure; introduction to population genetics.

**BIO 202 Introductory Ecology**
**(Units = 2, Status = C, LH = 15, PH = 45)**

**Course Contents**
Concept and definition of ecosystem. Autecology and synecology. Ecology at community level. Ecological classification. Molecular Ecology. Organismal Ecology. Population Ecology. Global Ecology. Landscape Ecology. Habitat types. Terrestrial biomass. Aquatic biomass. Specific features of each biomass. Biotic components of habitat. Natural destruction. Factors of communities. Success of

community interaction. Natural cycle. Dynamics of population.

**BIO 208: Biostatistics**
**(2 Units C: LH 15; PH 45**)

**Course Contents**
Variability in biological data: continuous and discontinuous variables. statistical sampling procedures. observations and problems of estimation. representation and summarization of biological data. frequency distribution. measures of central tendency and dispersion. Probability theory. normal, binomial and Poisson distribution. t-test, f-test and chi-square test. analysis of variance (ANOVA) and covariance. principles of experimental design. correlation, linear and curvilinear regression and transformation.

**ZOO 211 Invertebrate Zoology**
**(2 Units; Core; L = 30, PH =45)**

**Course Contents**
Introduction to the diversity of lower invertebrates. Classification of lower invertebrates. Morphology life cycle and physiology of lower invertebrates. Identification of lower invertebrates. The systematics, inter-relationship, and basic organization of the lower invertebrates, of the Phylum Protozoa, Porifera, Coelenterate, Platyhelminths, Nematoda, Entoprocta, Nemertinea, Acanthocephala, and Rotifera.

**BCH 201 General Biochemistry I**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
Introductory chemistry of amino acids, their properties, reactions and biological functions. Classification of amino acids: neutral, basic and acidic; polar and non-polar; essential and nonessential amino acids. Peptides. Introductory chemistry and classification of proteins. Biological functions of proteins. Methods of their isolation, purification and identification. Primary, secondary, tertiary and quaternary structures of proteins. Basic principles of tests for proteins and amino acids. Introductory chemistry of carbohydrates, lipids and nucleic acids. Nomenclature of nucleosides and nucleotides, effects of acid and alkali on hydrolysis of nucleic acids.

**BCH 202 General Biochemistry II**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
The cell theory. Structures and functions of major cell components. Cell types, constancy and diversity. Cell organelles of prokaryotes and eukaryotes. Chemical composition of cells. Centrifugation and methods of cell fractionation. Structure, function and fractionation of extracellular organelles. Water, total body water and its distribution. Regulation of water and electrolyte balance. Disorder of water and electrolyte balance. Acidity and

alkalinity, pH and pK values and their effects on cellular activities.

**CHM 210 Physical Chemistry I**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
Kinetic theory of gases; science of real gases; the laws of thermodynamics; 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 I**
**(2 Units C: LH 15; PH 45)**

The course forgrounds the Chemistry of aromatic compounds. The structures of simple sugars, starch and cellulose, peptides, and proteins. Chemistry of bifunctional compounds. Energetics, kinetics, and the investigation of reaction mechanisms. Mechanisms of substitution, elimination, addition, and rearrangement reactions. Stereochemistry. Examples of various named organic reactions e.g., Grignard reaction, Aldol and related reactions. Simple alicyclic carbon compounds and their synthesis.

**CHM 212: Inorganic Chemistry I**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
Chemistry of first row transition metals. Introduction to coordination 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 organometallic chemistry. Role of metals in biochemical systems. Concepts of hard and soft acids and bases. Oxidation and reduction reactions

**300 Level**

**GST 312: Peace and Conflict Resolution**
**(2Units C: LH 30)**

**Course Contents**

The GST course is meant to introduce students to the basic concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic and geo-political conflicts. Structural conflict theory, realist theory of conflict and frustration-aggression conflict theory. Root causes of conflict and violence in Africa: indigene and settlers' phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations, selected conflict case studies – Tiv-Junkun, Zango Kartaf, chieftaincy and land disputes and many more. peace building, management of conflicts and security, peace & human development. Approaches to peace & conflict management: (religious, government, community leaders and many more.). Elements of peace studies and conflict resolution, conflict dynamics assessment scales: constructive & destructive. Justice and legal framework and concepts of social justice. The Nigeria legal system. Insurgency and terrorism. Peace Mediation and Peace Keeping. Peace and security council (international, national and local levels). Agents of conflict resolution: conventions, treaties, community policing, evolution and imperatives. Alternative dispute resolution (ADR): a). dialogue b). arbitration c). negotiation d). collaboration and many more Roles of international organizations in conflict resolution: (a). The

United Nations (UN) and its conflict resolution organs. (b). The African Union & Peace Security Council (c). ECOWAS in peace keeping. Media and traditional institutions in peace building. Managing post-conflict situations/crisis: refugees. internally displaced persons (IDPs). The role of NGOs in post-conflict situations/crisis.

**ENT312: Venture Creation**
**(2 Units C: LH 30; PH 45)**

**Course Contents**
Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research); entrepreneurial finance (venture capital, equity finance, Micro finance, Personal savings, small business investment organizations and Business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, first mover advantage, E-commerce business models and successful E-commerce companies,). Small business management/family business. Leadership & management. Basic book keeping. Nature of family business and family business growth model. Negotiation and business communication (Strategy and tactics of negotiation/bargaining. Traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching).

Technological Solutions (the concept of market/customer solution, customer solution and emerging technologies. Business applications of new technologies - Artificial Intelligence (AI), Virtual/Mixed Reality (VR), Internet of Things (IoTs), Blockchain, Cloud Computing, Renewable Energy etc. Digital Business and E-Commerce Strategies).

**MCB 398 Entrepreneurship for Microbiology**
**(2 Units C: LH 30)**

**Course Contents**

It is a course that introduces the students of Microbiology to the basic concepts of entrepreneurship and Business skills. Scope of various aspects of Applied Microbiology- Medical Microbiology, Public health Microbiology, Immunology, Agricultural Microbiology, Food and Dairy Microbiology, Industrial Microbiology, Microbial Ecology, Petroleum Microbiology, Microbial Genetics and Molecular Biology, Genetic Engineering, Impact Assessment, Health Safety and Environment. Students will be exposed to employment opportunities in these aspects. Students will be introduced to various self – employment opportunities in these aspects of Microbiology. Students will be assisted in designing businesses of their choice within these aspects. The designed business may be validated by a professional entrepreneur educator and a professional in the field of study that relates to the business in question so as to assess the workability of the business as a small scale business, the financial cost of the business, market outlet of the business, economic gain of the business and its sustainability. Team (5 to 7 students) work will be encouraged so as to prevent repeated business design by single individuals, reduce financial cost of setting individual businesses and strengthen the manpower capacity of the business. Success stories of business entrepreneurs would be included in the curriculum especially in the student field of study so as to motivate the student to develop interest towards self – employment and self-productivity Students with best business design would be given recognition.

**MCB 305: Fungi of Medical, Food and Industrial Importance**
**(2 Units C: LH 30)**

**Course Contents**
Structure, life cycles, physiology and classification of fungi. Fungi of medical, food and industrial Importance, fungal pathogenicity, immunity epidemiology, incidence treatment- Superficial mycoses (ringworm, superficial candidosis, pityriasis), subcutaneous mycoses (Mycetoma, Histoplasmosis, Phaeohyphomycosis). Systemic mycoses coccidomycoses, blastomycose, Paracocidio-domycosis, aspergillosis, cryptococcosis). Fungi of food and industrial importance (Aspergillus niger, Saccharomyces cerevisiae importance. Metabolites of fungi, industrial uses of fungi. Fungi in medicine.

**MCB 307: Immunology**
**(3 Units: C LH 30; PH 45)**

**Course Contents**
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, effect or systems of parasite killing and nature of resistance in plants. Animal and human vaccine production.

**MCB 309: Food Microbiology**
**(2 Units C: LH 30; PH 45)**

**Course Contents**
The distribution, role and significance of micro-organisms in food. The examples of international and national fermented foods. Intrinsic and extrinsic parameters of foods that affect microbial growth. Food spoilage and food borne diseases. Microbial indices of food sanitary quality international and national microbiology standards for food quality. Diseases of animal transmittable to man via food products. Rapid methods for assessing microbiological quality of foods. Traditional and modern methods for food preservation. 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 micro-organisms in food. Exploitation of micro-organisms in novel processes for the production of food ingredients.

**MCB 322: Bacterial Diversity**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
The morphology, life cycle and biochemical characteristics of bacteria. Systematic study of bacteria (autotrophic-photoautotrops, chemoautotrophs and heterotrophic-enterobacteriaceae, pseudomonadaceae, bacillaceae) and other prokaryotes (Mycoplasma, Clamydia), their nature, characteristics, habitats, identification and isolation.

**MCB 324: Microbial Ecology**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
Microbes and ecological theory. Microbial evolution (chemical and cellular evolution) and biodiversity, phylogeny, physiological, morphological and genetic adaptations of micro-organisms to their environment. Microbial interactions (interactions among microbial populations, interaction between microorganisms and plants interactions between microorganisms and animals). Micro-organisms in natural ecosystems. The life of micro-organisms in air, springs, rivers, lakes and seas. Biogeochemical cycling of elements in water, soil and sediments (including methanogenesis, methylotrophy transformations involving carbon, nitrogen, sulphur, phosphorus and manganese etc.). Microbial community dynamics (include genetic/molecular diversity indices, species diversity indices). Biotechnology aspects of microbial ecology (e.g. global warming, microbial enhanced oil recovery, liquid

waste treatment, recovery of metals and biofuel generation). Aeromicrobiology.

**MCB 399: Industrial Attachment II**
**(12 Weeks) (3 Units C)**

**Course Contents**
This course entails that students be posted to industrial establishments such as food processing, brewing, distillery industries, pharmaceutical companies into places, research institutes, petroleum companies, petrochemical companies, government regulatory agencies, medical and health institutions. After a successful mandatory period, a report is written and submitted for grading.

**MCB 301 Food Quality Assessment and Safety**
**(2CU E; LH 15; PH 45)**

**Course Contents**
Agents important in food spoilage, food borne illnesses (food intoxication/poisoning and food infection). Food preservation methods (physical, chemical and biological). Monitoring food quality and safety (sampling and sampling procedures, chemical and microbiological analysis). The use of indices/markers in food analysis, microbiological standards and specifications. Food plant sanitation (general cleaning and disinfection). Bacteriology of water. Food-plant water characteristics. Food solid wastes characteristics and treatment. Introduction to hazards analysis critical control point (HACCP). Agencies involved in food safety and quality

management: International agencies and their functions. Nigerian agencies and their functions. Nigerian food laws.

**MCB 302 Soil and Agricultural Microbiology**
**(2CU C; LH 15; PH 45)**

**Course Contents**
This is a course that dwells on the soil environment: Composition, Physical, Chemical and biological properties of soil. Microbial flora of soil environment—Bacteria, Fungi, Actinomycetes, vines, Algae and Protozoa. Microbe-plant interactions: Rhizosphere interaction, Plant growth promoting bacteria and endophytic bacteria. Positive interactions as in symbiotic Nitrogen fixation and mycorrhizal association. Soil microbes and Human health: Soil-borne pathogens and plant diseases. Soil microbes as sources of natural products for drug leads. Industrial potentials of soil microorganisms. Energy and nutrient flow. Mechanisms of dispersal of microorganisms in the environment- Passive, active mechanisms and vectors. Organic matter decomposition. Sources of organic matter. Microbial decomposers. Factors affecting organic matter decomposition and environmental significance of microbes. Biogeochemical cycling (Carbon, Nitrogen, Phosphorus, Sulphur).

**MCB 303 Biodeterioration**
**(2CU C; LH 15; PH 45)**

**Course Contents**
The course is concern with the definition of biodeterioration, the principles of biodeterioration of materials including food,

fuel, paper, paints, metals, textile and leather. Factors favouring deterioration of materials. Major microbial groups involved in deterioration. Impact of processing and new technologies on biodeterioration. Biodeterioration control.

**MCB 304 Plant Microbiology**
**(2CU E; LH 15; PH 45)**

**Course Contents**
Significance of plant health. Classification and identification of plant pathogenic microorganisms. Concepts, of disease, infection, Pathogenesis, host-pathogen relationship. Storage techniques of plant products (fruits and vegetables). Microbial pathogenicity and disease resistance in plants. Plant disease epidemics. Diseases of commercial and ornamental plants. Plant disease management. Pathogen-saprophyte interactions and production of plant secondary metabolites and their application, hyper-parasitism, legume-rhizobium interaction.

**MCB 306 Field Course**
**(2CU C; PH 90)**

**Course Contents**
Students guided studies on the diversity and application of microorganisms in the environment (Bayero University campuses, neighbouring communities, Kano metropolis and possibly Northern Nigeria)

**MCB 308 Pharmaceutical Microbiology**
**(2CU C; LH 15; PH 45)**

**Course Contents**

Introduction to antibiotics and therapeutic agents. Chemical characteristics, modes of actions and therapeutic applications of various classes of antibiotics and chemotherapeutic agents. Major categories of therapeutic agents: antibacterial, anti-fungal, anti-viral and anti-parasitic agents. Resistance to antimicrobial agents: mechanisms of resistance to antibiotics and other chemotherapeutic agents. Laboratory methods for determination of antibiogram. Sources of natural products with antimicrobial properties. Basic Pharmacodynamics and pharmacokinetics.

## 400 Level

### MCB 405: Principles of Epidemiology & Public Health Microbiology
**(2 Units C: LH 30)**

**Course Contents**

Epidemiology and epidemiological concepts and types of epidemiology. 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. Transmission routes and infectious doses (airborne, waterborne, urogenital transmissions, arthropod borne, direct contact). Controlling epidemics (reducing or eliminating reservoirs, breaking transmission routes, reducing number of susceptible individuals, quarantine). Epidemiological investigations and surveillance. Disease surveillance. Emergency preparedness and global early warning System.

### MCB 407: Pathogenic Microbiology
**(3 Units C: LH 45)**

**Course Contents**

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

**MCB 412: Microbial Genetics**
**(3 Units C: LH 45)**

**Course Contents**
Principles of genetic analysis; plasmids (conjugative and non-conjugative plasmids). Plasmid nomenclature, and transposable genetic elements, mutagenesis and DNA repairs, bacteriophages genetics and genetics of nitrogen fixation. Mechanism and nature of mutation, induction, isolation and characterization of mutants and mutagens. Genetic recombination in prokaryotes including transformation, transduction, conjugation, proptoplast fusion, site directed mutation, genetic engineering (recombinant DNA technology), DNA splicing, Restriction endonucleases and methylases DNA ligases, their nomenclature phage conversion (cosmids) and transfection. 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 C: LH 30; PH 45)**

**Course Contents**
Microorganisms used in industrial microbiology. Screening for productive strains. Strain improvement. Fermentation systems. Design and use of fermenters. Micro-organisms of industrial importance. Patent and intellectual property rights.

Classification of microbial products by use. Relationship between primary and secondary metabolism. Characteristics, sources and strain improvement of industrial micro-organisms. Microbial preservation of industrial organisms. Culture collections. 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**
**(3 Units C: LH 45)**

**Course Contents**

Review of bacterial anatomy and cytochemistry. Dynamics of growth (batch and continuous culture). Nutrition and energy metabolism of micro-organisms. Effect of physical and chemical factors on growth; biochemistry of various microbial processes such as transport, regulation and respiration. Biosynthesis of microbial products. Bioenergetics, autotrophic (photoautotrophs and chemoautotrophs) metabolism, catabolism and anabolic reactions, activation energy and Enzyme action and control 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 C: LH 30; PH 45)**

**Course Contents**

Impact Assessment (IA) of microbial contamination of soil, surface water, ground water and air in relation to the deterioration of the environment. Legal frame work for impact assessment; environmental impact assessment (EIA); post impact assessment (PIA); environmental evaluation studies(EES). Environmental audits, environmental compliance monitoring reports; soil, air and water pollution. Organic, inorganic pollutants in the environment; microbiology of aquatic, terrestrial environments. Carbon trading; acute toxicity testing, bioaccumulation (bioconcentration and biomagnification). Waste disposal (physical, chemical and biological methods) and management (cradle to grave). Microbial indicators for inorganic and organic pollution in water, methods of water and sewage treatment with emphasis on specific micro-organisms involved. Techniques for estimation of microbial populations in water (Membrane filtration and multiple tube fermentation techniques). Total and faecal coliform; disease transmission by water. Biochemical and chemical oxygen demand

**MCB 431: Petroleum Microbiology**
**(2 Units C: LH 30)**

**Course Contents**

The course provides among others, the definition of petroleum, types of petroleum and origin of petroleum. Geological formations (types of reservoirs). Exploration and production activities (upstream, mid-stream and downstream activities). Surface assets, subsurface assets, offshore and onshore operations. Drilling wastes, production wastes, management of these wastes. Sanitary water, hydrotest water, Produced water, formation water, Injection water, drilling fluids chemical composition, drill cuttings (top hole and bottom hole). Environmental considerations in the discharge of wastes onshore and offshore, cutting reinjection technology and thermo desorption units (TDU). Biogenesis of fossil fuels with emphasis on the role of micro-organisms. Petroleum prospecting; primary recovery. Secondary recovery and tertiary 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. Biodegradation of organics. Factors affecting persistence/recalcitrance of organics. Biodegradability testing, bioremediation strategies (In-situ and ex-situ techniques, biostimulation and bioaugumentation) reservoir souring, sulphate reducing bacteria, seawater reinjection challenges. Bacterial desulfurisation and denitrogenisation of crude oil, oil spill countermeasures, surfactants and biosurfactants. Emusification and demulsification.

**MCB 482: Virology & Tissue Culture**
**(2 Units C: LH 30)**

**Course Contents**
The course describes the 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.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 491: Research Project**
**(6 Units C: PH 270)**

**Course Contents**
This is about how to go about writing a research project to be undertaken on any area of microbiological and/or biotechnological interest. The project should be such that students could complete it (production of final report) within a period of not more than five months.

**MCB 401 Aquatic Microbiology**
**(2CU C; LH 15; PH 45)**

**Course Contents**
Aquatic Microbiology is about the ecology of fresh and salt water. Water pollution and self-purification. Microbiology of water supply, disease transmission, water treatment and public health. Microbiology of waste disposal including sewage treatment and disposal. Biological and chemical oxygen demand tests for sewage and water.

**MCB 403 Introduction to Research Methods and Bioinformatics**
**(2CU C; LH 15; PH 45)**

**Course Contents**
This is about the definition of research. Types and purpose of research, academic and scientific writing. Problems

encountered by researchers. Ethical issues in research. How to write a research proposal, components of research proposal, types and use of search engines, literature review, sampling techniques, presentation of data (pie chart, bar chart, histogram, tables, graphs), descriptive and inferential statistical tools, abstracting and referencing, plagiarism and plagiarism checks. Reference managers (Endnote, Mendeley etc.). Application of computer in research, Introduction to bio informatics basic bioinformatics tools. DNA & protein sequence analysis.

**MCB 404 Analytical microbiology and quality control (2CU C; LH 15; PH 45)**

**Course Contents**

Quality control in microbiology laboratory. Good Laboratory Practices. Standard Operating Procedures (SOP). Health problem, statistical methods and sensory evaluation in quality control. Standards and specifications. Quality control of water, foods, beverages and pharmaceuticals. Quality control of techniques in immunology (Serology, Chromatography, immunophoresis, immunodiffusion etc.). Factors affecting the quality of the various facets of clinical diagnostic bacteriology**.** Quality control of commercially prepared bacteriological media. Maintenance and use of stock cultures. Control of microbiological *in-vitro* diagnostic reagents**.** Quality control in sterilization procedures and of antibiotic susceptibility discs.

# B.Sc. PHYSICS WITH ELECTRONICS

## Overview

The programme equips the students with broad knowledge of Physics and electronics to address the challenges of the 21st century. The classroom instruction includes lectures and laboratory research. Students industrial work experience scheme (SIWES) is included in the syllabus to provide students with necessary skills for employment and entrepreneurship. The first and second year comprise of introductory courses in physics, mathematics, computer science and general studies. Foundation courses in physics that underpin an understanding of electronics and basic electronics courses are provided at the third and fourth year with entrepreneurship courses that will equip the graduates of the programme with relevant skills for job creation and innovations in the areas of applied physics and electronics

## Philosophy

The Philosophy of the curriculum of physics with electronics is meant to broaden the electronics engineering base of students who may wish to study pure electronics with physics without the Electrical Engineering aspects and also prepares them for higher degrees in Physics and Electronics Engineering. The programme is designed to give the students theoretical and practical skills in the areas of applied physics and electronics such as medical radiology, magnetic resonance imaging, analogue electronics systems, digital electronics systems, etc.

**Objectives**
The objectives of the programme are to:

**Unique Features**

1. The programme is unique in the way in which it is designed to provide the students with broader knowledge of physics and electronics so that they can utilize modern discoveries in physics for innovations in electronics.
2. The programme is also unique in the way in which applied physics and digital electronics system courses are included in the curriculum to prepare the students for global challenges.

**Employability Skills**
The programme is designed to provide the students with employability skills in the following areas:
1. IT Skills.
2. Time management.
3. Creativity.
4. Resourcefulness.
5. Communication.
6. Organization.

**21st Century Skills**
The 21st century skills of the programme are
1. Communication.
2. Creativity.
3. Collaboration.
4. Critical Thinking.
5. Innovation.
6. Technology literacy.

7. Flexibility

## Admission and Graduation Requirements for BSc Physics/ Electronics

### Admission Requirements

The entry requirements shall be at least passes at credit level at Senior Secondary Certificate (SSC) in five subjects at not more than two sittings. Such subjects include English Language, Mathematics, Physics and Chemistry. In addition, an acceptable pass in the Unified Tertiary Matriculation Examination (UTME) is required for admission into 100 Level.

Candidates with at least two A level passes in Physics and Mathematics at the Advanced Level may be considered for admission into 200 Level.

### Graduation Requirements

Expected duration for UTME candidates shall be 4 years and students are required to pass a minimum of 120 units, while for direct entry students, expected duration for graduation shall be 3 years and would be expected to pass a minimum of 90 units which must include all compulsory courses.

## Global Course Structure

### Level 100

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST - 111 | Communication in English | 2 | C | 15 | 45 |
| GST - 112 | Nigerian Peoples and Culture | 2 | C | 30 | - |
| MTH - 101 | Elementary Mathematics I | 2 | C | 30 | - |
| MTH - 102 | Elementary Mathematics II | 2 | C | 30 | - |
| COS - 101 | Introduction to Computing Sciences | 3 | C | 30 | 45 |
| PHY - 101 | General Physics I | 2 | C | 30 | - |
| PHY - 102 | General Physics II | 2 | C | 30 | - |
| PHY - 103 | General Physics III | 2 | C | 30 | |
| PHY - 104 | General Physics IV | 2 | C | 30 | - |
| PHY - 107 | General Physics Practical I | 1 | C | - | 45 |
| PHY - 108 | General Physics Practical II | 1 | C | - | 45 |
| BIO - 101 | General Biology I | 2 | E | 30 | - |
| BIO - 102 | General Biology II | 2 | E | 30 | - |
| BIO - 107 | General Biology Practical I | 1 | E | - | 45 |
| BIO - 108 | General Biology Practical II | 1 | E | - | 45 |
| CHM - 101 | General Chemistry I | 2 | E | 30 | - |
| CHM - 102 | General Chemistry II | 2 | E | 30 | - |
| CHM - 107 | General Chemistry Practical I | 1 | E | - | 45 |

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| CHM - 108 | General Chemistry Practical II | 1 | E | - | 45 |
| MTH - 103 | Elementary Mathematics III | 2 | C | 30 | - |
| STA - 112 | Probability I | 3 | C | 45 | - |
| **Total** | | **38** | | | |

**200 Level**

| Course Code | Course Title | Units | Status | LH | PH |
|---|---|---|---|---|---|
| GST - 212 | Philosophy, Logic and Human Existence | 2 | C | 30 | - |
| ENT - 211 | Entrepreneurship and Innovation | 2 | C | 15 | 45 |
| PHY - 205 | Thermal Physics | 3 | C | 45 | - |
| PHY - 206 | General Physics VII (Energy & Environment) | 2 | C | 30 | - |
| PHY - 211 | Workshop Practice | 2 | C | 15 | 45 |
| PHY - 213 | Classical Physics I | 2 | C | 30 | |
| COS - 201 | Computer Programming I | 2 | C | 30 | - |
| MTH - 201 | Mathematical Methods I | 2 | C | 30 | - |
| MTH - 202 | Elementary Differential Equations | 2 | C | 30 | - |
| PHY - 201 | General Physics V (Modern Physics) | 2 | C | 30 | - |
| PHY - 202 | Introduction to Electric Circuits and Electronics | 2 | C | 30 | - |
| PHY - 207 | General Physics Practical | 1 | C | | 45 |
| PHY - 208 | General Physics Practical | 1 | C | | 45 |
| STA - 211 | Probability II | 3 | C | 45 | - |
| STA - 202 | Statistic for Science and Engineering | 3 | C | 45 | - |

| Course Code | Course Title | Units | Status | LH | PH |
|---|---|---|---|---|---|
| PYE - 220 | Electronics and IT Workshop | 2 | C | 15 | 30 |
| PYE - 221 | Introduction to Electronics: Digital and Analog Circuits | 2 | C | 30 | |
| **Total** | | **35** | | | |

**300 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST - 312 | Peace and Conflict Resolution | 2 | C | 30 | - |
| ENT - 312 | Venture Creation | 2 | C | 15 | 45 |
| PHY - 301 | Analytical Mechanics I | 2 | C | 30 | - |
| PHY - 303 | Electromagnetism | 3 | C | 45 | - |
| PHY - 305 | Quantum Physics | 3 | C | 45 | - |
| PHY - 306 | Statistical and Thermal Physics | 2 | C | 30 | - |
| PHY - 312 | Analogue Electronics | 2 | C | 30 | - |
| PHY - 315 | Electronics | 2 | C | 30 | - |
| PHY - 316 | Circuit Theory | 2 | C | 30 | - |
| PHY - 317 | Experimental physics V | 1 | C | - | 45 |
| PHY - 325 | Measurement and Instrumentation | 2 | C | 30 | - |
| PHY - 399 | Industrial Attachment | 3 | C | | |
| MTH - 304 | Complex Analysis I | 2 | C | 30 | - |
| PHY - 318 | Semiconductor Devices | 3 | C | 45 | - |

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| PYE - 320 | Electronics Practical (Digital) | 1 | C | - | 45 |
| PYE - 321 | Introduction to Embedded Systems | 2 | C | 30 | - |
| PYE - 322 | Industrial Electronics Design | 2 | E | 30 | - |
| PYE - 323 | Power Electronics | 2 | C | 30 | - |
| **Total** | | **38** | | | |

**400 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| PHY - 401 | Quantum Mechanics I | 3 | C | 45 | - |
| PHY - 403 | Mathematical Methods in Physics I | 3 | C | 45 | - |
| PHY - 404 | Mathematical Methods in Physics II | 3 | C | 45 | - |
| PHY - 413 | Digital Systems | 2 | C | 30 | - |
| PHY - 415 | Digital Communication Systems | 2 | C | 30 | |
| PHY - 417 | Advanced Electronics Lab | 1 | C | - | 45 |
| PHY - 422 | Digital Electronics | 2 | C | 30 | - |
| PHY - 423 | Entrepreneurship in Physics Electronics | 2 | C | 30 | |
| PHY - 499 | Project | 6 | C | - | 270 |
| PYE - 430 | Communication Systems and Principles | 2 | C | 30 | |
| PYE - 431 | Introduction to Nanoelectronics | 2 | C | 30 | - |
| PYE - 432 | Control Systems and Automation | 2 | C | 30 | - |
| PYE - 433 | Data Communication and Networking | 2 | E | 30 | - |
| PYE - 434 | Artificial Intelligence and Applications | 2 | E | 30 | - |
| PYE - 435 | Signals and Systems | 2 | C | 30 | - |

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| PYE - 436 | Quantum Electronics and Computing | 2 | E | 30 | |
| PYE - 437 | Digital Signal Processing | 2 | E | 30 | |
| **Total** | | **40** | | | |

## Course Contents and Learning Outcomes

## 100 Level

### GST 111: Communication in English
### (2 Units C: LH 15; PH 45)

### Course Contents

The course introduces Science Sound patterns in English Language(vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). Sentence in English (types: structural and functional, simple and complex). Grammar and usage (tense, mood, modality and concord, aspects of language use in everyday life). Logical and critical thinking and reasoning methods (logic and syllogism, inductive and deductive argument and reasoning methods, analogy, generalisation and explanations). Ethical considerations, Copyright rules and infringements. Writing activities: (pre-writing, writing, post writing, editing and proofreading; brainstorming, outlining, paragraphing. Types of writing: summary, essays, letter, curriculum vitae, report writing, note making etc. Mechanics of writing). Comprehension strategies: (reading and types of reading, comprehension skills, 3RsQ). Information and Communication Technology in modern language learning. Language skills for effective communication. Major word formation processes. Writing and reading comprehension strategies. Logical and critical reasoning for meaningful presentations. Art of public speaking and listening. Report writing.

**GST 112: Nigerian Peoples and Culture**
**(2 Units C: LH 30)**

**Course Contents**

This is about Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and culture; peoples and culture of the ethnic minority groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; Colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; Nationalist movements and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian civil war). Concept of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigeria people; trade, skill acquisition and self-reliance). Social justice and national development (law definition and classification. Judiciary and fundamental rights. Individual, norms and values (basic Nigeria norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts. Cultism, kidnapping and other related social vices). Re-orientation, moral and national values (The 3R's – Reconstruction, Rehabilitation and Re-orientation; Re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline (WAI), War Against Indiscipline and Corruption(WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

**COS 101: Introduction to Computing Sciences**
**(3 Units C: LH 30; PH 45)**

**Course Contents**

Brief history of computing. Description of the basic components of a computer/computing device. Input/Output devices and peripherals. Hardware, software and human ware. Diverse and growing computer/digital applications. Information processing and its roles in society. The Internet, its applications and its impact on the world today. The different areas/programs of the computing discipline. The job specializations for computing professionals. The future of computing.

**Lab Work:** Practical demonstration of the basic parts of a computer. Illustration of different operating systems of different computing devices including desktops, laptops, tablets, smart boards and smart phones. Demonstration of commonly used applications such as word processors, spreadsheets, presentation software and graphics. Illustration of input and output devices including printers, scanners, projectors and smart boards. Practical demonstration of the Internet and its various applications. Illustration of browsers and search engines. How to access online resources.

**MTH 101: Elementary Mathematics I (Algebra and Trigonometry)**
**(2 Units C: LH 30)**

**Course Contents**
Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers; integers, rational and irrational numbers, mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem. Complex numbers; algebra of complex numbers; the Argand diagram. De-Moivre's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

**MTH 102: Elementary Mathematics II (Calculus)**
**(2 Units C: LH 30)**

**Course Contents**
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.

**PHY 101: General Physics I (Mechanics)**
**(2 Units C: LH 30)**

**Course Contents**
space and time. units and dimension. vectors and scalars. differentiation of vectors: displacement, velocity and acceleration. Kinematics. Newton laws of motion (Inertial frames, Impulse, force and action at a distance, momentum conservation). relative motion. Application of Newtonian

mechanics. equations of motion. conservation principles in physics, conservative forces, conservation of linear momentum, Kinetic energy and work, Potential energy, System of particles, Centre of mass. Rotational motion. torque, vector product, moment, rotation of coordinate axes and angular momentum, polar coordinates. conservation of angular momentum; Circular motion. Moments of inertia, gyroscopes and precession. gravitation: Newton's Law of Gravitation, Kepler's Laws of Planetary Motion, Gravitational Potential Energy, Escape velocity, Satellites motion and orbits.

**PHY 102: General Physics II (Electricity & Magnetism) (2 Units C: LH 30)**

**Course Contents**

Forces in nature. Electrostatics (electric charge and its properties, methods of charging). Coulomb's law and superposition. Electric field and potential. Gauss's law. Capacitance. Electric dipoles. Energy in electric fields. Conductors and insulators. DC circuits (current, voltage and resistance. Ohm's law. Resistor combinations. Analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère's laws. Magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz's laws. Step up and step down transformers. Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, and resistance.

**PHY 103: General Physics III (Behaviour of Matter)**
**(2 Units C: LH 30)**

**Course Contents**

Heat and temperature (temperature scales). Gas laws. General gas equation. Thermal conductivity. First Law of thermodynamics (heat, work and internal energy, reversibility). Thermodynamic processes (adiabatic, isothermal, isobaric). Second law of thermodynamics (heat engines and entropy). Zeroth law of thermodynamics. Kinetic theory of gases. Molecular collisions and mean free path. Elasticity (Hooke's law, Young's, shear and bulk moduli). Hydrostatics (Pressure, buoyancy, Archimedes' principles). Bernoulli's equation and incompressible fluid flow. Surface tension (adhesion, cohesion, viscosity, capillarity, drops and bubbles).

**PHY 104: General Physics IV (Vibration Waves and Optics)**
**(2 Units C: LH 30)**

**Course Contents**

Simple harmonic motion (SHM): energy in a vibrating system, Damped SHM, Q values and power response curves, Forced SHM, resonance and transients, Coupled SHM. Normal modes. Waves: types and properties of waves as applied to sound; Transverse and Longitudinal waves; Superposition, interference, diffraction, dispersion, polarization; Waves at interfaces; Energy and power of waves, the 1-D wave equation, 2-D and 3-D wave equations, wave energy and power, phase and group velocities, echo, beats, the Doppler effect, Propagation of sound in gases, solids and liquids and their properties. Optics: nature and propagation of light; reflection, refraction, and internal reflection, dispersion, scattering of light, reflection and refraction at plane and spherical surfaces, thin lenses and optical instruments; wave nature of light; Huygens's principle, interference and diffraction.

**PHY 107: General Practical Physics I**
**(1Unit C: PH 45)**

**Course Contents**
This is an introductory course that emphasizes the s quantitative measurements, the treatment of measurement errors, and graphical analysis. A variety of experimental techniques should 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, 102, 103 and PHY 104. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

**PHY 108: General Practical Physics II**
**(1Unit C: PH 45)**

**Course Contents**
This is a practical course that is a continuation of PHY 107 and it is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on

the basic physical techniques for observation, measurements, data collection, analysis and deduction

**BIO 101: General Biology I**
**(2 units C: LH 30)**

**Course Contents**

Cell structure and organization, functions of cellular organelles. characteristics and classification of living things. chromosomes, genes; their relationships and importance. general reproduction. interrelationships of organisms (competitions, parasitism, predation, symbiosis, commensalisms, mutualism, saprophytism). heredity and evolution (introduction to Darwinism and Lamarkism, Mendelian laws, explanation of key genetic terms). elements of ecology and types of habitat.

**BIO 102: General Biology II Learning Outcomes**
**(2 Units C: LH 30)**

**Course Contents**

Basic characteristics, identification and classification of viruses, bacteria and fungi.
A generalized survey of the plant and animal kingdoms based mainly on the study of similarities and differences in the external features. Ecological adaptations. Briefs on physiology to include nutrition, respiration, circulatory systems, excretion, reproduction, growth and development.

**BIO 107: General Biology Practical I**
**(1 Unit C: PH 45)**

**Course Contents**
Common laboratory hazards. prevention and first aid. measurements in biology. uses and care of microscope. compound and dissecting microscope. Biological drawings and illustration, scaling, accuracy and proportion. use of common laboratory apparatus and laboratory experiments designed to illustrate the topics covered in **BIO 101.**

**BIO 108: General Biology Practical II**
**(1 Unit C: PH 45)**

**Course Contents**
Anatomy of flowering plants, primary vegetative body. stem, leaf and root to show the mature tissues namely parenchyma, collenchyma, sclerenchyma, xylem and phloem. Types of fruits and seeds. Care and use of dissecting kits and other biological wares. Dissection and general histology of animal tissues based on vertebrate forms. Morphology and functions of epithelial, muscular, nervous and connective tissues. Examination of various groups of lower invertebrates under microscopes, identification of various groups of organisms in Animal Kingdom. Andany experiment designed to emphasize the practical aspects of topics in BIO 102.

**CHM 101: General Chemistry I**
**(2 Units: C: LH 30)**

**Course Contents**
Atoms, molecules, elements and compounds and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridization and shapes of simple molecules. Valence Forces and structure of solids. Chemical equations and stoichiometry, chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry, rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

**CHM 102: General Chemistry II**
**(2 Units C: LH 30)**

**Course Contents**
Historical survey of the development and importance of organic chemistry, fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures and nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds. Determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry. Nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The Chemistry of selected metals and

non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

**CHM 107: General Chemistry Practical I**
**(1 Unit C: PH 45)**

**Course Contents**
Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

**CHM 108: General Chemistry Practical II**
**(1 Unit C: PH 45)**

**Course Contents**
Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

**MTH 103: Elementary Mathematics III (Vectors, Geometry and Dynamics)**
**(2 Units C: LH 30)**

**Course Contents**
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. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

**STA 112: Probability I**
**(3 Units C: LH 45)**

**Course Contents**
Permutation and combination. Concepts and principles of probability. Random variables. Probability and distribution functions. Basic distributions: Binomial, geometric, Poisson, normal and sampling distributions; exploratory data analysis.

**200 Level**

**GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)**

**Course Contents**

The course introduces the Science students to the basics and scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

**ENT 211: Entrepreneurship and Innovation (2 Units C: LH 15; PH 45)**

**Course Contents**

Concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship,). Theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship and creative destruction). Characteristics of entrepreneurs (opportunity seeker, risk taker, natural and nurtured, problem solver and change agent, innovator and creative thinker). Entrepreneurial thinking (critical thinking, reflective thinking, and creative thinking). Innovation (concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and forming alliances and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office, networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

**PHY 205: Thermal Physics**
**(3 Units C: LH 45)**

**Course Contents**

The foundations of classical thermodynamics including the definition of temperature. The first law. Work, heat and internal energy. The second law. Carnot cycles and Carnot engines. Zeroth law. Entropy and irreversibility. Thermodynamic potentials and the Maxwell relations. Ideal gas equation. Internal energy and internal molecular modes. Qualitative discussion of phase transitions. Gibbs free energy. Clausius-Clapeyron equation. Examples of phase transitions. Van der Waals gas. Kinetic theory. Mean free path. Equi-partition of energy. Heat transfer. Diffusion rate.

**PHY 206: General Physics VI (Energy and Environment) (2 Unit C: LH 30)**

**Course Contents**

This course is designed to introduce the students to the basics of energy sources and climate impacts. Energy requirements and consumption. Energy processing and conversion. Energy units and pricing. The greenhouse effect. Biological forms of energy (fossil fuels and biofuels). Basic nuclear physics. The atom, radioactivity and decay laws. Interaction of radiation with matter. Nuclear fission principles and energetics. Chain reaction and dynamics. Reactor types and control. Current status of nuclear fission as a power source. Nuclear fusion principles and energetics. (Examples in stars and on earth). Thermonuclear fusion. Nuclear fuels. Ignition and the Lawson criterion. Magnetic and inertial confinement. Current status of nuclear fusion as a power source. Stellar fusion. Proton-proton chain and CNO cycle. Solar power technologies. Solar thermal. Solar photovoltaic. Wind energy. Nature of wind. Wind power and wind turbines. Betz criterion. Energy from waves and tides. Principles of water waves, energy, and power. Wave power extraction. Origin and properties of tides. Tidal stream power and tidal range power. Power from fluids. Hydro power. Energy transportation and storage. Thermal pollution. Energy costs, capacity, reserves, and efficiency. Emerging environmental effects of energy processing.

**PHY 211: Workshop Practice**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
The course is about workshop layout and safety. Basic hand tools and bench work practices. Measurement and gauging. Sheet metal operations. Casting. Cutting, drilling, turning, and milling. Metal joining devices and adhesives in common use. Soldering techniques and wrap joints. Plain and cylindrical generation of smooth surface using power operated machines. Criteria for selection of materials used for construction (metallic and non-metallic). Instrumentation and measuring techniques. Multi-meters and oscilloscopes. Extension of instrument range. A survey of the use of electronic circuit devices (e.g., diodes, transistors including FET, integrated circuits). Photocells. Basic circuit development and analysis. Wood logging. Wood types and processing. Plastic types and working. Plastic moulding, bending, and encapsulation.

**PHY 213: Classical Physics I**
**(2 Units C: LH 30)**

**Course Contents**
This is an introduction to classical mechanics. Space and time. Linear kinematics. Linear and angular momentum. Force and torque. Motion in a plane. Newtonian gravity. The two-body systems. Forces and equilibrium. Particle dynamics. Force fields and potentials. Collisions. Conservative forces. Inertial frames and non-inertial frames. Motion in rotating frames. Centrifugal force. Central force motions. Kepler's motion in a

central force field. Particle orbits as conic sections. Kepler's laws. Rigid body motion and rotational dynamics. Moment of inertia. Free rotation and stability. Gyroscopes.

**COS 201: Computer Programming I**
**(3 Units C1: LH 30; PH 45)**

**Course Contents**

The knowledge of computer is very essential. This course introduces students to computer programming. Functional programming; Declarative programming; Logic programming; Scripting languages. Introduction to object-orientation as a technique for modelling computation. Introduction of a typical object-oriented language, such as Java. Basic data types, variables, expressions, assignment statements and operators. Basic object-oriented concepts: abstraction; objects; classes; methods; parameter passing; encapsulation. Introduction to Strings and string processing; Simple I/O; control structures; Arrays; Simple recursive algorithms; inheritance; polymorphism.

**Lab work**: Programming assignments involving hands-on practice in the design and implementation of simple algorithms such as finding the average, standard deviation, searching and sorting. Practice in developing and tracing simple recursive algorithms. Developing programmes involving inheritance and polymorphism.

**PYE220: Electronics and IT workshop**
**(2 Units C: LH 15, PH 30)**

**Course Contents**

This is a workshop package. It introduces the students to electronic circuit design. Introduction to simulation tools (Simulink, Multism, electronic workbench etc). Introduction to embedded systems. Programming embedded systems using C++/C and Flowcode. PCB design. Mini project (electronics). Introduction to computer hardware and software. Troubleshooting and repair of hardware/software (memory, CPU, OS and application software). Introduction to computer networks. LAN/WLAN design. Cabling (terminating RJ 45 and RJ 11) standard. SOHO router configuration. Introduction to netwok simulators (packet tracer). Network configuration. Design and implementation of Wireless network. Troubleshooting networks. IT project management.

**MTH 201: Mathematical Methods I**
**(2 Units C: LH 30)**

**Course Contents**

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 and three variables. Partial derivatives chain rule, extrema, lagrangian multipliers. Increments, differentials, and linear approximations. Evaluation of line integrals. Multiple integrals.

**MTH 202: Elementary Differential Equations (2 Units C: LH 30)**

**Course Contents**

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 differential equations. Application to geometry and physics.

**STA 202: Statistics for Physical Sciences and Engineering (3 Units C: LH 45)**

**Course Contents**

Scope for statistical methods in physical sciences and engineering. Measures of location, partition and dispersion. Elements of probability. Probability distribution: binomial Poisson, geometric, hypergeometric, negative-binomial, normal poisson, geometric, hypergeometric, negative-binomial, normal, Student's t and chi-square distributions. 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**
**(3 Units C: LH 45)**

**Course Contents**
Further permutation and combination. probability laws. conditional probability, independence. Bayes' theorem. probability distribution of discrete and continuous random variables: binomial, Poisson, geometric, hypergeometric, rectangular (uniform), negative exponential, binomial. Expectations and moments of random variables. Chebyshev's inequality. joint marginal and conditional distributions and moments. limiting distributions. discrete and continuous random variables, standard distributions, moments and moment-generating functions. laws of large numbers and the central limit theorem.

**PHY 201: General Physics IV (Elementary Modern Physics)**
**(2 Units C: LH 30)**

**Course Contents**
Defects in Newtonian Mechanics. Galilean relativity. The speed of light. Inertial frames and the concept of an observer. The principles of Einstein's Special Theory of Relativity. Lorentz transformation. Time dilation and length contraction. Transformation of velocities. Doppler effect. Relativistic energy and momentum. Basic properties of atoms and molecules. Experimental basis of quantum theory. Electrons and quanta. Bohr's theory of atomic structure. Energy levels and spectra. De Broglie hypothesis. The uncertainty principle. Black body radiation. The momentum operator. Time-

independent Schrödinger equation. The infinite square well. Simple applications in particle and nuclear physics. Compton effect. Thermionic emission. Radioactivity. Detection and measurement of charged particles (including the treatment of detectors). X-rays.

**PHY 202: Introduction to Electric Circuits and Electronics (2 Units C: LH 30)**

**Course Contents**

The courses introduces the students to D.C. Circuits. Sources of emf and current. Resistor combinations. Kirchhoff's Laws. Network analysis and circuit theorems. Mesh currents method, Node-voltage, Thevenin and Norton theorem, superposition principle. A.C. Circuits. Sinusoidal wave-forms. RMS and peak values. Power. Resistance, inductance and capacitance in a.c. circuits. Impedance and admittance. Series and parallel RLC circuits. Q factor. Resonance. The transformer. Electronics: filters. Amplification and the transistor. Bipolar junction and field effect transistors. Equivalent circuits. Amplifiers. Feedback. Oscillators. Signal generators. Semiconductors (devices and characteristics). The pn-junction. Simple diodes. Photodiodes. LEDs.

**300 Level**

**GST 312: Peace and Conflict Resolution**
**(2 Units C: LH 30)**

**Course Contents**
Even the students of Science require to know the basics of the concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory. Root causes of conflict and violence in Africa: indigene and settlers phenomenon; Boundaries/boarder disputes; Political disputes; Ethnic disputes and rivalries; Economic inequalities; Social disputes; Nationalist movements and agitations; Selected conflict case studies – Tiv-Junkun; Zango Kataf, Ife/Modakeke, Aguleri/Omuleri, Native Birom/Fulani settlers in the Plateau chieftaincy and land disputes etc. Peace building, management of conflicts and security: peace & human development. Approaches to peace & conflict management --- (religious, government, community leaders etc.). Elements of peace studies and conflict resolution: conflict dynamics assessment scales: constructive & destructive. Justice and legal framework: concepts of social justice; the Nigeria legal system. Insurgency and terrorism. Peace mediation and peace keeping. Peace & security council (international, national and local levels) Agents of conflict resolution – conventions, treaties community policing: evolution and imperatives. Alternative Dispute Resolution, ADR. Dialogue b). Arbitration, c). Negotiation d). Collaboration etc. Roles of International Organizations in

Conflict Resolution. (a). The United Nations, UN and its Conflict Resolution Organs. (b). The African Union & Peace Security Council (c). ECOWAS in peace keeping. Media and traditional institutions in peace building. Managing post-conflict situations/crisis: refugees. Internally Displaced Persons, IDPs. The role of NGOs in post-conflict situations/crisis.

**ENT 312: Venture Creation**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
This is an entrepreneurial course that opens with opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, first mover advantage, E-commerce business models and successful E-Commerce companies,). Small business management/family business: leadership & management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery

demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (the concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - Artificial Intelligence (AI), Virtual/Mixed Reality (VR), Internet of Things (IoTs), Blockchain, Cloud Computing, Renewable Energy etc. Digital Business and E-Commerce strategies).

**PHY 301: Analytical Mechanics I**
**(2 Units C: LH 30)**

**Course Contents**

Review of Newtonian Mechanics. Motion of a particle in one, two and three dimensions. Internal forces. External forces. Forces of constraint. Systems of particles and collision theory. Newtonian gravitation; conservative forces and potentials, oscillations, central force problems; accelerated frames of reference. Rigid body dynamics. Rotational problems and space coordinates. Mechanics of continuous media. Galilean relativity. Relativistic kinematics and dynamics. Applications of relativistic kinematics.

**PHY 303: Electromagnetism**
**(3 Units C: LH 45)**

**Course Contents**

Review of Vector calculus. Electrostatics and Magnetostatics. Magnetization and magnetic susceptibility. Laplace's equation and boundary value problems. Multipole expansions. EM waves in dielectric and magnetic materials. Polarization of EM waves. Electromagnetic induction. Faraday's and Lenz’s laws. A.C. Circuits. Maxwell's equations. Lorentz covariance and special relativity. Gauss theorem in dielectrics. Poisson’s equations. Uniqueness theorem. Magnetic properties. Motors. Generators. Poynting vectors.

**PHY 305: Quantum Physics**
**(3 Units C: LH 45)**

**Course Contents**
Wave-particle duality and the uncertainty principle. Basic principles of the quantum theory. Time dependent Schrodinger equation. Energy levels and potential wells. Reflection and transmission of potential barriers. Operators and quantum states. Commutation relations and compatibility of different observables. Orbital angular momentum. Particle in two dimensions. Familiar wave phenomena and their associated wave equations. Physical interpretation of the wave function as a probability amplitude. Energy levels and stationary states. Energy bands in periodic lattice. Solution of Schrodinger equation for a central potential in three dimensions. The hydrogen atom. Multi-electron atoms. The harmonic oscillator. Exchange symmetry.

**PHY 306: Statistical and Thermal Physics I**
**(2 Units C: LH 30)**

**Course Contents**
Basic theory of thermodynamics. Basic of probability theory. Microstates and macrostates. The concept of ensembles. Statistical interpretation of entropy and temperature. Isolated

systems and the microcanonical ensemble. Statistical physics of non-isolated systems. Derivation of the Boltzmann distribution and canonical ensemble. The partition function in thermodynamics. Non-interacting systems. Equipartition theorem. Density of states. Grand canonical ensemble. Fermi-Dirac and Bose-Einstein distributions. The ideal Fermi gas. Fermi energy. Heat capacity. The ideal Bose gas. Black body radiation. Bose-Einstein condensation.

**PHY312: Analogue Electronic Circuits**
**(2 Units C: LH 30)**

**Course Contents**
Review of single stage transistor amplifiers and operational amplifier circuits. Analysis and design of multistage amplifiers. Feedback, broadband and narrow band amplifiers, power amplifiers, voltage and current stabilizing circuits. Sinusoldal RC and LC crystal oscillators, other communication circuits.

**PHY315: Electronics**
**(2 Units C: LH 30)**

**Course Contents**
Thermionic emission, Vacuum tubes: diodes and transistors; semiconductors; p-n junction; characteristics of p-n junction; uses of diodes; bipolar junction and unipolar transistors, transistor biasing, transistor switch. Equivalent circuits of semi-conductors, diodes, transistors. Small and large signal operations. Wave from generation by transistors. Class A, B. and C amplifiers. Feedback amplifiers and control systems.

Multi-vibrators. Transmission lines. Basic communication theory and its practical significance.

**PHY317: Basic Experimental Physics V**
**(1 Units C: LH 15)**

**Course Contents**
This is a 3 hour/week laboratory course that covers basic experiments illustrative of the 2nd semester, 300 Level Physics Electronics syllabus.

**PHY316: Circuit Theory**
**(2 Units C: LH 30)**

**Course Contents**
It is designed to explore the Laplace and Fourier transformations, application of Laplace transformation to transient analysis of RLC circuits, transfer function concept, reliability of transfer functions, Foster and Cauer's methods of synthesis 2-port network synthesis, active filters. Analysis of continuous and discrete signals and systems, families. Concepts of small, medium, large and very large scale integration and their consequences. Some digital building blocks; flip-flops, counters, register, and decoders. Introduction to D/A and A/D conversion principles. Approximation to non-linear characteristics, analysis and synthesis of non-linear resistive circuits, harmonic analysis of non-linear dynamical circuits, transient states in non-linear circuits, applications of computers in the analysis of linear and non-linear circuits.

**PHY325 Measurement and Instrumentation**
**(2 Units C: LH 30)**

**Course Contents**
General instrumentation, Basic meter DC measurement. Basic meter in AC measurement, rectifier voltmeter, electrodynamometer and wattmeter, instrument transformers, DC and AC bridges and their applications, general form of AC bridge, universal impedance bridge, electronic instruments for the measurement of voltage, current, resistance and other circuit parameter, electronic voltmeters, AC voltmeters using rectifiers, electronic voltmeter, digital voltmeters, oscilloscope, vertical deflection system, horizontal deflection system, sampling CRO, instrument for generating and analysing waveforms, square wave and pulse generator, signal generators, function generators, wave analyzers, electronic counters and their applications, time base circuitry, universal counter measurement modes, analogue and digital data acquisition systems, tape recorders.

**PHY 399: Industrial Attachment**
**(3 Units C: 12 weeks)**

**Course Contents**
Students should be attached to some relevant organisations for additional 12 weeks at the 300 Level for the four (4) year program preferably during the long vacation, and for 24 weeks

at the 400 Level for the five (5) year B.Tech. programme during the second semester and the long....

**MTH304: Complex Analysis**
**(2 Units C: LH 30)**
**Course Contents**
Functions of a complex variable. Limits and continuity of functions of a complex variable. Deriving the Cauchy-Riemann equations. Analytic functions. Bi-linear transformations, conformal mapping, contour integrals. Cauchy's theorems and its main consequences, convergence of sequences and series of functions of a complex variable. Power series. Taylor series.

**PHY 318: Semiconductor Devices**
**(3 Units C: 45)**

**Course Contents**
Classes of semiconductor. The physics of semiconductors. Band structure of metals, semiconductors, and insulators. Semiconductor equilibrium. Doping and statistics. Carrier distribution, transport, and recombination. Carrier drift, diffusion, and conductivity. Hall effect. semiconductor growth. Semiconductor quantum structures. Modelling and application of selected semiconductor devices. P-n junction. Review of junction and bipolar transistor physics. Major emphasis on MOS devices including field effect transistors and charge coupled devices. Consideration of advanced bipolar structures. Schottky barrier devices. Optical properties of semiconductors (light emitting diodes and photo-detectors). Solar cells.

**400 Level**

**PHY 401: Quantum Mechanics I**
**(3 Units C: LH 45)**

**Course Contents**
The formulation of quantum mechanics in terms of state vectors and linear operators. Time evolution of the Schrodinger equation. The theory of angular momentum and spin. Electron spin and the Stern-Gerlach experiment. Identical particles and the Pauli exclusion principle. Multi-electron atoms. Approximation methods. Variational methods and WKB approximation for bound states and tunnelling. Time - independent perturbation theory. The fine structure of hydrogen. Harmonic oscillator. Creation and annihilation operators. External fields. Zeeman and Stark effects in hydrogen.

**PHY 403: Mathematical Methods for Physics I**
**(3 Units C: LH 45)**

**Course Contents**
Vector and scalar fields. Vector operators. Div, grad, and curl. Divergence theorem. Stoke's theorem. 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 Laguerre functions. The Dirac - Delta function. Integral transforms and fourier series. Fourier series and fourier transforms. The

Dirichlet conditions. orthogonality of functions. Fourier coefficients. Complex representation of fourier series. Laplace transform. Applications of transform methods to the solution of elementary differential equations of interest in physics and engineering.

**PHY 404: Mathematical Methods for Physics II**
**(3 Units C: LH 45)**

**Course Contents**
The course describes the 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, electromagnetic theory, quantum theory, diffusion phenomena; complex variable theory and their relation to selected physical problems. Complex differentiation and integration. Cauchy's theorem. Taylor's and Laurent's series. Ordinary differential equations of first and second order and their physical applications. Homogeneous partial differential equations.

**PHY413: Digital Systems**
**(2 Units C: LH 30)**

**Course Contents**
This is an introduction to analysis and design of digital systems. Boolean algebra and mapping methods; Karnaugh

and variable-entered maps, combinational logic realization with gates, multiplexers, read only memories (ROMs) and programmable logic arrays (PLAs). State machine analysis and design: state diagrams, state flip-flops, input and output forming logic, gate assignments, redundant states sequential counters, and mainly synchronous systems, state machine, realization with multiplexers, ROMs and PLAs. Asynchronous systems, approach to digital system design; top-down design, trial-and-error methods. Codes, number systems, and arithmetic operations, introduction to computer structures: register transfers, hardware programming methods. Von Neumann machines, and memory systems.

**PHY415: Digital Communication Systems**
**(2 Units C: LH 30)**

**Course Contents**
Block diagram of digital communication system, sampling theorem, Shanon theorem and applications in digital communication system. Advantages of digital signals. Noise in digital signals. Filtering and equalisation. Digital modulation techniques: FSK, ASK, QPSK, M-PSK, QAM, etc. Error detection and correction techniques. Encoders and decoders. Applications of digital communication system: satellite communication, telephoning, microwave, wireless communication, optical communication, broadband communication, internet technology.

**PHY417: Advanced Electronics Lab**
**(1 Units: C PH 45)**

**Course Contents**
This is a course of a 6-hour/week laboratory course on selected advanced experiments in analogue and digital electronics circuits taught.

**PHY 422: Digital Electronics**
**(2 Units C: LH 30)**

**Course Contents**
This is a course of review of elementary concepts. Switching properties of electronic devices. Switching and wave-shaping circuits. Generation of non-sinusoidal waveform: astable, monostable and bistable multivibrators, comparator, Schmitt trigger and time-base generators using discrete transistor, operational amplifier or other integrated circuits. Timer chips and their applications. Analysis and design of logic gates of various families (diode logic, RTL, TTL, ECL, MOS, and CMOS) of digital integrated circuits, interfacing between various logic numerical differentiation and integrations: initial and boundary value problems. Euler's method, Taylor series method, Runge-Kutta, predictors corrector methods, multi-step methods. Systems of equations and higher order equations. Finite difference calculus: difference equations.

**PHY423: Entrepreneurship in Physics Electronics**
**(2 Units C: LH 30)**

**Course Contents**

This involves the study of Electrical resistivity exploration method, principles of borehole geophysics, methods of medical X-ray radiography, techniques of magnetic resonance imaging (MRI), design and analysis of analogue electronics systems, design and analysis of digital electronics systems, methods of troubleshooting in analogue and digital systems, methods of troubleshooting in digital computers.

**PHY499: Research Project**
**(6 Units C: PH 270)**

The course enables the student to carry out a specific research project under the supervision of any experienced staff member. Many kinds of problems are acceptable – the only restriction is that the problem shall be a piece of work (experimental or theoretical) which will take about 15% of the student's time during the session and which is judged to be of adequate standard and non-trivial. A departmental committee chaired by the head of department will conduct an oral examination on the project. The mark will be awarded both on the basis of this report and on his performance at the oral examination.

**PYE436: Quantum Electronics and Computing**

**(2 Units E: LH 30)**

**Contents**

Introduction to Quantum Mechanics: Overview of Classical Mechanics, Key concepts of Quantum Mechanics,Wave-particle duality,Quantum states and measurements,Superposition and entanglement,Quantum gates and circuits. Quantum Information Theory:Classical vs Quantum Information,Quantum States and Operations,Quantum Measurements and Observables. Quantum Error Correction:Quantum Teleportation and Cryptography, Quantum,Computing Hardware, Quantum Bits and Qubits, Physical implementation of Qubits, Superconducting Circuits, Trapped IonsQuantum Dots, Topological Quantum Computing, Quantum, Computing Algorithms, Deutsch-JozsaAlgorithm, Simon's Algorithm
Grover's Search Algorithm, Shor's Factoring Algorithm, Quantum Machine Learning Algorithms, Quantum Electronics. Fundamentals of Quantum Electronics: Quantum Optics, Quantum Dots, Single-Photon Sources ,Quantum Sensors and Detectors, Quantum Computing Software and Tools, Quantum programming languages (Qiskit, Cirq), Quantum Computing Simulators and Emulators, Quantum Computing Libraries and Frameworks, Quantum Applications, Cryptography, Optimization, Machine Learning, Chemistry and Material Science, Quantum Simulation

**PYE432: Control Systems and Automation**
**(2 Units: LH 30)**

**Contents**

This course is on introduction to feedback control systems, modeling of dynamic systems, time-domain and frequency-domain analysis of control systems, control system design techniques, state-space analysis, digital control systems, nonlinear control systems, robust control systems, and control system applications in various fields. Students will learn about transfer functions, block diagrams, signal flow graphs, root locus technique, pole placement, PID controller design, controllability, observability, sampling and reconstruction of signals, uncertainty and sensitivity analysis, H-infinity control, μ-analysis, and more. Practical applications and simulations using software tools like MATLAB or LabVIEW may also be included. The course provides a strong foundation in Control Systems that prepares students for further study or careers in aerospace, automotive, manufacturing, robotics, and other related fields.

**PYE321: Introduction to Embedded System**
**(2 Units C: LH 30)**

**Course Contents**

The course Introduces the students to microcomputers and embedded systems: Processor architectures, microcontrollers used in embedded systems; CPU, memory and input output units; Interrupts; Introduction to hardware level programming of embedded systems: Programming in assembler, Programming in C, Development platforms for embedded software; Introduction to microcomputer interfaces: Digital I/O, Serial I/O, Timers, Analog-to-digital conversion, Pulse Width Modulation (PWM).

**PYE433: Data Communication and Networking**
**(2 Units E: LH 30)**

**Course Contents**
Introduction: network edge, end systems, access networks, links, network core, packet switching, circuit switching, network structure, delay, loss, throughput in networks, protocol layers, service models, Application Layer, Web and HTTP, Electronic mail, Domain Name System, video streaming and content distribution networks, Socket programming with UDP and TCP*, Transport Layer, multiplexing and demultiplexing, connectionless transport: UDP, principles of reliable data transfer, connection-oriented transport: TCP, principles of congestion control, TCP congestion control, Network layer: The Data Plane, control plane, Router architecture, IP: Internet Protocol, Generalized Forward and SDN, Network Layer: The Control Plane, routing protocols, intra-AS routing in the Internet: OSPF, routing among the ISPs: BGP, The SDN control plane, Link Layer and LANs, error detection, correction, multiple access protocols, data center networking, Wireless Networking, Wireless links, characteristics, IEEE 802.11 wireless LANs (Wi-Fi), Network Security, Message integrity, authentication, Securing e-mail, securing TCP connections: SSL, Firewalls and IDS.

**PYE434: Artificial Intelligence and Applications**

**(2 Units, LH 30)**

**Course Contents**

This is a course of Introduction to Artificial Intelligence: Intelligent Agents and Applications of Artificial Intelligence knowledge Representation and Reasoning: Propositional logic, Theory of first order logic, Inference in First order logic, Forward and Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.

**Machine Learning**: Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data – Naive Bayes models, Learning with hidden data – EM algorithm, Reinforcement learning.

**Pattern Recognition**: Introduction, Design principles of pattern recognition system, Statistical Pattern recognition, Parametre estimation methods – Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbour (NN) Rule, Bayes Classifier, Support Vector Machine (SVM), K – means clustering.

**PYE437: Digital Signal Processing**
**(2 Units, LH 30)**

**Course Contents**

Review of discrete-time signals and systems with emphasis on sampling and quantization. Introduction to DSP hardware architecture, including fixed-point vs. floating-point processors and the multiply-accumulate unit. Convolution and spectral analysis using the discrete-time Fourier transform. The discrete Fourier transform, the fast Fourier transform (FFT), and use of the FFT for convolution and spectral analysis. Z- transforms, pole-zero analysis of discrete-time systems, and pole-zero-based digital filter design. Analysis of FIR and IIR discrete-time systems with emphasis on phase response. Design and implementation of FIR digital filters. Design and implementation of IIR digital filters. Introduction to multi-rate signal processing and filter banks. The course will provide students with a solid foundation in DSP theory and its practical applications.

**PYE322: Industrial Electronics Design**
**(2 Units E: LH 30)**

**Course Contents**

Solid-state devices and circuits; Programmable controllers; Thyristors; Lasers; Fiber optics ; Power supplies; Op-amp circuits; Open- and closed-loop (feedback) systems; Input devices; Output devices; AC and DC motors; Motor control devices; Robots and other motion control systems; Data communications.

**PYE431: Introduction to Nanoelectronics**
**(2 Units; LH 30)**

**Course Content**

This is a one course that introduces students to nanoscience. Introduction to nanotechnology. Synthesis of nanomaterials. Characterization of nanomaterials. Properties of materials at the nanoscale. Advanced research in nanoscience and nanotechnology. Classes of nanomaterials. Natural nanomaterials and Artificial nanomaterials. Nanoelectronics and nanophotonic. Ohm's law in nanoelectronics MOSFET, Nano-MOSFET (Operation, Short Channel Effects, Limits on Subthreshold Swing and its Consequences, Challenges in Scaling), Introduction to Bulk MOSFET, Carbon Nanotubes, Nanowires, Single and Double Gate MOSFET.

**PYE435: Signals and Systems**
**(2 units C: LH 30)**

**Course Contents**

Introduction to signals and systems; basic concepts and definitions, time and frequency domain representations, and classification of signals and systems.Signal Analysi; Analogy between Vectors and Signals, Orthogonal Signal Space, Signal approximation using Orthogonal functions, Mean Square Error, Closed or complete set of Orthogonal functions, Orthogonality in Complex functions, Classification of Signals and systems, Exponential and Sinusoidal signals, Concepts of Impulse function, Unit Step function, Signum function. Fourier analysis; Fourier series, Fourier transform, frequency response, and applications. Fourier Transforms involving

Impulse function and Signum function, Introduction to Hilbert Transform.The Laplace transformation and its applications in system response analysis, transfer function, and stability analysis are then covered. Discrete-time signals and systems are introduced, including the discrete Fourier transform, FFT algorithm, and applications. The Z-transform and its properties, sampling and reconstruction of signals, and time and frequency analysis of linear time-invariant systems are covered.Filter characteristic of Linear System, Distortion less transmission through a system, Signal bandwidth, System Bandwidth, Ideal LPF, HPF, and BPF characteristics, Causality and Paley-Wiener criterion for physical realization, Relationship between Bandwidth and rise time, Convolution and Correlation of Signals, Concept of convolution in Time domain and Frequency domain, Graphical representation of Convolution. State-space analysis and its advantages, controllability and observability, and stability analysis using eigenvalues are then discussed. Applications of signal and system theory in communication systems, control systems, audio and image processing, and biomedical signal analysis are introduced.Sampling Theorem: Graphical and analytical proof for Band Limited Signals, Impulse Sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, Effect of under sampling – Aliasing, Introduction to Band Pass Sampling.

**PYE323: Power Electronics**
**(2 Units: LH 30)**

**Course Contents**

This in introduces students to the basics of three-phase circuits, connections, voltage and current analysis and real and reactive power calculations; the fundamentals of electricity conversion from the form supplied by the source to the forms required by the load; power electronic conversion techniques, including the basic converters (DC-DC, AC-DC and DC-AC) and their power switching and control methods; the methods of circuit analysis applicable to switched mode circuits; essential properties of the relevant semiconductor devices; simple converters for practical applications. Characteristics of power devices; DC-DC converters; AC Current, Voltage and Power; AC-DC converters and Inverters (DC-AC converters).

**PYE 430: Communications Systems and Principles**
**(3 Units C: LH45)**

**Course Contents**

Taxonomies of telecom systems. Electromagnetic spectrum. Signal waveforms. Information. Audio. Data. Video. Conversion of sound to electrical signals. Amplitude. Frequency. Phase. Wave-shape. The relationship between velocity (v), frequency (f) and wavelength ($\lambda$). Analog and digital signals. Time and frequency domain representations of signals. Analog Modulation Techniques (AM, FM, and PM). Transmission of signals through guided and unguided media; copper pairs, coaxial, waveguides, optical fibres and wireless radio. Introduction to Microwave Communication.

Introduction to networks services and their impact on society. LANs, MANs, and WANs. Data networks. The internet. Global navigation. Electromagnetic spectrum and frequency allocation for various services. Basic principles of switching; space and time division switching networks; store-and-forward switching; examples of switching systems. Components of Telecommunication Systems.Digital Communication Systems. Data Communication. Transmission Systems. Introduction to 5G Networks. Internet of Things (IoT) and Cloud Computing in Telecommunication. Satellite communication Systems.

## B.Sc. COMPUTER SCIENCE

**Overview**

The B.Sc. Computer Science programme teaches the essential ideas of Computer Science emphasizing the core elements of computer programming, networking, and futuristic technology, demystifying and bringing patterns to life with practical's. Students of this programme are equipped with the study of the algorithmic process and the computational machines ranging from algorithms, practical issues in implementing computing systems in the hardware as well as the software. The graduates of this programme will understand the impact of computing and its application, as well as acquire skills in Computer Programming, Analysis of systems and procedures, and Software Development.

**Philosophy**

The philosophy of Computer Science programme is to provide broad and high quality education that emphasises the theoretical and algorithmic foundations of computing, which guide design, implementation and application of computation systems.

**Objectives**

The specific objectives are to:

1. create in students the awareness of and enthusiasm for Computer Science and its capabilities;
2. provide students with a broad and balanced foundation of Computer Science knowledge and practical skills;

3. prepare students to formulate real world problems in Computer Science, employ problem-solving skills and use appropriate tools and technologies to obtain valid and realistic solutions;
4. develop in students the ability to analyse, evaluate and propose alternative solutions to given software and/or algorithm designs;
5. develop students' abilities in self-management and teamwork;
6. prepare students to be proficient, professional and ethical in their careers;
7. prepare students to communicate effectively both orally and in writing; and
8. develop in students the ability to engage in life-long learning and growth in Computer Science and to be potential job creators.

**Unique Features of the Programme**

The unique features of the programme are:

1. deliberate emphasis on coverage and developing competence on the usage of open source software;
2. additional hands-on practical component in a number of courses to emphasise students' engagement in the learning process for better learning and development of soft skills; and
3. emphasis on formal methods and algorithmic coverage of computing concepts and principles.

**Employability Skills**

In Nigeria, like in many other countries, there is an abundance of opportunities for people with computing skills. However, given the intense competition in the job market, a good Computer Science degree may be necessary but not sufficient for employment. In addition to a good degree, employers are increasingly requiring candidates to demonstrate employability skills such as communication and teamwork, organisation and management, critical thinking, leadership, technology skills and self-management. The courses in this programme have been tailored to help develop and enhance acquisition of these skills by graduates of the programme.

**21st Century Skills**

Among the 21st Century skills for the programme are:

1. creativity;
2. information literacy;
3. media literacy;
4. flexibility;
5. social skills;
6. Problem solving;
7. collaboration;
8. global awareness;
9. innovation skills; and
10. critical thinking.

**Admission and Graduation Requirements**

**Admission requirements**

**4 Year Degree Programme**

In addition to appropriate UTME-Score, a candidate must possess five Senior Secondary certificate (SSC)-credits passes including English Language, Mathematics, Physics and any other relevant Science subjects in not more than two sittings.

**3 Year Degree Programme:**

**Direct Entry**

A minimum of a credit at the University/National Diploma or NCE with other five Senior School Certificate (SSC) credit passes in relevant Science subjects three of which must be in English Language, Mathematics, Physics.

**Minimum duration**

The minimum duration of the Computer Science degree programme is four academic sessions for UTME. However, it is three academic sessions for candidates admitted to the 200 Level.

**Graduation requirements**

To be eligible for the award of the Bachelor degree in Computer Science, a student must have:

1. passed all the core courses, university and faculty/school required courses and electives;
2. accumulated a minimum of 120 course units for students admitted through UTME and 90 course units for students admitted to 200 level; and
3. attain a minimum CGPA of 1.00.

In order for a student to graduate, they must be found worthy in character throughout the period of his/her studentship and must accumulate the total units prescribed for the programme from Core, Faculty and General Studies courses as well as SIWES, Seminar and Final Year Project.

**Graduation Requirements**

Expected duration for UTME candidates shall be 4 years and students are required to pass a minimum of 120 units, while for direct entry students, expected duration for graduation shall be 3 years and would be expected to pass a minimum of 90 units which must include all compulsory courses.

## Global Course Structure

### Level 100

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST - 111 | Communication in English | 2 | C | 15 | 45 |
| GST - 112 | Nigerian Peoples and Culture | 2 | C | 30 | 0 |
| MTH - 101 | Elementary Mathematics I | 2 | C | 30 | 0 |
| MTH - 102 | Elementary Mathematics II | 2 | C | 30 | 0 |
| PHY - 101 | General Physics I | 2 | C | 30 | 0 |
| PHY - 102 | General Physics II | 2 | C | 30 | 0 |
| PHY - 107 | General Practical Physics I | 1 | C | 0 | 45 |
| PHY - 108 | General Practical Physics II | 1 | C | 0 | 45 |
| STA - 111 | Descriptive Statistics | 3 | C | 45 | 0 |
| COS - 101 | Introduction to Computing Sciences | 3 | C | 30 | 45 |
| COS - 102 | Problem Solving | 3 | C | 30 | 45 |
| ICT - 102 | Introduction to Information and Communication Technology | 2 | C | 30 | 0 |
| CSC - 101 | Computer Application Packages | 2 | C | 30 | 45 |
| COS - 103 | Introduction to Computer Programming | 3 | C | 30 | 45 |
| **Total** | | **38** | | | |

**200 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST - 212 | Philosophy, Logic and Human Existence | 2 | C | 30 | 0 |
| ENT - 211 | Entrepreneurship and Innovation | 2 | C | 30 | 0 |
| MTH - 201 | Mathematical Methods I | 2 | C | 30 | 0 |
| MTH - 202 | Elementary Differential Equations | 2 | C | 30 | 0 |
| COS - 201 | Computer Programming I | 3 | C | 30 | 45 |
| COS - 202 | Computer Programming II | 3 | C | 30 | 45 |
| CSC - 203 | Discrete Structures | 2 | C | 30 | 0 |
| CSC - 299 | SIWES I | 3 | C | 0 | 135 |
| IFT - 211 | Digital Logic Design | 2 | C | 15 | 45 |
| IFT - 212 | Computer Architecture and Organisation | 2 | C | 15 | 45 |
| SEN - 201 | Introduction to Software Engineering | 2 | C | 30 | 0 |
| IFT - 201 | Introduction to Web Technologies | 2 | C | 15 | 45 |
| INS - 202 | Human-Computer Interactions | 2 | C | 15 | 45 |
| INS - 204 | System Analysis and Design | 3 | C | 30 | 45 |
| **TOTAL** | | **32** | | | |

**NOTE: ***SIWES will take place during long vacations of 200 Level and 300 Level.**

**300 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST - 312 | Peace and Conflict Resolution | 2 | C | 30 | 0 |
| ENT - 312 | Venture Creation | 2 | C | 15 | 45 |
| CSC - 301 | Data Structures | 3 | C | 30 | 45 |
| CSC - 308 | Operating Systems | 3 | C | 30 | 45 |
| CSC - 309 | Artificial Intelligence | 2 | C | 15 | 45 |
| CSC - 322 | Computer Science Innovation and New Technologies | 2 | C | 15 | 45 |
| CSC - 399 | SIWES II | 3 | C | 0 | 135 |
| CYB - 201 | Introduction to Cyber security and Strategy | 2 | C | 30 | 0 |
| DTS - 304 | Data Management I | 3 | C | 30 | 45 |
| ICT - 305 | Data Communication System & Network | 3 | C | 30 | 45 |
| IFT - 302 | Web Application Development | 2 | C | 15 | 45 |
| SEN - 301 | Object-Oriented Programming | 2 | C | 15 | 45 |
| IFT - 303 | Mobile Application Development | 2 | C | 15 | 45 |
| DTS - 302 | Big Data Computing | 2 | C | 15 | 45 |
| **TOTAL** | | **33** | | | |

**SIWES II now holds during the long vacation of 300L**

**400 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| COS - 409 | Research Methodology and Technical Report Writing | 3 | C | 45 | 0 |
| CSC - 401 | Algorithms and Complexity Analysis | 2 | C | 30 | 0 |
| CSC - 402 | Ethics and Legal Issues in Computer Science | 2 | C | 30 | 0 |
| CSC - 497 | Final Year Project I | 3 | C | 0 | 135 |
| CSC - 498 | Final Year Project II | 3 | C | 0 | 135 |
| INS - 401 | Project Management | 2 | C | 30 | 0 |
| CSC - 403 | Introduction to Parallel Programming | 3 | E | 30 | 45 |
| CSC - 404 | Operations Research | 3 | E | 45 | 0 |
| COS - 401 | Soft Skills in Computing | 2 | C | 15 | 0 |
| CYB - 404 | Cloud Computing | 2 | C | 30 | 45 |
| DTS - 404 | Data Mining | 3 | C | 30 | 45 |
| DTS - 403 | Data Visualisation for Data-driven Decision Making | 2 | C | 15 | 45 |
| DTS 405 | Statistical Computing Inference and Modelling | 2 | C | 30 | 45 |
| **TOTAL** | | **32** | | | |

**100 Level**

**Course Content**

**GST 111: Communication in English**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
Sound patterns in English Language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). Sentence in English (types: structural and functional, simple and complex). Grammar and Usage (tense, mood, modality and concord, aspects of language use in everyday life). Logical and Critical Thinking and Reasoning Methods (Logic and Syllogism, Inductive and Deductive Argument and Reasoning Methods, Analogy, Generalisation and Explanations). Ethical considerations, Copyright Rules and Infringements. Writing Activities: (Pre-writing, writing, post writing, editing and proofreading; brainstorming, outlining, paragraphing. Types of writing, Summary, Essays, Letter, Curriculum Vitae, Report writing, Note making, etc. Mechanics of writing). Comprehension Strategies: (Reading and types of Reading, Comprehension Skills, 3RsQ). Information and Communication Technology in modern language learning. Language skills for effective communication. Major word formation processes. Writing and reading comprehension strategies. Logical and critical

reasoning for meaningful presentations. Art of public speaking and listening. Report writing.

**GST 112: Nigerian Peoples and Culture**
**(2 Units C: LH 30)**

**Course Contents**

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and culture; peoples and culture of the ethnic minority groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; Colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; Nationalist movement and struggle for independence). Nigeria and challenges of nation-building (military intervention in Nigerian politics; Nigerian Civil War). Concept of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigeria people; trade, skill acquisition and self-reliance). Social justice and national development (law definition and classification). Judiciary and fundamental rights. Individual, norms and values (basic Nigeria norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts. Cultism, kidnapping and other related social vices). Re-orientation, moral and national values (The 3R's – Reconstruction, Rehabilitation and Re-orientation) Re-orientation Strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline (WAI), War Against Indiscipline and Corruption (WAIC), Mass Mobilisation for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

**MTH 101: Elementary Mathematics I (Algebra and Trigonometry)**
**(2 Units C: LH 30)**

**Course Contents**
Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers; integers, rational and irrational numbers, mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem. Complex numbers; algebra of complex numbers; the Argand diagram. De-Moivre's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

**MTH 102: Elementary Mathematics II (Calculus)**
**(2 Units C: LH 30)**

**Course Contents**
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.

**PHY 101: General Physics I (Mechanics)**
**(2 Units C: LH 30)**

**Course Contents**
Space and time. Units and dimension, Vectors and Scalars, Differentiation of vectors. Displacement, velocity and acceleration. Kinematics. Newton laws of motion (Inertial frames, Impulse, force and action at a distance, momentum conservation). Relative motion. Application of Newtonian mechanics. Equations of motion. Conservation principles in physics, Conservative forces, conservation of linear momentum, Kinetic energy and work, Potential energy, System of particles, Centre of mass. Rotational motion. Torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates. Conservation of angular momentum. Circular motion. Moments of inertia, gyroscopes and precession. Gravitation: Newton's Law of Gravitation, Kepler's laws of planetary motion, Gravitational potential energy, Escape velocity, Satellites motion and orbits.

**PHY 102: General physics II (Electricity & magnetism)**
**(2 Units C: LH 30)**

**Course Contents**
Forces in nature. Electrostatics (electric charge and its properties, methods of charging). Coulomb's law and superposition. Electric field and potential. Gauss's law. Capacitance. Electric dipoles. Energy in electric fields.

Conductors and insulators. DC circuits (current, voltage and resistance. Ohm's law. Resistor combinations. Analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère's laws. Magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz's laws. Step up and step down transformers. Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, and resistance.

**PHY 107: General Practical Physics I**
**(1 Unit C: PH 45)**

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

**PHY 108 - General Practical Physics II**
**(1 Unit C: PH 45)**

**Course Contents**
This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100

level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

**STA 111: Descriptive Statistics**
**(3 Units C: LH 45)**

**Course Contents**
Permutation and combination. Concepts and principles of probability. Random variables. Probability and distribution functions. Basic distributions: Binomial, geometric, Poisson, normal and sampling distributions; exploratory data analysis.

**COS 101: Introduction to Computing Sciences**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
Brief history of computing. Description of the basic components of a computer/computing device. Input/Output devices and peripherals. Hardware, software and human ware. Diverse and growing computer/digital applications. Information processing and its roles in society. The Internet, its applications and its impact on the world today. The different areas/programs of the computing discipline. The job specializations for computing professionals. The future of computing.

**Lab Work:** Practical demonstration of the basic parts of a computer. Illustration of different operating systems of different computing devices including desktops, laptops, tablets, smart boards and smart phones. Demonstration of commonly used applications such as word processors, spreadsheets, presentation software and graphics. Illustration of input and output devices including printers, scanners, projectors and smart boards. Practical demonstration of the Internet and its various applications. Illustration of browsers and search engines. How to access online resources.

**COS 102: Problem Solving**
**(3 Units C: LH 30; PH 45)**

**Course Contents**

Introduction to the core concepts of computing. Problems and problem-solving. The identification of problems and types of problems (routine problems and non-routine problems). Method of solving computing problems (introduction to algorithms and heuristics). Solvable and unsolvable problems. Solution techniques of solving problems (abstraction, analogy, brainstorming, trial and error, hypothesis testing, reduction, literal thinking, means-end analysis, method of focal object, morphological analysis, research, root cause analysis, proof, divide and conquer). General Problem-solving process. Solution formulation and design: flowchart, pseudocode, decision table, decision tree. Implementation, evaluation and refinement. Programming in C, Python etc.

**Lab Work:** Use of simple tools for algorithms and flowcharts; writing pseudocode; writing assignment statements, input-output statements and condition statements; demonstrating simple programs using any programming language (Visual Basic, Python, C)

**ICT 102 Introduction to Information and Communication Technology, 2 Units, Elective, 30 LH, 0 PH**

**Course Contents**

Basic principle of computers. Computer "backbone". Data transmission. Random Access Memory. Permanent Memory. Graphic processing. Communication Ports. Input and Output Devices. Software types. Accessibility options. Computer types. Portable digital devices. Network Types. Internet. Instant messaging. Voice over Internet Protocol. Really Simple Syndication. Network communication. Internet data transfer. Data rate units. Internet access. Virtual (online) communities. Computer in the workplace. Telecommuting (telework).

**COS-101 Computer Application Packages. 2 Units, Elective, 15 LH, 45 PH**

**Course Contents**

Unit 1-Introduction to Computer Application: What are computer application packages? Types of computer application packages Overview of popular computer application packages. Unit 2-Microsoft Office Suites - Microsoft Word: Creating, editing, and formatting documents;

Working with tables, graphics, and charts; Collaborating on documents. Microsoft Excel: Creating, editing, and formatting spreadsheets; Working with formulas and functions; Creating charts and graphs. Microsoft PowerPoint: Creating, editing, and formatting presentations; Adding multimedia elements; Delivering presentations. Unit 3- Google Slides: Creating, editing, and formatting presentations; Adding multimedia elements; Delivering presentations

**COS-103 Introduction to computer programming. 2 Units, Elective, 15 LH, 45 PH**

**Course Contents**

Vital Python – Math, Strings, Conditionals, and Loops. Vital Python. Numbers: Operations, Types, and Variables. To Open a Jupyter Notebook. Python as a Calculator. Standard Math Operations. Basic Math Operations. Order of Operations. Spacing in Python. Number Types: Integers and Floats. Complex Number Types. Errors in Python. Variables. Variable Assignment. Changing Types. Reassigning Variables in Terms of Themselves. Variable Names. Multiple Variables. Comments. Docstrings. Theorem in Python. Strings: Concatenation, Methods, and input (). String Syntax. Escape Sequences with Quotes. Multi-Line Strings. The print () Function. String Operations and Concatenation. String Interpolation. Comma Separators. Format. The len () Function. String Methods. Casting. The input Function. String Indexing and Slicing. Indexing. Slicing Strings and Their Methods. Booleans and Conditionals. Booleans. Logical Operators. Comparison Operators. Comparing Strings. Conditionals. The if Syntax. Indentation. if else. The elif Statement. Loops. The while Loops. An Infinite Loop. break. Programs. The for Loop. The continue Keyword. Python Structures. The Power of Lists. List Methods. Accessing an Item from a List. Adding an Item to a List. Dictionary Keys and Values. a List and a Dictionary. Zipping and Unzipping Dictionaries Using zip (). Dictionary Methods. Tuples. A Survey of Sets. Set Operations. Choosing Types. Executing Python – Programs. Algorithms, and Functions Introduction. Python Scripts and Modules.

## 200 Level

**GST 212: Philosophy, Logic and Human Existence**
**(2 Units C: LH 30)**

**Course Contents**

The courses introduces the students the scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

**ENT 211: Entrepreneurship and Innovation**
**(2 Units C: LH 15; PH 45)**

**Course Contents**

Concept of Entrepreneurship (Entrepreneurship, Intrapreneurship/Corporate Entrepreneurship). Theories, Rationale and relevance of Entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship and creative destruction). Characteristics of Entrepreneurs (Opportunity seeker, risk taker, natural and nurtured, problem solver and change agent, innovator and creative thinker). Entrepreneurial thinking (Critical thinking, Reflective thinking, and Creative thinking).

Innovation (Concept of innovation, Dimensions of innovation, Change and innovation, Knowledge and innovation). Enterprise formation, partnership and networking (Basics of business plan, Forms of business ownership, business registration and forming alliances and joint ventures). Contemporary Entrepreneurship Issues (knowledge, skills and technology, intellectual property, virtual office, networking). Entrepreneurship in Nigeria (Biography of inspirational entrepreneurs, youth and women entrepreneurship, Entrepreneurship support institutions, Youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

**MTH 201: Mathematical Methods I**
**(2 Units C: LH 30)**

**Course Contents**

It is about the 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 and three variables. Partial derivatives chain rule, extrema, Lagrangian multipliers. Increments, differentials and linear approximations. Evaluation of line, integrals. Multiple integrals.

**MTH 202: Elementary Differential Equations**
**(2 Units C: LH 30)**

**Course Contents**

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.

**COS 201: Computer Programming I**
**(3 Units C1: LH 30; PH 45)**

**Course Contents**

Introduction to computer programming. Functional programming; Declarative programming; Logic programming; Scripting languages. Introduction to object-orientation as a technique for modelling computation. Introduction of a typical object-oriented language, such as Java. Basic data types, variables, expressions, assignment statements and operators. Basic object-oriented concepts: abstraction; objects; classes; methods; parameter passing; encapsulation. Introduction to Strings and string processing; Simple I/O; control structures; Arrays; Simple recursive algorithms; inheritance; polymorphism.

**Lab work**: Programming assignments involving hands-on practice in the design and implementation of simple algorithms such as finding the average, standard deviation, searching and sorting. Practice in developing and tracing simple recursive algorithms. Developing programmes involving inheritance and polymorphism.

**COS 202: Computer Programming II**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
This course is a continuation of CSC201. Review and coverage of advanced object-oriented programming - polymorphism, abstract classes and interfaces. Class hierarchies and programme organisation using packages/namespaces. Use of API – use of iterators/enumerators, List, Stack, Queue from API; Searching; sorting; Recursive algorithms; Event-driven programming: event-handling methods; event propagation; exception handling. Applications in Graphical User Interface (GUI) programming.

**Lab work**: Programming assignments leading to extensive practice in problem-solving and programme development with emphasis on object-orientation. Solving basic problems using static and dynamic data structures. Solving various searching and sorting algorithms using iterative and recursive approaches. GUI programming.

**CSC 203: Discrete Structures**
**(2 Units C: LH 30)**

**Course Contents**
Propositional Logic. Predicate Logic. Sets. Functions. Sequences and Summation. Proof Techniques. Mathematical induction. Inclusion-exclusion and Pigeonhole principles. Permutations and Combinations (with and without

repetitions). The Binomial Theorem. Discrete Probability. Recurrence Relations.

**CSC 299: SIWES I**
**(3 Units C: PH 135)**

**Course Contents**
Students would be attached to private and public organisations that are related to their course of study for a period of three months during the second-year session long break with a view to making them acquire practical experience and to the extent possible, develop skills in all areas of Computer Science. Students are supervised during the training period and shall be expected to keep records designed for the purpose of monitoring their performance. They are also expected to submit a report on the experience gained and defend their reports.

**IFT 211: Digital Logic Design**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
Introduction to information representation and number systems. Boolean algebra and switching theory. Manipulation and minimisation of completely and incompletely specified Boolean functions. Physical properties of gates: fan-in, fan-out, propagation delay, timing diagrams and tri-state drivers. Combinational circuits design using multiplexers, decoders, comparators and adders. Sequential circuit analysis and design, basic flip-flops, clocking and timing diagrams. Registers, counters, RAMs, ROMs, PLAs, PLDs, and FPGAs.

**Lab Work:** Simple combinational gates (AND, OR, NOT, NAND, NOR); Combinational circuits design using multiplexers, decoders, comparators and adders. Sequential circuit analysis and design using basic flip-flops (S-R, J-K, D, T flip-flops); Demonstration of registers, counters, RAMs, ROMs, PLAs, PLDs, and FPGAs.

**IFT 212: Computer Architecture and Organisation**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
This course teaches the students the basic principles of computer hardware and instruction set architecture. Internal CPU organisation and implementation. Instruction format and types, memory, and I/O instructions. Dataflow, arithmetic, and flow control instructions, addressing modes, stack operations, and interrupts. Data path and control unit design. RTL, microprogramming and hardwired control. The practice of assembly language programming. Memory hierarchy. Cache memory, Virtual memory. Cache performance. Compiler support for cache performance. I/O organisations.

**Lab Work:** Practical demonstration of the architecture of a typical computer. Illustration of different types of instructions and how they are executed. Simple Assembly Language programming. Demonstration of interrupts. Programming assignments to practice MS-DOS batch programming, Assembly Process, Debugging, Procedures, Keyboard input, Video Output, File and Disk I/O, and Data Structure. Demonstration of Reduced Instruction Set Computers.

Illustration of parallel architectures and interconnection networks.

**SEN 201: Introduction to Software Engineering**
**(2 units C: LH 30)**

**Course Contents**

Software Engineering concepts and principles. Design, development and testing of software systems. Software processes: software lifecycle and process models. Process assessment models. Software process metrics. Life cycle of software system. Software requirements and specifications. Software design. Software architecture. Software metrics. Software quality and testing. Software architecture. Software validation. Software evolution: software maintenance; characteristics of maintainable software; re-engineering; legacy systems; software reuse. Software Engineering and its place as a computing discipline. Software project management: team management; project scheduling; software measurement and estimation techniques; risk analysis; software quality assurance; software configuration management. Software Engineering and law.

**300 Level**

**GST 312: Peace and Conflict Resolution**
**(2 Units C: LH 30)**

**Course Contents**

Concepts of Peace, Conflict and Security in a multi-ethnic nation. Types and Theories of Conflicts: Ethnic, Religious, Economic, Geopolitical Conflicts; Structural Conflict Theory, Realist Theory of Conflict, Frustration-Aggression Conflict Theory. Root causes of Conflict and Violence in Africa: Indigene and Settlers Phenomenon; Boundaries/border disputes; Political disputes; Ethnic disputes and rivalries; Economic Inequalities; Social disputes; Nationalist Movements and Agitations; Selected Conflict Case Studies – Tiv-Junkun; Zango Kartaf, Chieftaincy and Land disputes, etc. Peace Building, Management of Conflicts and Security: Peace & Human Development. Approaches to Peace & Conflict Management (Religious, Government, Community Leaders, etc.). Elements of Peace Studies and Conflict Resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and Terrorism. Peace Mediation and Peace Keeping. Peace & Security Council (International, National and Local levels) Agents of Conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution, ADR. Dialogue b). Arbitration, c). Negotiation d). Collaboration, etc. Roles of International Organisations in Conflict Resolution. (a). The United Nations, UN and its Conflict Resolution Organs. (b). The African Union & Peace

Security Council (c). ECOWAS in Peace Keeping. Media and Traditional Institutions in Peace Building. Managing Post-Conflict Situations/Crisis: Refugees. Internally Displaced Persons, IDPs. The role of NGOs in Post-Conflict Situations/Crisis.

**ENT 312: Venture Creation**
**(2 Units C: LH 15; PH 45)**

**Course Contents**

Venture creation provides the students with the technical knowhow for the Opportunity Identification (Sources of business opportunities in Nigeria, Environmental scanning, Demand and supply gap/unmet needs/market gaps/market research, Unutilised resources, Social and climate conditions, and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, microfinance, personal savings, small business investment organisations, and business plan competition). Entrepreneurial marketing and e-commerce (Principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, first mover advantage, e-commerce business models and successful e-commerce companies,). Small business management/family business: Leadership & Management, basic bookkeeping, nature of family business and family business growth model. Negotiation and business communication (Strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching).

Technological solutions (the concept of market/customer solution, customer solution, and emerging technologies, business applications of new technologies- Artificial Intelligence (AI), Virtual/Mixed Reality (VR), Internet of Things (IoT), Blockchain, Cloud Computing, renewable energy, etc. digital business and e-commerce strategies).

**IFT-201 - Introduction to Web Technologies. 2 Units, Elective, 15 LH, 45 PH**

**Course Contents**

This course introduces the student to the knowledge of internet, the World Wide Web (WWW), and web development. WWW as a platform for interactive applications, content publishing, and social services. The role of HTTP and HTTPS in the context of web applications. Roles and operations of web browsers and the webserver. Interacting with web applications through forms. Using style sheets to separate document structure and document formatting. Web development tools and frameworks. Build a simple website that: organises information effectively, uses valid HTML and CSS, and applies appropriate web standards from standards bodies such as W3C. HTTP communication protocol. The mark-up languages HTML, XHTML, and XML, the CSS and XSLT standards for formatting and transforming web content. Interactive graphics and multimedia content on the web. Client-side programming using JavaScript. Impact of the World Wide Web on people's lives over time.

**INS 202 Human-Computer Interactions 2 Unit, Elective, 15 LH, 45 PH**

**Course Contents**

Foundations of HCI. The concept underlying the design of HCI. Principles of GUI. GUI toolkits. System design methods. User conceptual models and interface metaphors. Human cognitive and physical ergonomics. Human-centred software evaluation and development. GUI design and programming.

**INS 204 System Analysis and Design 2 Unit, Elective, 15 LH, 45 PH**

**Course Contents**

Structured approach to analysis and design of information systems for businesses. Software development life cycle. Structured top-down and bottom-up design. Dataflow diagramming. Entity relationship modelling. Computer aided software engineering. Input and output, prototyping design and validation. File and database design. Design of user interfaces. Comparison of structured and object-oriented design.

**Lab work:** Practical exercises on software development life cycle (SDLC) activities with different case studies. Use of different information systems case studies to apply the knowledge of structured top-down and bottom –up design, data flow diagram and entity relationship models.

**CSC 301: Data Structures**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
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.

**Lab work:** Writing C+/C++ functions to perform practical exercises and implement using the algorithms on arrays, records, string processing, queues, trees, pointers and linked structures.

**CSC 308 Operating System**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
Fundamentals of operating systems design and implementation. History and evolution of operating systems. Types of operating systems. Operating system structures. Process management: processes, threads, CPU scheduling, process synchronisation. Memory management and virtual memory. File systems; I/O systems; Security and protection; Distributed systems; Case studies.

**Lab work**: Practical hands-on engagement to facilitate understanding of the material taught in the course. All the process, memory, file and directory management issues will be demonstrated under the LINUX operating system. Also UNIX commands will be briefly discussed. Alternatively, hands-on exposure may be through the use of operating systems developed for teaching, like TempOS, Nachos, Xinu or MiniOS. Another possibility is through programming exercises that implement and simulate algorithms taught. Simulation of CPU scheduling algorithms, producer-consumer problem, memory allocation algorithms, file organisation techniques, deadlock algorithms and disk scheduling algorithms.

**CSC 309: Artificial Intelligence**
**(2 Units C: LH 15; PH 45)**

**Course Contents**

Overview of Artificial Intelligence. History of AI. Goals of AI. AI Technique. Types of AI. Branches and applications of AI. Advantages and Disadvantages. Introduction to Intelligent Agents. Agent Performance, Examples of Agents, Agent Faculties, Rationality, Agent Environment. Agent Architectures. Search. General Classes of AI Search Algorithm Problems. Problem Solving by Search. Types of AI Search Techniques and Strategies. Introduction to the types of problems and techniques in AI. Problem-Solving methods. Major structures used in AI programmes. Knowledge Representation. KR and Reasoning Challenges. KR Languages. Knowledge representation techniques such as predicate logic, non-monotonic logic, and probabilistic reasoning. Semantic Network - types of relationships, semantic network inheritance, types and components. Introduction to Frames. Natural Language Processing (NLP).

Introduction to natural language understanding and various syntactic and semantic structures. Introduction to Expert Systems - characteristics, components, types, requirements, technology, development. Programming Languages for AI. Introduction to computer image recognition.

**Lab Work:** This is a lab based practice inspired by Practical 17 Group practical in (i) Turing test practical - Students can act out their own version of the Turing test (ii) Facial recognition practical to aid in teaching students how machine learning works with students simulating a facial recognition algorithm. Practical applications of NLP in groups – (i) Question Answering focuses on building systems that automatically answer the questions asked by humans in a natural language (ii) Spam detection application for detecting unwanted e-mails getting to a user's inbox (iii) Sentiment analysis/opinion mining should be used on the web to analyse the attitude, behaviour, and emotional state of the sender, implemented through a combination of NLP and statistics (iv) Practical exercise of machine translation used to translate text or speech from one natural language to another natural language such as the Google Translator (v) Developing a model to provide word processor software for the spelling correction (vi) Developing a model for speech recognition for converting spoken words into text (vii) Implementing a Chatbot to provide the staff/student's chat services. OR

Group Practical exercise on agents and its environment using simulation of a colony of ants foraging for food; model simulating a message between agents; model simulating the flocking behaviour of birds; model to apply standard search algorithm to the classic search problem of missionaries and cannibals, and how to use communicating agents for searching networks. Some computer AI animation exercises for any branch of AI. Practical exercise on simple robots coupling and programming. Group project of building a lawn robot for trimming grasses, or any simple design and implementation of robotics.

**CSC 322: Computer Science Innovation and New Technologies**
**(2 Units C: LH 30)**

**Course Contents**
Fundamental concepts of innovation and business ideas in general. Product development. Business leadership. Digital marketing. Entrepreneurial opportunities in IT. Legal issues and Business ethics. New venture creation process. Business feasibility planning. Market research. Business strategy. Business models and Business plans. Technical presentations. Report on a successful entrepreneurial outfit.

**CSC 399: SIWES II**
**(3 Units C: PH 135)**

**Course Contents**
Students are attached to private and public organisations for a period of three months during the second-year session long break with a view to making them acquire practical experience and to the extent possible, develop skills in all areas of Computer Science. Students are supervised during the training period and shall be expected to keep records designed for the purpose of monitoring their performance. They are also

expected to submit a report on the experience gained and defend their reports.

**CYB 201: Introduction to Cyber security and Strategy (2 Units C: LH 30)**

**Course Contents**

Basic concepts: cyber, security, confidentiality, integrity, availability, authentication, access control, non-repudiation and fault-tolerant methodologies for implementing security. Security policies, best current practices, testing security, and incident response, Risk management, disaster recovery and access control. Basic cryptography and software application vulnerabilities. Evolution of cyber-attacks. Operating system protection mechanisms, intrusion detection systems, basic formal models of security, cryptography, steganography, network and distributed system security, denial of service (and other) attack strategies, worms, viruses, transfer of funds/value across networks, electronic voting, secure applications. Cyber security policy and guidelines. Government regulation of information technology. Main actors of cyberspace and cyber operations. Impact of cyber security on civil and military institutions, privacy, business and government applications; examination of the dimensions of networks, protocols, operating systems, and associated applications. Methods and motives of cyber security incident perpetrators, and the countermeasures employed by organisations and agencies to prevent and detect those incidences. Ethical obligations of security professionals. Trends and development in cyber security. Software application vulnerabilities. Evolution of cyber security and national security strategies, requirements to the typologies of cyber-attacks that require policy tools and domestic response. Cyber security strategies evolving in the face of big risk. Role of standards and frameworks.

**DTS 304: Data Management I**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
Information Management Concepts. Information storage & retrieval. Information management applications. Information capture and representation. Analysis and indexing - search, retrieval, information privacy. Integrity and security. Scalability, Efficiency and Effectiveness. Introduction to database systems. Components of database systems. DBMS functions. Database architecture and data independence. Database query language. Conceptual models. Relational data models. Semi-structured data models. Relational theory and languages. Database Design. Database security and integrity. Introduction to query processing and optimisation. Introduction to concurrency and recovery.

**Lab work**: Practical exercise on information representation, capture, storage and retrieval. Learn how to analyse data and index for easy searching and indexing. Practical on creating database files and models. How to create and use various database designs. How to query the created database. Methods of concurrency and recovery in database. Learn how to secure the database.

**ICT 305: Data Communication Systems and Network (3 Units C: LH 30; PH 45)**

**Course Contents**

Types and sources of data. Simple communications network. Transmission definitions, one way transmission, half duplex transmission, transmission codes, transmission modes, parallel transmission, serial transmission, bit synchronisation, character synchronisation, synchronous transmission, asynchronous transmission, efficiency of transmission. Introduction to network protocol. Seven Layer ISO-OSI standard protocols and network architecture. Transport protocols, session services protocols, and other protocols. Institute of Electrical and Electronics Engineering 802 standards. Error control and Data Compression: Forward Error Control; error detection methods; parity checking; linear block codes, cyclic redundancy checking; feedback error control, data compression, Huffman coding and dynamic Huffman coding. Local Area Networks: medium access control techniques – Ethernet, token bus and token ring; fibre distributed data interface, metropolitan area network. Peer-to-peer, Client Server. Client-Server Requirements: GUI design standards, interface independence, platform independence, transaction processing, connectivity, reliability, backup, and recovery mechanisms. Features and benefits of major recovery mechanisms. Network OS: (e.g., Novell NetWare, UNIX/LINUX, OS/2 & Windows NT). INTERNET: Definition, architecture, services, internet addressing. Internet protocol, IPv4, IPv6.

**Lab Work:** Demonstration of simple communications networks. Illustration of applications at the various levels of the OSI model. Demonstration of different types of Local Area Networks (LANs). Illustration of Metropolitan Area Networks. Illustration of Error Detection and Error Correction techniques. Demonstration of Network Operating Systems.

**IFT 302 - Web Application Development.**
**2 Units, Elective, 15 LH, 45 PH**

**Course Contents**
Introduction to framework-based web development using a contemporary language like PHP and ASP net. Principles of web pages (dynamic and static) and website design. The tool used in web development. Client-side and server-side languages. Creation of interactive, dynamic websites using a common web architecture and object-based database access. Design, implementation, and testing of web-based applications including related software, databases, interfaces, and digital media. Standard object models, and the use of server-side programmes for database and file access; testing, software quality assurance; and the process of publishing Web sites. Hands-on PHP and Python programme using open-source software (Apache, PHP, Python, JavaScript, and MySQL). Programming for web development includes control structures, objects, functions, and the use of composite data types. Deploying dynamic content using JavaScript. Designing and developing dynamic web pages and creating, validating, transforming, and formatting data using PHP.

**Lab Work:** Simple PHP programming. Design of simple web pages. Creation of dynamic websites. Design of client-side and server-side programmes. Demonstration of web-based applications with database access. Use of JavaScript to develop dynamic content. Use of Python to develop dynamic web pages.

**SEN 301 Object-Oriented Programming 2 Unit, Elective, 15 LH, 45 PH**

**Course Contents**

Object-oriented approach to information system development, particularly in. reference to the earlier stages of analysis and design. Importance of modelling principles of modelling Object-oriented modelling. Conceptual model of the Unified Modelling Language (UML) Architecture Software development life cycle. The principles and basic concepts of object orientation and the different aspects of object-oriented modelling as represented by the UML technique. Case study of a typical UML-based CASE tool.

**Lab Work:** Practical exercises on different requirements specification and design activities; developing problem statements, SRS documents and Use Case Diagrams; designing UML Activity diagrams, UML Class diagrams and State Chart diagrams; drawing partial layered, logical architecture diagram with UML package diagram notation; Designing Component and Deployment diagrams.

**IFT-303 - Mobile Application Development. 2 Units, Elective, 15 LH, 45 PH**

**Course contents**

Introduction to developing mobile applications. Mobile operating systems capabilities, application architecture, and major components, such as activities, services, broadcast receivers, etc. Development of interactive applications using widget libraries, web-based services. Basic concepts of 2D graphics and animation. An SQL database engine, and multithreading. Multiplatform mobile application development. Mobile application basics and features; Android application basics, UI design. Data storage; networking application design. Advanced application design (sensors, camera, GPS, Audio, etc.), graphics and games, web-based hybrid application design. Design and implement a simple mobile application for a given mobile platform. Metrics and methods to evaluate the performance of mobile applications. Mobile application perspectives and impact. **Lab Work:** Demonstration of a Simple Mobile Application. Design and Development of interactive mobile applications. Demonstration of multiplatform mobile application development. Development of Android applications including UI design and data storage design. Demonstration of advanced mobile application design. Illustration of metrics for measuring the performance of mobile applications.

**DTS 302: Big Data Computing. 2 Units, Elective, LH 15; PH 45**

**Course Contents**

Installation: Cloudera VM, Jupyter server. Big data retrieval and relational querying: Postgres databases, NoSQL data, MongoDB, Aerospike, and Pandas for data aggregation and working with data frames. Big Data Integration: Splunk and Datameer. Big Data Processing: Apache Spark, Hadoop, Spark Core (Spark MLlib and GraphX). Big Data Applications (Graph Processing). Big Data Streaming Platforms for Fast Data.

**Lab Work:** Analysing Twitter Data using Spark and MongoDB. Learn Big Data analytics skills. Practical procedure for the crafting of an enterprise-scale cost-efficient Big. Data and machine learning solution to uncover insights and value from data. Use the practical exercises to bridge the gap between the theoretical world of technology with the practical ground reality of building corporate Big Data and data science platforms. Hands-on exposure to Hadoop and Spark (or any of the BD tools), build machine learning dashboards using R and R Shiny, create web-based apps using NoSQL databases. Practical assignment of BD security.

**400 Level**

**COS 409: Research Methodology and Technical Report Writing**
**(3 Units C: LH 45)**

**Course Contents**

Foundations of Research. Types of Research. Research Approaches. Significance of Research. Research Methods versus Methodology. Research Process. Criteria and Strategy for Good Research. Problems Encountered by Researchers in Nigeria. Principles of Scientific Research. Scientific investigation. Problem formulation. Definition and technique of the Research Problem. Selection of Appropriate Method for Data Collection- Primary Data and Secondary Data. Guidelines for Constructing Questionnaire/Schedule. Guidelines for Successful Interviewing. Difference between Survey and Experiment. Eloping Research Proposal and Research Plan. Formulation of working hypothesis and Testing. Literature review. Procedure for reviewing related relevant studies and referencing cited works. Types of Reports. Technical Report Writing. Layout and mechanics of writing a Research Report. Standard Techniques for Research Documentation. Sampling Design. Different Types of Sample Designs. Steps in Sampling Design. Criteria of Selecting a Sampling Procedure. Methods of analysis. Processing and Analysis of Data Elements/Types of Analysis. Interpretation and Presentation of results. How to prepare References and Bibliography.

**CSC 401: Algorithms and Complexity Analysis**
**(2 Units C: LH 30)**

**Course Contents**

It deals with the basic algorithmic analysis. Asymptotic analysis of Upper and average complexity bounds. Standard Complexity Classes. Time and space trade-offs in analysis recursive algorithms. Algorithmic Strategies. Fundamental computing algorithms. Numerical algorithms. Sequential and Binary search algorithms. Sorting algorithms, Binary Search trees. Hash tables. Graphs and their representation.

**CSC 402: Ethics and Legal Issues in Computer Science**
**(2 Units C: LH 30)**

**Course Contents**

The course addresses social, ethical, legal and managerial issues in the application of Computer Science to the information technology industry. Through seminars and case studies, human issues confronting Computer Science graduates will be addressed. Topics include managerial and personal ethics, computer security, privacy, software reliability, personal responsibility for the quality of work, intellectual property, environment and health concerns, and fairness in the workplace.

**CSC 497: Final Year Project I**
**(3 Units C: PH 135)**

**Course Contents**
This is an independent or group investigation of the appropriate software, hardware, communication and networks or IT related problems in Computer Science carried out under the supervision of a lecturer. Before registering, the student must submit a written proposal to the supervisor to review. The proposal should give a brief outline of the project, estimated schedule of completion, and computer resources needed. A formal written report is essential and an oral presentation may also be required.

**CSC 498: Final Year Project II**
**(3 Units C: PH 135)**

**Course Contents**
This is a continuation of CSC 497. This contains the implementation and the evaluation of the project. A formal written report, chapters 4-5 have to be approved by the supervisor. A final report comprising chapters 1 - 5 will be submitted to the department for final grading. An oral presentation is required.

**INS 401 Project Management**
**(2 Units C: LH 30)**

**Course Contents**
Introduction to Project Management. The Project Management Lifecycle: Project management and systems development or

acquisition. The project management context. Technology and techniques to support the project management lifecycle, and Project management processes. Managing Project Teams: Project team planning, motivating team members, Leadership, power and conflict in project teams, and managing global project teams. Managing project communication and enhancing team communication. Project Initiation and Planning. Managing Project Scope: Project initiation, how organisations choose projects, Activities, and Developing the project charter. Managing Project Scheduling: Common problems in project scheduling, and Techniques for project scheduling. Managing Project Resources: Types of resources (human, capital, time), and Techniques for managing resources. Project quality and tools to manage project quality. Managing project risk and tools for managing project risk. Managing Project Procurement: Alternatives to systems development, External acquisition, Outsourcing-domestic and offshore. Steps in the procurement process, and managing the procurement process. Project Execution, Control and Closure: Managing project execution, monitoring progress and managing change. Documentation and communication, and Common problems in project execution. Managing Project Control and Closure: Obtaining information, Cost control, Change control, administrative closure, Personnel closure, Contractual closure and Project auditing.

**CSC 403 Introduction to Parallel Programming. 2 Unit, Elective, 15 LH, 45 PH**

**Course Contents**

This course asks of why Parallel Computing? Modifications to the von Neumann Model. Parallel Hardware. Parallel Software. Input, Output and Performance. Distributed-Memory Programming with MPI. The Trapezoidal Rule in MPI. Collective Communication. Performance Evaluation of MPI Programs. A Parallel Sorting Algorithm. Processes, Threads, and Pthreads. Matrix-Vector Multiplication. Critical Sections, Busy-Waiting & Mutexes. Producer-Consumer Synchronisation and Semaphores. Barriers and Condition Variables. Read-Write Locks. Caches, Cache Coherence, and False Sharing.

**CSC 404 Operation Research. 2 Unit, Elective, 15 LH, 45 PH**

**Course Contents**

This is about the 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.

**COS 401: Soft Skills and Professionalism in Computing. 2 Units, Elective,  LH 15; PH 0**

**Course Contents**

The course teaches the students of the basic of effective communication skills for IT marketers. Teamwork and Collaboration for Professional Success. Creative and Critical Thinking. Effective Approaches to Solving Problems, & Evaluating Solutions. Time management for Personal & Professional Productivity. Effective approaches to Decision making. Developing Trust and Increasing Your Influence in Society. Creating & delivering impactful presentations. Stress management and mental wellbeing . Adaptability and Building personal resilience. Career Planning. Pitches and Persuasion. Negotiation Skills for Business and IT consultancy. Openness to criticism and conflict response Style. Leadership: Theories, principles and styles of leadership. Team management Strategies. Introduction to professionalism in Computing. Code of ethics and principles for various professions in Computing and IT.

**CYB-404 Cloud Computing and Security. 2 Units, Elective, 15 LH, 45 PH**

**Course contents**

Introduction to cloud computing. Objectives, challenges, application domains, advantages. Computational and storage cloud architectures; Service level agreements, service lifecycle management. Elasticity and scalability techniques. Information, account and billing management. Cloud service model, service provisioning and access models. Cloud Service

Models: Software as a Service layer; Platform as a Service layer; Infrastructure as a Service layer. Virtualization and resource management. Distributed object storage clouds. Data storage and retrieval based on content. Computational tasks execution in storage clouds. Quality of service approaches. Requirements and parameters classification. Monitoring and control mechanisms. Quality of service guarantees. Security in the Cloud: Cloud threats; Threat Mitigation, Cloud and Security Risks. Google AppEngine. OpenStack. Apache Hadoop / MapReduce

**DTS 404 Data Mining. 2 Units, Elective, 15 LH, 45 PH**

**Course Contents**

Relational Databases: Mapping conceptual schema to relational schema; Database Query Languages (SQL) and NoSQL, Concept of functional dependencies & multi-valued dependencies. Transaction processing; distributed databases, XML and semantic Web. Data warehousing. Introduction to data science. Introduction to Data Warehouse, OLTP Systems; Differences between OLTP Systems and Data Warehouse: Characteristics of Data Warehouse; Functionality of Data Warehouse: Advantages and Applications of Data Warehouse. Advantages, Applications: Top- Down and Bottom-Up Development Methodology: Tools for Data warehouse development: Data Warehouse Types. Introduction: Scope of Data Mining: What is Data Mining. How Data Mining Works, Predictive Modelling: Data Mining and Data Warehousing: Architecture for Data Mining: Profitable Applications: Data Mining Tools.

**Lab work**: Practical exercises on basic R commands and data structures for manipulating data; how to read data from multiple formats in and out of R, using loops, conditional statements, and functions to automate common data management tasks. Exercises on how to clean and manage multiple complex datasets, manipulate textual data, basic web scraping techniques, for both standard web pages and the Twitter API. Work on techniques and hardware necessary to manage large datasets efficiently. Practical exercise on managing multiple data sets by example; working with text data; converting long- and wide-format data; and dealing with messy data. R Programming Fundamentals for data I/O and packages, looping and conditional statements, and functions.

**DTS 403 Data Visualisation for Data-driven Decision Making. 2 Units, Elective, 15 LH, 45 PH**

**Course Contents**

Various methods for presenting data for visualisation as well as how to choose between them. Fundamentals of data presentation using tables, graphs, images and video animations. Create engaging visualisations using graphs, images and video animations. Data summaries, working with tables, presenting data through graphs and plots, presenting data through video animation, creating interactive/augmented visualisation of data (ability to zoom into sections). Lab work: Practical experiments on different methods of presenting data for visualisation. Practice on how to use graphs, tables, images, and video on animation for data presentation

**DTS 405 Statistical Computing Inference and Modelling. 2 Units, Core, 30 LH, 45 PH**

**Course Contents**

Fundamentals of Data Science. Methodology of extracting knowledge from big datasets as well as various tools and platforms for Data Science. What is Data and why is it important? Basic classification of Data (Structured, semi-structured and unstructured data), Scope of Data Science, Steps of Data Science Process: Data collection, Pre-processing, training, and testing. Rudiments of data visualisations; Distributions, Probability, and Simulations; Predictions and Models. Use cases in various domains such Image, Natural Language, Audio and Video. Basic introduction to knowledge extraction: Data mining, Business Intelligence & Knowledge management, Introduction to Big Data integration and intelligence, Introduction to Data Analytics, Introduction to programming. Lab work: Practical experiments on data science process steps in simulated models. Practical application of the methods and tools used in data science for prediction models with some simulated exercises. Practical experiments on how to extract knowledge; how to mine valuable data from large sets of data sets using data mining processes and methods. Learn how to integrate business intelligence in big data along with some data analytics practical exercises. Simple exercises on R programming to enhance the coding knowledge acquired during theory class.

# B.Sc. CYBER SECURITY

## Overview

Recent developments in computing, network technologies, internet, and cloud technologies have necessitated for the need for reliability and secure exchange of digital information that are vital to most human activities such as banking, medicine, infrastructure management and elections. As the use of information technology expands, so are the potential consequences of cyber-attacks, and the need for a skilled workforce to prevent and defend against them. However, the pool of available talent to build and certify applications designed to withstand attacks, diagnose and prevent security intrusions is inadequate to meet the growing needs all over the world. Government agencies, business organisations, industries and military are scrambling to find qualified professionals to safeguard their systems, businesses and infrastructures.

The programme focuses on equipping students with sufficient knowledge, and skills to minimise and prevent cyber security threats and incidents. Students are also equipped with demonstrable abilities to gather, analyse, and present evidence of any cyber security bridges in organisation in a professional way. The graduates of this programme will understand the impact of cybercrime on business and the public and be able to identify and implement specific security practices, features and techniques to enhance the security of computers, computer-based systems and cyberspace.

**Philosophy**
The philosophy of the programme is to build capacity and develop human capital in the field of cyber security, to safeguard business transactions, corporate assets, critical infrastructure and all cyber operations in cyberspace, nationally and globally.

**Objectives**
The objectives are to:
1. produce graduates with requisite foundation knowledge of cyber security, skills and strategies that would enable them to detect and prevent cyber-fraud;
2. empower graduates with the ability to analyse cyber security threats, attacks and risks for organisations, with the capacity to develop detective codes and supportive software agents to address cyber security threats;
3. develop graduates with knowledge of cryptography and steganography for privacy of information on computer systems and digital forensic science techniques for the detection of cybercrimes;
4. produce graduates who can think critically about cyber intelligence security issues, develop and implement tactics strategic to cyber security, drawing on national and international recent case studies;
5. prepare graduates for the purpose of self-employment, cyber security-based job placement and professional practice in government and industries.

**Unique Features of The Programme**
The uniqueness of the cyber security programme is the introduction of big data analytics, cyber threat intelligence and

cyber conflict, deep and dark web security, cyber threat hunting, monitors and controllers, artificial intelligence cyber defence application and surveillance in cyber defence operations.

**Employability Skills**

Cyber security skills are hard skills that are required in all jobs. The employability of the unified and global skills are grouped into soft and hard skills along with technical and implementation skills. Graduates of Cyber security will have:

1. soft skills of excellent presentation and communications skills, ability to clearly articulate complex cyber-concepts, and usage of active listening skills.
2. technical skills of understanding the architecture, administration, and management of operating systems, networking, and virtualisation software; usability of firewalls and network load balancers; software development concepts and software analytics skills; common programming languages; and obtaining cyber security certifications essential and prerequisite for employment.
3. implementation skills of cyber hunting, cyber intelligence and cyber threat modelling; vulnerability assessment; identify the cyber security controls in place and how they are used; and use of the coding skills to write codes that automate cyber security tasks.

**21st Century Skills**

Cyber security students will be required to have the following 21st century skills:

1. problem-solving skills;

2. critical thinking;
3. communication skills;
4. creativity;
5. collaboration;
6. information literacy;
7. global awareness;
8. innovation skills; and
9. social skills.

**Admission And Graduation Requirements**

**Admission requirements**

**4 Year Degree Programme**

In addition to appropriate UTME-Score, a candidate must possess five Senior Secondary
Certificate (SSC)-credits passes including English Language, Mathematics, Physics and any other relevant Science subjects in not more than two sittings.

**3 Year Degree Programme: The Direct Entry**

**Direct Entry**

A minimum of a credit at the University/National Diploma or NCE with other five Senior Secondary Certificate (SSC) credit passes in relevant Science subjects three of which must be in English Language, Mathematics, Physics.

**Minimum duration**

The minimum duration of the Cyber security degree programme is four academic sessions for UTME students, however, it is three academic sessions for candidates admitted to the 200 Level.

**Graduation requirements**

To be eligible for the award of the Bachelor degree in Cyber security, a student must have:

1. Passed all the core courses, university and faculty/school required courses and electives.
2. Accumulated a minimum of 120 course units for students admitted through UTME and 90 course units for students admitted to 200 level.
3. Attain a minimum CGPA of 1.00.

To graduate in the programme a student must be found worthy in character throughout the period of his/her studentship and must accumulate the total units prescribed for the programme from Core, Faculty and General Studies courses as well as SIWES, Seminar and Final Year Project.

## Global Course Structure

### 100 Level

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST - 111 | Communication in English | 2 | C | 15 | 45 |
| GST - 112 | Nigerian Peoples and Culture | 2 | C | 30 | 0 |
| MTH - 101 | Elementary Mathematics I | 2 | C | 30 | 0 |
| MTH - 102 | Elementary Mathematics II | 2 | C | 30 | 0 |
| PHY - 101 | General Physics I | 2 | C | 30 | 0 |
| PHY - 102 | General Physics II | 2 | C | 30 | 0 |
| PHY - 107 | General Practical Physics I | 1 | C | 0 | 45 |
| PHY - 108 | General Practical Physics II | 1 | C | 0 | 45 |
| STA - 111 | Descriptive Statistics | 3 | C | 45 | 0 |
| COS - 101 | Introduction to Computing Sciences | 3 | C | 30 | 45 |
| COS - 102 | Problem Solving | 3 | C | 30 | 45 |
| COS - 101 | Introduction to Application Packages | 2 | C | 15 | 45 |
| ICT - 102 | Introduction to Information and Communication Technology | 2 | C | 30 | 0 |
| COS - 103 | Introduction to Computer Programming | 3 | C | 30 | 45 |
| **TOTAL** | | **30** | | | |

**Level 200**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST - 212 | Philosophy, Logic and Human Existence | 2 | C | 30 | 0 |
| ENT - 211 | Entrepreneurship and Innovation | 2 | C | 15 | 45 |
| COS - 201 | Computer Programming I | 3 | C | 30 | 45 |
| COS - 202 | Computer Programming II | 3 | C | 30 | 45 |
| CYB - 201 | Introduction to Cyber security and Strategy | 2 | C | 30 | 0 |
| CYB - 203 | Cybercrime, Law and Countermeasures | 2 | C | 30 | 0 |
| CYB - 299 | SIWES I | 3 | C | 0 | 135 |
| INS - 204 | Systems Analysis and Design | 3 | C | 30 | 45 |
| SEN - 201 | Introduction to Software Engineering | 2 | C | 30 | 0 |
| CSC - 201 | Data Structures | 3 | C | 30 | 45 |
| CSC - 202 | Algorithms and Complexity Analysis | 2 | C | 30 | 0 |
| IFT - 212 | Computer Architecture and Organization | 2 | C | 15 | 45 |
| MTH - 223 | Number Theory | 2 | C | 30 | 0 |
| **TOTAL** | | **31** | | | |

**NOTE: ***SIWES I and II will take place during long vacations of 200 Level and 300 Level.**

**300 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST - 312 | Peace and Conflict Resolution | 2 | C | 30 | 0 |
| ENT - 312 | Venture Creation | 2 | C | 15 | 45 |
| CYB - 301 | Cryptography Techniques, Algorithms and Applications | 2 | C | 15 | 45 |
| CYB - 302 | Biometrics Security | 2 | C | 15 | 45 |
| CYB - 303 | Cyber security Risks Analysis, Challenges and Mitigation | 2 | C | 30 | 0 |
| CYB - 304 | Information and Big Data Security | 2 | C | 15 | 45 |
| CYB - 305 | Digital Forensics and Investigation Methods | 2 | C | 15 | 45 |
| CYB - 322 | Cyber security Innovation and New Technologies | 2 | C | 15 | 45 |
| CYB - 399 | SIWES II | 3 | C | 0 | 135 |
| CSC - 309 | Artificial Intelligence | 2 | C | 15 | 45 |
| DTS - 304 | Data Management I | 3 | C | 30 | 45 |
| ICT - 305 | Data Communication Systems and Network | 3 | C | 30 | 45 |
| CSC - 308 | Operating Systems | 3 | C | 30 | 45 |
| **TOTAL** | | **21** | | | |

**SIWES II now holds during the long vacation of 300L**

**400 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| COS - 409 | Research Methodology and Technical Report Writing | 3 | C | 45 | 0 |
| CYB - 401 | Systems Vulnerability Assessment and Testing | 2 | C | 15 | 45 |
| CYB - 402 | Steganography-Access Methods and Data Hiding | 2 | C | 15 | 45 |
| CYB - 403 | Cyber Threat Intelligence and Cyber Conflict | 2 | C | 30 | 0 |
| CYB - 404 | Cloud Computing Security | 2 | C | 30 | 0 |
| CYB - 405 | Ethical Hacking and Reverse Engineering | 2 | C | 15 | 45 |
| CYB - 406 | Deep and Dark Web Security | 2 | C | 15 | 45 |
| CYB - 497 | Final Year Project I | 3 | C | 0 | 135 |
| CYB - 498 | Final Year Project II | 3 | C | 0 | 135 |
| CYB - 401 | Network Security | 3 | C | 30 | 45 |
| CYB - 402 | Malware Analysis | 3 | C | 30 | 45 |
| IFT - 434 | Blockchain Technology and Application | 3 | C | 30 | 45 |
| SEN - 403 | Open-Source Software Development and Applications | 2 | E | 15 | 45 |
| **TOTAL** | | **21** | | | |

## Course Contents

### 100 Level

### GST 111: Communication in English
### (2 Units C: LH15; PH 45)

### Course Contents
Sound patterns in English Language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). Sentence in English (types: structural and functional, simple and complex). Grammar and Usage (tense, mood, modality and concord, aspects of language use in everyday life). Logical and Critical Thinking and Reasoning Methods (Logic and Syllogism, Inductive and Deductive Argument and Reasoning Methods, Analogy, Generalisation and Explanations). Ethical considerations, Copyright Rules and Infringements. Writing Activities: (Pre-writing, Writing, Post-writing, Editing, and Proofreading; Brainstorming, outlining, Paragraphing, Types of writing, Summary, Essays, Letter, Curriculum Vitae, Report writing, Note making, etc. Mechanics of writing). Comprehension Strategies: (Reading and types of Reading, Comprehension Skills, 3RsQ). Information and Communication Technology in modern Language Learning. Language skills for effective communication. Major word-formation processes. Writing and reading comprehension strategies. Logical and critical reasoning for meaningful presentations. Art of public speaking and listening. Report writing.

**GST 112: Nigerian Peoples and Culture**
**(2 Units C: LH 30)**

**Course Contents**
Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and culture; peoples and culture of the ethnic minority groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; Colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; Nationalist movement and struggle for independence). Nigeria and challenges of nation-building (military intervention in Nigerian politics; Nigerian Civil War). Concept of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigeria people; trade, skill acquisition and self-reliance). Social justice and national development (law definition and classification). Judiciary and fundamental rights. Individual, norms and values (basic Nigeria norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts. Cultism, kidnapping and other related social vices). Re-orientation, moral and national values: The 3Rs – Reconstruction, Rehabilitation and Re-orientation; Re-orientation Strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline (WAI), War Against Indiscipline and Corruption(WAIC), Mass Mobilisation for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

**MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)**

**Course Contents**

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

**MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)**

**Course Contents**

Function of a real variable, graphs, limits and idea of continuity. The derivative, as the 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.

**PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)**

**Course Contents**

Space and time; units and dimension, Vectors and Scalars, Differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton laws of motion (Inertial frames, Impulse, force and action at a distance, momentum conservation); Relative motion; Application of Newtonian mechanics; Equations of motion; Conservation principles in physics, Conservative forces, conservation of linear momentum, Kinetic energy and work, Potential energy, System of particles, Centre of mass; Rotational motion; Torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; Circular motion; Moments of inertia, gyroscopes and precession; Gravitation: Newton's Law of Gravitation, Kepler's Laws of Planetary Motion, Gravitational Potential Energy, Escape velocity, Satellites motion and orbits.

**PHY 102: General physics II (Electricity & magnetism) (2 Units C: LH 30)**

**Course Contents**

Forces in nature. Electrostatics (electric charge and its properties, methods of charging). Coulomb's law and superposition. Electric field and potential. Gauss's law. Capacitance. Electric dipoles. Energy in electric fields. Conductors and insulators. DC circuits (current, voltage and resistance. Ohm's law. Resistor combinations. Analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère's laws. Magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz's laws. Step up and step down transformers. Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, and resistance.

**PHY 107: General Practical Physics I**
**(1 Unit C: PH 45)**

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

**PHY 108 - General Practical Physics II**
**(1 Unit C: PH 45)**

**Course Contents**
This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

**STA 111: Descriptive Statistics**
**(3 Units C: LH 45)**

**Course content**
Statistical data. Types, sources and methods of collection. Presentation of data. Tables chart and graph. Errors and approximations. Frequency and cumulative distributions. Measures of location, partition, dispersion, skewness and Kurtosis. Rates, ratios and index numbers.

**COS 101: Introduction to Computing Sciences**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
Brief history of computing. Description of the basic components of a computer/computing device. Input/Output devices and peripherals. Hardware, software and human ware. Diverse and growing computer/digital applications. Information processing and its roles in society. The Internet, its applications and its impact on the world today. The different areas/programs of the computing discipline. The job specializations for computing professionals. The future of computing.

**Lab Work:** Practical demonstration of the basic parts of a computer. Illustration of different operating systems of different computing devices including desktops, laptops, tablets, smart boards and smart phones. Demonstration of commonly used applications such as word processors, spreadsheets, presentation software and graphics. Illustration of input and output devices including printers, scanners, projectors and smart boards. Practical demonstration of the Internet and its various applications. Illustration of browsers and search engines. How to access online resources.

**COS 102: Problem Solving**
**(3 Units C: LH 30; PH 45)**

**Course Contents**

Introduction to the core concepts of computing. Problems and problem-solving. The identification of problems and types of problems (routine problems and non-routine problems). Method of solving computing problems (introduction to algorithms and heuristics). Solvable and unsolvable problems. Solution techniques of solving problems (abstraction, analogy, brainstorming, trial and error, hypothesis testing, reduction, literal thinking, means-end analysis, method of focal object, morphological analysis, research, root cause analysis, proof, divide and conquer). General Problem-solving process. Solution formulation and design: flowchart, pseudo-code, decision table, decision tree. Implementation, evaluation and refinement. Programming in C, Python etc.

**Lab Work:** Use of simple tools for algorithms and flowcharts; writing pseudo-code; writing assignment statements, input-output statements and condition statements; demonstrating simple programs using any programming language (Visual Basic, Python, C)

**COS 101 Computer Application Packages.**
**(2 Unit; Core; LH=15, PH=45)**

**Course Contents**
The course is an introduction to Computer Application; what are computer application packages, types of computer application packages Overview of popular computer application packages. Microsoft Office Suite Microsoft Word; Creating, editing, and formatting documents, working with tables, graphics, and charts, collaborating on documents. Microsoft Excel; Creating, editing, and formatting spreadsheets, working with formulas and functions, creating charts and graphs Microsoft PowerPoint; Creating, editing, and formatting presentations, adding multimedia elements, Delivering presentation.

**ICT 102 Introduction to Information and Communication Technology.**
**(2 Unit; Core; LH=30)**

**Course Content**
This contain the basic principle of computers. Computer "backbone". Data transmission. Random Access Memory. Permanent Memory. Graphic processing. Communication Ports. Input and Output Devices. Software types. Accessibility options. Computer types. Portable digital devices. Network Types. Internet. Instant messaging. Voice over Internet Protocol. Really Simple Syndication. Network communication. Internet data transfer. Data rate units. Internet

access. Virtual (online) communities. Computer in the workplace. Telecommuting (telework).

**COS-103 Introduction to Computer Programming.**
**3 Unit, Core, LH=30, PH=45**

**Course Content**

Vital Python – Math, Strings, Conditionals, and Loops. Vital Python. Numbers: Operations, Types, and Variables. To Open a Jupyter Notebook. Python as a Calculator. Standard Math Operations. Basic Math Operations. Order of Operations. Spacing in Python. Number Types: Integers and Floats. Complex Number Types. Errors in Python. Variables. Variable Assignment. Changing Types. Reassigning Variables in Terms of Themselves. Variable Names. Multiple Variables. Comments. Docstrings. Theorem in Python. Strings: Concatenation, Methods, and input(). String Syntax. Escape Sequences with Quotes. Multi-Line Strings. The print() Function. String Operations and Concatenation. String Interpolation. Comma Separators. Format. The len() Function. String Methods. Casting. The input() Function. String Indexing and Slicing. Indexing. Slicing Strings and Their Methods. Booleans and Conditionals. Booleans. Logical Operators. Comparison Operators. Comparing Strings. Conditionals. The if Syntax. Indentation. if else. The elif Statement. Loops. The while Loops. An Infinite Loop. break. Programs. The for Loop. The continue Keyword. Python Structures. The Power of Lists. List Methods. Accessing an Item from a List. Adding an Item to a List. Dictionary Keys and Values. a List and a Dictionary. Zipping and Unzipping Dictionaries Using zip (). Dictionary Methods. Tuples. A

Survey of Sets. Set Operations. Choosing Types. Executing Python – Programs. Algorithms, and Functions Introduction. Python Scripts and Modules.

## 200 Level

### GST 212: Philosophy, Logic and Human Existence
### (2 Units C: LH 30)

**Course Contents**

This is a GST course that introduces the Science students to the Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

### ENT 211: Entrepreneurship and Innovation
### (2 Units C: LH 15; PH 45)

**Course Contents**

Concept of Entrepreneurship (Entrepreneurship, Intrapreneurship/ Corporate Entrepreneurship,). Theories, Rationale and relevance of Entrepreneurship (Schumpeterian and other perspectives, Risk-Taking, Necessity and opportunity-based entrepreneurship and Creative destruction). Characteristics of Entrepreneurs (Opportunity seeker, Risk taker, Natural and Nurtured, Problem solver and change agent, Innovator and creative thinker). Entrepreneurial thinking

(Critical thinking, Reflective Thinking, and Creative thinking). Innovation (Concept of innovation, Dimensions of innovation, Change and innovation, Knowledge and innovation). Enterprise formation, partnership and networking (Basics of Business Plan, Forms of business ownership, Business registration and forming alliances and joint ventures). Contemporary Entrepreneurship Issues (Knowledge, Skills and Technology, Intellectual property, Virtual office, Networking). Entrepreneurship in Nigeria (Biography of inspirational Entrepreneurs, Youth and women entrepreneurship, Entrepreneurship support institutions, Youth enterprise networks and Environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

**COS 201: Computer Programming I**
**(3 Units C: LH 30; PH 45)**

**Course Contents**

Essentials of computer programming. Types of programming: Functional programming; Declarative programming; Logic programming; object-oriented programming. Scripting languages; structured programming principles. Basic data types, variables, expressions, assignment statements, and operators. Basic object-oriented concepts: abstraction; objects; classes; methods; parameter passing; encapsulation. Class hierarchies and programme organisation using packages/namespaces. Use of API – use of iterators/enumerators, List, Stack, Queue from API. Searching; sorting; Recursive algorithms. Event-driven programming: event-handling methods; event propagation; exception handling. Introduction to Strings and string processing. Simple I/O; control structures; Arrays. Simple recursive algorithms; inheritance; polymorphism.

**Lab work**: Programming assignments; design and implementation of simple algorithms, e.g., average, standard deviation, searching and sorting. Developing and tracing simple recursive algorithms. Inheritance and polymorphism.

**COS 202: Computer Programming II**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
Review and coverage of advanced object-oriented programming - polymorphism, abstract classes and interfaces. Class hierarchies and programme organisation using packages/namespaces. Use of API – use of iterators/enumerators. List. Stack. Queue from API. Searching. Sorting. Recursive algorithms. Event-driven programming: event-handling methods; event propagation; exception handling. Applications in Graphical User Interface (GUI) programming.

**Lab work**: Programming assignments leading to extensive practice in problem-solving and programme development with emphasis on object-orientation. Solving basic problems using static and dynamic data structures. Solving various searching and sorting algorithms using iterative and recursive approaches. GUI programming.

**CYB 201: Introduction to Cyber security and Strategy (2 Units C: LH 30)**

## Course Contents

Basic concepts: cyber, security, confidentiality, integrity, availability, authentication, access control, non-repudiation and fault-tolerant methodologies for implementing security. Security policies, best current practices, testing security, and incident response. Risk management, disaster recovery and access control. Basic cryptography and software application vulnerabilities. Evolution of cyber-attacks. Operating system protection mechanisms, intrusion detection systems, basic formal models of security, cryptography, steganography, network and distributed system security, denial of service (and other) attack strategies, worms, viruses, transfer of funds/value across networks, electronic voting, secure applications. Cyber security policy and guidelines. Government regulation of information technology. Main actors of cyberspace and cyber operations. Impact of cyber security on civil and military institutions, privacy, business and government applications; examination of the dimensions of networks, protocols, operating systems, and associated applications. Methods and motives of cyber security incident perpetrators, and the countermeasures employed by organisations and agencies to prevent and detect those incidences. Ethical obligations of security professionals. Trends and development in cyber security. Software application vulnerabilities. Evolution of cyber security and national security strategies, requirements to the typologies of cyber-attacks that require policy tools and domestic response. Cyber security strategies evolving in the face of big risk. Role of standards and frameworks.

**CYB 203: Cybercrime, Law and Countermeasures**
**(2 Units C: LH 30)**

**Course Contents**

The course avails the students of the general introduction on cybercrime. Definition of cybercrime. Types and categories of cybercrime and threats to the national critical infrastructure. Investigation process and procedure for cybercrime. Strategies of cybercrime perpetrators. Possible ways of curbing/preventing them. Technical aspects of computer cybercrime investigations, threats, and types of attacks and defences used by terrorists and criminals. Successful use of online social networks for cybercrime investigation. Concepts, trends, and methods in computer and network forensics investigations. Skills and knowledge in digital evidence collection and evaluation. Policies, legal issues, international jurisdiction, and privacy issues. Introduction to cyber law and countermeasures. Studies in cyber law application at the international and national levels with examples from European, North American, South American and Asian Countries. The cyber law framework in Nigeria. Challenges and opportunities for cyber law and countermeasure enforcement in Nigeria.

**CYB 299: SIWES I**
**(3 Units C: PH 135)**

**Course Contents**

Students are attached to private and public organisations for a period of three months during the second year session long break with a view to making them acquire practical experience and to the extent possible, develop skills in all areas of Cyber security. Students are supervised during the training period and shall be expected to keep records designed for the purpose of monitoring their performance. They are also expected to submit a report on the experience gained and defend their reports.

**INS 204: Systems Analysis and Design**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
Structured approach to analysis and design of information systems for businesses. Software development life cycle. Structured top-down and bottom-up design. Dataflow diagramming. Entity relationship modelling. Computer aided software engineering. Input and output, prototyping design and validation. File and database design. Design of user interfaces. Comparison of structured and object-oriented design.

**Lab work**: Practical exercises on software development life cycle (SDLC) activities with different case studies. Use of different information systems case studies to apply the knowledge of structured top-down and bottom –up design, dataflow diagram and entity relationship models.

**SEN 201: Introduction to Software Engineering**
**(2 units; C) (LH 30)**

**Course Contents**

Software Engineering concepts and principles. Design, development and testing of software systems. Software processes: software lifecycle and process models. Process assessment models. Software process metrics. Life cycle of software system. Software requirements and specifications. Software design. Software architecture. Software metrics. Software quality and testing. Software architecture. Software validation. Software evolution: software maintenance; characteristics of maintainable software; re-engineering; legacy systems; software reuse. Software Engineering and its place as a computing discipline. Software project management: team management; project scheduling; software measurement and estimation techniques; risk analysis; software quality assurance; software configuration management. Software Engineering and law.

**CSC 201 Data Structures,**
**3 Unit, Core, 30 LH, 45 PH**

**Course Content**

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.

**Lab work:** Writing C+/C++ functions to perform practical exercises and implement using the algorithms on arrays, records, string processing, queues, trees, pointers and linked structures.

**CSC 202 Algorithms and Complexity Analysis,**
**2 Unit, Core, 30 LH**

**Course Content**

Basic algorithmic analysis. Asymptotic analysis of Upper and average complexity bounds. Standard Complexity Classes. Time and space trade-offs in analysis recursive algorithms. Algorithmic Strategies. Fundamental computing algorithms. Numerical algorithms. Sequential and Binary search algorithms. Sorting algorithms, Binary Search trees. Hash tables. Graphs and their representation.

**IFT 212 Computer Architecture and Organization,**
**2 Unit, Core, 15 LH, 45 PH**

**Course Content**

Principles of computer hardware and instruction set architecture. Internal CPU organisation and implementation. Instruction format and types, memory, and I/O instructions. Dataflow, arithmetic, and flow control instructions, addressing modes, stack operations, and interrupts. Data path and control unit design. RTL, microprogramming and hardwired control. The practice of assembly language programming. Memory hierarchy. Cache memory, Virtual memory. Cache performance. Compiler support for cache performance. I/O organisations.

**Lab work:** Practical demonstration of the architecture of a typical computer. Illustration of different types of instructions and how they are executed. Simple Assembly Language programming. Demonstration of interrupts. Programming assignments to practice MS-DOS batch programming, Assembly Process, Debugging, Procedures, Keyboard input, Video Output, File and Disk I/O, and Data Structure. Demonstration of Reduced Instruction Set Computers. Illustration of parallel architectures and interconnection networks.

**MTH 223 Number Theory,**
**2 Unit, Core, 30 LH**

**Course Content**

Primes, divisibility, division algorithm, unique factorization, Greatest common divisor, Modular arithmetic, congruences, Euclid's algorithm, residue classes, multiplicative inverses, Fermat's little theorem, Euler's theorem, Langrange's theorem.

**300 Level**

**Course Contents**

Concepts of Peace, Conflict, and Security in a multi-ethnic nation. Types and Theories of Conflicts: Ethnic, Religious, Economic, Geo-political Conflicts; Structural Conflict Theory, Realist Theory of Conflict, Frustration-Aggression Conflict Theory. Root causes of Conflict and Violence in Africa: Indigene and settlers Phenomenon; Boundaries/border disputes; Political disputes; Ethnic disputes and rivalries; Economic Inequalities; Social disputes; Nationalist Movements and Agitations; Selected Conflict Case Studies – Tiv-Jukun; Zango Kataf, Chieftaincy, and Land disputes, etc. Peace Building, Management of Conflicts and Security: Peace & Human Development. Approaches to Peace & Conflict Management --- (Religious, Government, Community Leaders, etc.). Elements of Peace Studies and Conflict Resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and Terrorism. Peace Mediation and Peace Keeping. Peace & Security Council (International, National, and Local levels) Agents of Conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution, ADR. a) Dialogue b). Arbitration, c). Negotiation d). Collaboration, etc. Roles of International Organisations in Conflict Resolution. (a). The United Nations, UN, and its Conflict Resolution Organs. (b). The African Union & Peace Security Council (c). ECOWAS in Peace Keeping. Media and Traditional Institutions in Peace Building. Managing Post-Conflict Situations/Crisis: Refugees.

Internally Displaced Persons, IDPs. The role of NGOs in Post-Conflict Situations/Crisis

**ENT 312: Venture Creation**
**(2 Units C: LH 15; PH 45)**

**Course Contents**

Opportunity Identification (Sources of business opportunities in Nigeria, Environmental scanning, Demand and supply gap/unmet needs/market gaps/market research, Unutilised resources, Social and climate conditions, and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, microfinance, personal savings, small business investment organisations, and business plan competition). Entrepreneurial marketing and e-commerce (Principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, first mover advantage, e-commerce business models and successful e-commerce companies,). Small business management/family business: Leadership & Management, basic bookkeeping, nature of family business and family business growth model. Negotiation and business communication (Strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (the concept of market/customer solution, customer solution, and emerging technologies, business applications of new technologies- Artificial Intelligence (AI), Virtual/Mixed Reality (VR), Internet of

Things (IoT), Blockchain, Cloud Computing, renewable energy, etc. digital business and e-commerce strategies).

**CYB 301: Cryptography Techniques, Algorithms and Applications (2 Units C: LH 15; PH 45)**

**Course Contents**

Introduction to cryptography, symmetric and asymmetric cryptography, key management, and encryption algorithms. Introduction to simple cryptosystems. Cryptanalysis. Stream ciphers, Block ciphers and Feistel ciphers. Multiple encryption. Hash functions. Data integrity, authentication, and perfect secrecy. Public-key cryptography and discrete algorithms-ELGamal cryptography. Algorithms for the discrete logarithm problem. Algorithmic number theory. Probabilistic primality testing. Security of ELGamal and RSA Encryption, and RSA Key Generation. Discrete logarithm cryptographic schemes. Conventional and public-key cryptography. Selected cryptosystems, including Data Encryption Standard (DES) and Rivest-Shamir-Adleman (RSA) algorithm. AES encryption algorithm, a symmetric 128-bit block data encryption technique. PKI, SSL, and VPN. Digital signatures, pseudo-random number generation, cryptographic protocols and cryptanalytic techniques. Use of protocols, hashing and certificates and certificate authorities. Policies, procedures, and methods for the proper use of cryptography in secure systems. Applications of cryptography to signal.

**Lab work**: Practical exercise on writing cryptography algorithms. Work on cryptographic techniques. Practice cryptanalysis of cipher and how to use protocols. Understand hash functions and learn how to hash, produce secured digital signatures and certificates. Learn the procedures and methods for the proper use of cryptography in secure systems. Practice primality testing. Practical assignments on ELGamal, DES and RSA encryption security, generation of RSA key and discrete logarithm cryptographic schemes.

**CYB 302: Biometrics Security**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
Introduction to biometrics and digital image processing. Matlab in biometric image/signal processing. Biometric algorithms and systems with emphasis on face, fingerprint, eyes (iris), speech (voice). Automated biometric identification multimodal biometrics. Biometric data: raw data, template data, and data methods. Biometric matching basics: biometric authentication, enrolment, correct user, and incorrect user. Match threshold and matching performance. Setting a threshold. Biometric authentication: matching data, ground truth, calculating errors rates and graphs. Biometric data: Storage of biometric data elements, transactions, errors and quality upgrades. Data security and integrity. Privacy issues and other aspects of biometrics. Applications of biometrics and future trends. Challenging issues: security strength and recognition rates. Alternatives of passwords and smart cards.

**Lab work**: Practical exercise on biometric capture, image processing, matching threshold and performance. Learn the practical aspect of automated biometric identification of multimodal, authentication and calculation of error rates. Work on biometric algorithms, privacy and security of stored biometric data.

**CYB 303: Cyber security Risks Analysis, Challenges and Mitigation (2 Units C; LH 30)**

**Course Contents**

Principles of applied information security management. Cyber security challenges. Cyber security risks, challenges and the path forward. Recognising risks. Overview of decision and risk analysis techniques. Mitigating risks and vulnerabilities. Effective use of assessments for cyber security risk mitigation. Mitigating cyber security risk with the cloud. Proactive measures mitigate critical cyber security challenges. Critical corporate and military cyber security risks. Evolving challenges in cyber risk management. The social implication of information technology to national development, cyber-attacks, control, distribution and safety of information. Economic and geopolitical factors that have made African countries vulnerable to cyber-attacks and the steps that can be taken to address this. Governance and security policy. Threat and vulnerability management. Incident management, risk assessment and risk management frameworks. Information leakage, crisis management and business continuity. Legal and compliance, security awareness and security implementation considerations. ISO 27000 series and the Plan-Do-Check-Act model. Assessment of threats and vulnerabilities. Incident response, forensics and investigations. Dealing with classified/sensitive data. Legal and regulatory drivers and issues. Certification. Common criteria, security education and training. Practical considerations when implementing the frameworks to address current and future threats.

**Lab work**: Practical approach to cyber hygiene. Practice cyber security risk mitigation in the cloud and how to use proactive measures to mitigate the learned challenges. Work on applying the decision and risk analysis techniques. Master how to mitigate risks and vulnerabilities.

**CYB 304: Information and Big Data Security**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
This course is introduction to big data. Small data vs. big data. What is big data? The evolution of data/big data. Big data characteristics-3Vs/6Vs. Unique features of big data. Importance of big data? Why does big data matter? Sources of big data. Formats of data. Applications of big data. Use case-issues and solutions. Big data technology. Big data as an opportunity. Example of big data. Big data statistics. Business intelligence vs. big data vs. data mining. Big data handling and techniques. Using the cloud for big data. Big data challenges/problems. How businesses are utilising big data. Big data technologies. Operational and analytical big data. Big data skills. Big data adoption. Big data analysis in practice. Case study session, preparation of case study report and presentation. The big data platform and key aspects. Governance for big data. Big data components. Big data driven organisational change and essential analytical tools and techniques. Develop big data solutions. System and management view of information and big data security.

Requirements for information and big data security. Systems-design process and lifecycle security management of information systems. Basic policies on information security and methodologies. Information-security risk management, security policies, security in the systems-engineering process. Laws related to information security and management of operational systems. Apply machine learning techniques and other big data programming languages. Analyse big data recommendations. Cloud-based big data analysis.

**Lab work**: Practice on data acquisition and how to initiate discovery on raw data using discovery systems. Learn Big Data analytics skills. Practical procedure for the crafting of an enterprise-scale cost-efficient Big Data and machine learning solution to uncover insights and value from data. Use the practical exercises to bridge the gap between the theoretical world of technology with the practical ground reality of building corporate Big Data and data science platforms. Hands-on exposure to Hadoop and Spark (or any of the BD tools), build machine learning dashboards using R and R Shiny, create web-based apps using NoSQL databases. Practical assignment of information and BD security.

**CYB 305: Digital Forensics and Investigation Methods (2 Units C: LH 15; PH 45)**

**Course Contents**

Introduction to digital forensics, digital evidence, and increasing awareness of digital evidence. Challenging aspects of digital evidence. Best practices in securing, processing, acquiring, examining and reporting on digital evidence. Cyber trail and challenging aspects of the cyber trail. Brief history of computer crime and cybercrime investigation. Cyber auditing. Evolution of investigative tools. Language of computer crime investigation. The role of computers in crime, technology and law, jurisdiction, pornography and obscenity, child pornography, privacy, copyrights and the "theft" of digital intellectual property. The investigative process and investigative reconstruction, with digital evidence. Examine techniques and tools used by computer forensics investigations such as acquisition, preservation, recovery, and analysis of evidence obtained from portable and stationary computer storage devices, personal digital assistants (PDAs), and cell phones. Current technologies and methods as well as leading edge techniques with practical based exercises/projects and research opportunities.

**Lab work**: Practical exercises on how to make use of various techniques and tools for computer forensics investigations and cyber trail during cybercrime investigations. Practice cyber auditing skills. Work on applying the best practices in securing, processing, acquiring, examining and reporting on digital evidence with current technologies and methods in forensics investigation.

**CYB 322: Cyber security Innovation and Entrepreneurship**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
Fundamental concepts of innovation, and business ideas in general. Product development. Business leadership. Digital

marketing. Entrepreneurial opportunities in Cyber security. Legal issues and business ethics. New venture creation process. Business feasibility planning. Market research. Business strategy. Business models and business plans. Technical presentations. Report on a successful entrepreneurial outfit.

**CYB 399: SIWES II**
**(3 Units C: PH 135)**

**Course Contents**
Students would be attached to any private or public organisations for a period of three months during the third year session-long break with a view to making them acquire additional practical experience in all areas of Cyber security over and above what is gained in CYB 299. Students are supervised during the training period and shall be expected to keep records designed for the purpose of monitoring their performance. They are also expected to submit a report on the experience they gained and defend their reports.

**CSC 309: Artificial Intelligence**
**(2Units C: LH 15; PH 45)**

**Course Contents**
Overview of Artificial Intelligence. History of AI. Goals of AI. AI Technique. Types of AI. Branches and applications of AI. Advantages and Disadvantages. Introduction to Intelligent Agents. Agent Performance, Examples of Agents, Agent Faculties, Rationality, Agent Environment. Agent Architectures. Search. General Classes of AI Search

Algorithm Problems. Problem Solving by Search. Types of AI Search Techniques and Strategies. Introduction to the types of problems and techniques in AI. Problem-Solving methods. Major structures used in AI programmes. Knowledge Representation. KR and Reasoning Challenges. KR Languages. Knowledge representation techniques such as predicate logic, non-monotonic logic, and probabilistic reasoning. Semantic Network - types of relationships, semantic network inheritance, types and components. Introduction to Frames. Natural Language Processing (NLP). Introduction to natural language understanding and various syntactic and semantic structures. Introduction to Expert Systems - characteristics, components, types, requirements, technology, development. Programming Languages for AI. Introduction to computer image recognition.

**Lab work:** Group practical in (i) Turing test practical - Students can act out their own version of the Turing test (iii) Facial recognition practical to aid in teaching students how machine learning works with students simulating a facial recognition algorithm. Practical applications of NLP in groups – (i) Question Answering focuses on building systems that automatically answer the questions asked by humans in a natural language (ii) Spam detection application for detecting unwanted e-mails getting to a user's inbox (iii) Sentiment analysis/opinion mining should be used on the web to analyse the attitude, behaviour, and emotional state of the sender, implemented through a combination of NLP and statistics (iv) Practical exercise of machine translation used to translate text or speech from one natural language to another natural language such as the Google Translator (v) Developing a model to provide word processor software for the spelling correction (vi) Developing a model for speech recognition for converting spoken words into text (vii) Implementing a Chatbot to provide the staff/student's chat services. OR Group Practical exercise on agents and its environment using simulation of a colony of ants foraging for food; model simulating a message between agents; model simulating the flocking behaviour of birds; model to apply standard search algorithm to the classic search problem of missionaries and cannibals, and how to use communicating agents for searching networks. Some computer AI animation exercises for any branch of AI. Practical exercise on simple robots coupling and programming. Group project of building a lawn robot for trimming grasses, or any simple design and implementation of robotics.

**DTS-301 Data Management I**.
**(3 Unit; Core; LH=30, PH=45)**

**Course Content**

Information Management Concepts. Information storage & retrieval. Information management applications. Information capture and representation. Analysis and indexing -search, retrieval, information privacy. Integrity and security. Scalability, Efficiency and Effectiveness. Introduction to database systems. Components of database systems. DBMS functions. Database architecture and data independence. Database query language. Conceptual models. Relational data models. Semi-structured data models. Relational theory and languages. Database Design. Database security and integrity.

Introduction to query processing and optimisation. Introduction to concurrency and recovery

**ICT-305 Data Communication Systems and Network I.**
**(3 Unit; Core; LH=30, PH=45)**

**Course Content**

The course treats all the types and sources of data. Simple communications network. Transmission definitions, one way transmission, half duplex transmission, transmission codes, transmission modes, parallel transmission, serial transmission, bit synchronisation, character synchronisation, synchronous and asynchronous transmission. Introduction to network protocol. Seven Layer ISO-OSI standard protocols and network architecture. Transport protocols, session services protocols, and other protocols. Institute of Electrical and Electronics Engineering 802 standards. Error control and Data Compression: Forward Error Control; error detection methods; parity checking; linear block codes, cyclic redundancy checking; feedback error control, data compression, Huffman coding.Local Area Networks: medium access control techniques; fibre distributed data interface, and metropolitan area network. Peer-to-peer, Client Server. Client-Server Requirements: GUI design standards, interface and platform independence, transaction processing, backup, and recovery mechanisms. Features and benefits of major recovery mechanisms. Network OS: INTERNET: Definition, architecture, services, internet addressing. Internet protocol, IPv4, IPv6.

**CSC-308 Operating Systems.**
**3 Unit, Core, 30 LH, 45 PH**

**Course Content**

This is about the fundamentals of operating the systems design and implementation. History and evolution of operating systems. Types of operating systems. Operating system structures. Process management: processes, threads, CPU scheduling, process synchronisation. Memory management and virtual memory. File systems; I/O systems; Security and protection; Distributed systems; Case studies.

**Lab work**: Practical hands-on engagement to facilitate understanding of the material taught in the course. All the process, memory, file and directory management issues will be demonstrated under the LINUX operating system. Also, UNIX commands will be briefly discussed. Alternatively, hands-on exposure may be through the use of operating systems developed for teaching, like TempOS, Nachos, Xinu or MiniOS. Another possibility is through programming exercises that implement and simulate algorithms taught. Simulation of CPU scheduling algorithms, producer-consumer problem, memory allocation algorithms, file organisation techniques, deadlock algorithms and disk scheduling algorithms.

**400 Level**

**COS 409: Research Methodology and Technical Report Writing**
**(3 Units C: LH 45)**

**Course Contents**

The course prepares the students on the foundations of Research. Types of Research. Research Approaches. Significance of Research. Research Methods versus Methodology. Research Process. Criteria and Strategy for Good Research. Problems Encountered by Researchers in Nigeria. Principles of Scientific Research. Scientific investigation. Problem formulation. Definition and technique of the Research Problem. Selection of Appropriate Method for Data Collection**-** Primary Data and Secondary Data. Guidelines for Constructing Questionnaire/Schedule. Guidelines for Successful Interviewing. Difference between Survey and Experiment. Eloping Research Proposal and Research Plan. Formulation of working hypothesis and Testing. Literature review. Procedure for reviewing related relevant studies and referencing cited works. Types of Reports. Technical Report Writing. Layout and mechanics of writing a Research Report. Standard Techniques for Research Documentation. Sampling Design. Different Types of Sample Designs. Steps in Sampling Design. Criteria of Selecting a Sampling Procedure. Methods of analysi**s.** Processing and Analysis of Data Elements/Types of Analysis. Interpretation and Presentation of results. How to prepare References and Bibliography.

**CYB 401: Systems Vulnerability Assessment and Testing (2 Units C: LH 15; PH 45)**

**Course Contents**

Definition of systems vulnerability. Methods and the testing methods using different techniques. Mitigation of risks and how to enhance the security of a company's infrastructure. Penetration testing methodologies, test planning and scheduling. Information gathering. Password cracking. Penetration testing and security analysis. Social engineering, Internal and external penetration testing. Router penetration testing, security analysis, reporting and documentation. Operating systems fingerprinting. Remote network mapping. Software and operational vulnerabilities. Attack surface analysis. Fuzz testing. Patch management. Security auditing.

**Lab work**: Practical exercise on systems vulnerability, assessment methods and the testing methods using techniques to effectively identify and mitigate risks to the security of a company's infrastructure. Perform penetration testing using various methodologies, along with the test planning and scheduling. Work on password cracking and social engineering penetration testing and security analysis. Identify software and operational vulnerabilities in a given environment and how to overcome these vulnerabilities. Execute attack surface analysis, fuzz testing, patch management, and perform security auditing.

**CYB 402: Steganography: Access Methods and Data Hiding**
**(2 Units C: LH 15; PH 45)**

**Course Contents**

History of secret writing. An overview of steganography. Introduction to steganography - Definition of steganography. Why is steganography important? Steganography vs. Encryption. Uses of steganography. Problem of steganography. Steganography applications and methods. Steganography types and methods - text steganography, images steganography, video and audio steganography. Steganography techniques. Survey of different steganography techniques for encrypting the data. Information hiding: steganography and steganalysis. Data hiding methods, techniques and access methods. Requirements for data hiding. Steganography and Business - the basics of embedding, different aspects in information-hiding systems. Steganographic algorithm. Security of a steganographic algorithm. Steganography detection, finding images, and verifying hidden content. Research and practical experimentation of data hiding tools. Research on investigation techniques and the latest countermeasures.

**Lab work**: Practice secret writing using different methods and tools. Learn how to use steganography methods and techniques for encrypting the data. Master data hiding methods, techniques and access methods using case study exercises. Write samples steganography algorithm and secure the algorithm. Detect elements of steganography, finding images, and verifying hidden content in a given text, image, audio and video samples.

**CYB 403: Cyber Threat Intelligence and Cyber Conflict (2 Units C: LH 30)**

**Course Contents**

Techniques for detecting, responding to and defeating organised cybercrimes and cyberwar activities. Analysing successful and unsuccessful advanced persistent threats and malware campaigns. Analyse divergent national and international policies for combating cyber terrorism and terrorist tactics worldwide. Understanding Cyber threat intelligence - defining threats, Understanding risk, Cyber threat intelligence and its rule, Expectations of organisations and analysts, and indicators of compromise. Tactical threat intelligence. Role of a tactical threat intelligence analyst, expected skills and tradecraft. The Kill Chain and Intrusion Analysis. Indicator lifecycle. Introduction to operational threat intelligence - Role of an operational threat intelligence analyst, Need for information sharing and peers. Models and methods for managing intelligence, campaigns and threat actors. Introduction to strategic threat Intelligence - role of a strategic threat intelligence analyst. Threat modelling, Organisational change and security posturing. Event recording and incident sharing. Evolution of counterterrorism and cyber conflict.

**CYB 404: Cloud Computing Security**
**(2 Units C: LH 30)**

**Course Contents**
Introduction to cloud computing, cloud computing vendors, cloud computing threats, cloud reference model. Cloud-enabling technologies. Services, Service-Oriented Architectures. Cloud service models. Cloud deployment models. Introduction to data centres: servers, data storage, networking and virtualisation. Data centre networking. Introduction to server virtualisation software: VMware VSphere. Virtual machine management: configuration, placement and resource allocation. Power efficiency in virtual data centres. Fault tolerance in virtual data centres**.** The cloud cube model and security for cloud computing. Security in the cloud. Cloud threats, threat mitigation and security risks. Real world issues with cloud computing. Cloud security alliance. National Institute of Standards and Technology, Information Assurance Framework. Cloud audit. Cloud management audit/assurance programme, Cloud business continuity planning. Building a cloud. Architectural best practices: Designing for the cloud. Economics of the cloud. Cloud strategy. Cloud standards and the future. Security of the cloud.

**CYB 405: Ethical Hacking and Reverse Engineering**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
The course introduces the students to ethical hacking, attacks, threats, hackers, measures and countermeasures. Overview of ethical hacker strategies. Focus on how perimeter defences

work, how intruders escalate privileges and methods of security systems. Intrusion detection, policy creation, social engineering. Techniques and technologies for understanding the operation of malicious software and attacks. Threats and defence mechanisms. Attack phases. Secure network infrastructure. DDoS attacks, buffer overflows and virus creation. Network Infrastructure Attacks, Hacking Methodology, Developing ethical hacking plans. Footprinting and reconnaissance. Scanning Networks. Enumeration and system hacking. Malware threats. Sniffing. Social engineering. Physical security. Password vulnerabilities - cracking passwords. Denial of Service. Session hijacking. Hacking web servers. Hacking web applications. sql injection, hacking wireless networks. Hacking mobile platforms. Evading IDS, Firewalls, and Honeypots. Explores techniques and technologies for understanding the operation of malicious software and attacks. Techniques for detection, identification and prevention. Reverse engineering of code and network exploits as a method for understanding and development of countermeasures.

**Lab work**: This is to put into practice the ethical hacker strategies and methods. Work on a sample perimeter defences and identify how intruders escalate privileges and methods of security systems. Practical exercises on the techniques and technologies of malicious software and attacks. Learn how to perform system hacking, mobile platform hacking, crack password, remove introduced vulnerabilities and evade IDs, firewalls, and honeypots. Apply reverse engineering of code and network exploits as a method for understanding and development of countermeasures. Utilise foot printing and reconnaissance, and scanning networks.

**CYB 406: Deep and Dark Web Security**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
It is about how to provide security by understanding the workings of dark web, deep web, clear net. Tor Onion, Silk Road. How to get on the dark web. Users of dark and deep web. Invisible Web Search Engines. Privacy and anonymity as core values of the darknet. Decentralisation on the dark web. Accessing the Deep web and the Dark web through the TOR browser. Web security. Cryptocurrencies. Overview on Dark Web and Deep Web. The Hidden side/area of the web. Deep/Dark Web Anonymity, TOR, Hidden services, TAILS, Web Security, Cryptocurrencies. Crypto Trading and Cryptomining. Cryptocurrencies, Anonymity & Security. How to install a VPN, and adequate browsers like Chrome, Opera, or Firefox with tracking technologies**.** How Does the Dark Web Work? Reasons for Accessing the Dark Web. Security issues of Dark and Deep web. How to use the Tor over VPN method **-** Session logs storage. Encryption of traffic. Protection against malicious Tor exit nodes. How to use Tor over VPN **-** bypass blocked Tor nodes, ISP visibility in accessing onion content, susceptible to end-to-end timing attacks. Tor alternatives such as I2P, Matrix.org, Orbot, Globus Secure Browser, Comodo Ice Dragon and FreeNet. Cons and Pros of Tor. Use of virtual machine software. Navigating the Dark Web. The Hidden Wiki as Wikipedia’s evil twin. Search engines such as DuckDuckGo, Torch, the

triple-W Virtual Library, Uncensored Hidden Wiki, and ParaZite. Commercial services. Email clients. Darknet version of social media and instant messaging - Zuckerberg's Facebook, BlackBook, Torbook, Campfire, MadIRC Chat Server. Safety on the dark web. Inside the dark and deep web. The Best Sites and Services on the Dark Web. Deep web radio. Benefits of Deep and Dark web. Cyber Threats and Dangers on the Deep/DarkWeb. How to fight hackers underground. Dark web and Deep web monitoring.

**Lab work**: Install your VPN. Practice how to access the Deep web and the Dark web with enhanced security. Investigate advanced and famous websites located on the Deep and Dark Web. Practically learn how to anonymously access the darknet and TOR hidden services (onion services), and how to enter the dark web while staying safe. Try to visit the best sites and buy an educational resource.

**CYB 497: Final Year Project I**
**(3 Units C: PH 135)**

**Course Contents**
The final year project is to develop an independent or group investigation of appropriate cyber security related problems carried out under the supervision of a lecturer. The student must submit a written proposal to the supervisor to review. The proposal should give a brief outline of the project with the statement of problem, aim, objectives, scope, significance, research gap, proposed research methodology, estimated schedule of completion, and resources needed. A formal

written report is essential and an oral presentation may also be required.

Topics from emerging trends such as applications in artificial intelligence, steganography, quantum computing, big data, cloud security, ethical hacking, cyber hunting, internet security, penetration testing, network intrusion and prevention, threat management, cyber security risk mitigation in the cloud, biometrics, digital image processing, Blockchain, quantum computing, edge computing, Internet of Things, 5G security, etc.

**CYB 498: Final Year Project II**
**(3 Units C:PH 135)**

**Course Contents**
This is a continuation of CYB 497. This includes the research methodology, analysis of data using statistical tools, performance evaluation, standard documentation of the project, referencing style, programming of the prototype/simulation model, plagiarism and grammarly check, and PowerPoint presentation skill. The formal written report made up of chapters four and five approved by the supervisor as having make the requirement will be submitted to the Department for final grading. An oral presentation is required.

**CYB-401 Network Security.**
**3 Unit, Core, 30 LH, 45 PH**

**Course Content**

Introduction to Network Security: This section would provide an overview of network security and introduce the key concepts and principles that form the basis of network security. Security Threats and Vulnerabilities: This section would cover the different types of security threats and vulnerabilities that networks face, including malware, hacking, denial of service attacks, and social engineering. Network Security Tools and Technologies: This section would introduce students to the various tools and technologies used to secure networks, including firewalls, intrusion detection and prevention systems, VPNs, and encryption. Network Security Protocols: This section would cover the different network security protocols, including SSL/TLS, IPSec, and SSH, and explain how they are used to secure network communications. Access Control and Authentication: This section would cover access control and authentication mechanisms, including user authentication, role-based access control, and multi-factor authentication. Network Security Management: This section would cover network security management, including risk assessment, security policy development, and incident response planning.

Legal and Ethical Issues in Network Security: This section would cover the legal and ethical issues related to network security, including privacy, data protection, and intellectual property.

**CYB-402 Malware Analysis.**
**3 Unit, Core, 30 LH, 45 PH**

**Course Content**
The course covers Malware Analysis and Reverse Engineering, Types, Purpose, Limitation and Process of Malware Analysis, The Effective Malware Analys. Malware Taxonomy: Malware Classes, Malware Deployment, Infection Vectors, Types of Infection Vectors, Potential Infection Vectors. The Two States of Malware: Static and Dynamic, Protective Mechanisms, Malware Dependencies. Malware Research lab: Malware Collection, Your own Backyard, Free Sources, Research Mailing Lists, Sample Exchange, Commercial Sources, Honeypots, Setting up Static and Dynamic Labs. Malware Inspection, The Portable Executable File, Proper Way to Handle Files, Inspecting Static and Dynamic Files, Tools of the Trade.

**IFT-434 Blockchain Technology and Application.**
**3 Unit, Core, 30 LH, 45 PH**

**Course Content**
An (Deeper) Overview of Bitcoin, Alternative coins and Networks. Methods of Blockchain Security. Public, Syndicated and Hybrid Blockchains. Securing, Interconnecting Public and Private Blockchains. Smart Contracts: Overview of Algorithmic Decision Making. Smart Contracts: Distributed Autonomous Organizations. Smart Contracts: Connecting external data and physical resources (Oracles, and IoT). Machine driven and Socially driven

Oracles, syndication and their respective issues. Reality Keys, Truthcoin (Bitcoin Hivemind), Orisi, Town Crier, ChainLink, as oracles. The rising importance of decentralized reputation mechanisms and sources of new "clout". Contract Autonomy, Transparency and Monetization. Use Cases: Augur, Gnosis and reputation as a tradable commodity basis for a social oracle system. Use Cases: Blockchain-based IoT functionalities and challenges, use-cases: Slock.it and Oraclize. Use Cases: Open Bazaar and other platforms as decentralized information and reputation (super) marketplaces, reputation brokerages and smart darknet marketplaces (Daemon). Use Cases: Additional functions of decentralized markets beyond mere products.

**SEN 403 Open-Source Software Development and Applications**
**(2 Unit; Elective; LH=15, PH=45)**

**Course Content**

This course is an introduction to open-source software development: what open-source software development is and why it is important. Open-source licensing: different types of open-source licenses and their implications. Tools and technologies: This will cover the various tools and technologies used in open-source development such as version control systems, issue trackers, and collaborative platforms. Building and contributing to open-source projects: how to find and contribute to existing open-source projects as well as how to start your own. Best practices for open-source development: code reviews, testing, documentation, and communication. Community management: how to manage an open-source community and how to handle conflicts that may arise. Open-source business models: business models that can be used for open-source software development such as support and services, dual licensing, and open core.

# B.Sc. SOFTWARE ENGINEERING

**Overview**

The software development industry presents huge opportunities within the context of an expanding global economy that is increasingly becoming digital. With the enormous potentials of this sector of the economy and the ever increasing need for large and complex software systems, there is great promise to grow a large crop of software engineers as a force for sustainable socio-economic development. In addition to its core Computer Science foundation, Software Engineering also involves human and technical processes, and therefore borrows and adapts from the field of project management as well as from traditional engineering practice.

**Philosophy**

The philosophy of Software Engineering focuses on producing graduates who have the required knowledge and skills to develop and maintain quality software systems of scale for governments, organisations and businesses that adequately fulfil the functional and non-functional requirements of the systems within time and budget constraints.

**Objectives**

The specific objectives of the Software Engineering programme for students are to:

1. provide them a solid foundation in computing in such areas as problem solving, algorithm design, data structures and programming basics;
2. demonstrate practical skills in requirements analysis, system design, software architecture, software metrics, verification

and validation, and the software engineering process in general for the production of high quality software-based systems;
3. demonstrate expertise in programming in a number of different languages with emphasis on the production of robust, reliable, cost-effective and secure systems that are based on sound design and development principles;
4. train them to be able to effectively and efficiently manage the development of large, complex and critical software; and
5. enable them to have the requisite knowledge and skill base as well as adequate practical exposure and high ethical standards for the limitless professional career opportunities (including self-employment) in the software industry.

**Unique Features of The Programme**

Special efforts have been made to tailor the programme to the rapidly evolving software industry in Nigeria in particular and Africa in general especially in the following areas:

1. Development of skilled software engineers in mobile applications and web development
2. Rigorous training on how to effectively manage software projects in highly challenging circumstances
3. Grooming of software engineers with specialised skills in Software Engineering but very broad knowledge on the entire computing discipline.

**Employability Skills**

The critical importance and increasing proliferation of software systems in every aspect of human endeavour make it mandatory for today's software engineers to have all the necessary employability skills they require in today's competitive world. They include communication, teamwork and collaboration, negotiation and persuasion, problem solving, leadership, organisation, perseverance, motivation, confidence and the ability to work under pressure.

**21st Century Skills**

Among the 21st Century skills for the programme are:

1. creative thinking;
2. information literacy;
3. media literacy;
4. flexibility;
5. social skills;
6. problem solving,
7. social skills; and
8. innovation skills.

**Admission and Graduation Requirements**

The admission and graduation requirements are the same as for the other programmes in the computing discipline. They are as stated below:

**Admission requirements**

Candidates can be admitted into the Software Engineering degree programme by one of the following ways:

1. The Indirect/Preliminary Mode (4 years Degree Programme)
2. Direct Entry

**4 Year Degree Programme**

In addition to appropriate UTME-Score, a candidate must possess five Senior Secondary Certificate (SSC)-credits passes including English Language, Mathematics, Physics and any other relevant Science subjects in not more than two sittings.

**3 Year Degree Programme:**

**Direct Entry**

A minimum of a credit at the University/National Diploma or NCE with other five Senior Secondary Certificate (SSC) credit passes in relevant Science subjects three of which must be in English Language, Mathematics, Physics.

**Minimum duration**

The minimum duration of the Software Engineering degree programme is four academic sessions for UTME. The minimum duration will be three academic sessions for candidates admitted to the 200 Level

**Graduation requirements**

To be eligible for the award of the Bachelor degree in Software Engineering, a student must have:

1. passed all the core courses, university and faculty/school required courses and electives;
2. accumulated a minimum of 120 course units for students admitted through UTME and 90 course units for students admitted to 200 level.
3. completed successfully students' industrial training (SIWES), seminar and research project.
4. attain a minimum CGPA of 1.00.

To graduate, a student must be found worthy in character throughout the period of his/her studentship and must accumulate the total units prescribed for the programme from core, faculty, General Studies, SIWES, seminar and Final year project.

## Global Course Structure

### 100 Level

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST - 111 | Communication in English | 2 | C | 15 | 45 |
| GST - 112 | Nigerian Peoples & Culture | 2 | C | 30 | 0 |
| MTH - 101 | Elementary Mathematics I | 2 | C | 30 | 0 |
| MTH - 102 | Elementary Mathematics II | 2 | C | 30 | 0 |
| PHY - 101 | General Physics I | 2 | C | 30 | 0 |
| PHY - 102 | General Physics II | 2 | C | 30 | 0 |
| PHY - 107 | General Practical Physics I | 1 | C | 0 | 45 |
| PHY - 108 | General Practical Physics II | 1 | C | 0 | 45 |
| STA - 111 | Descriptive Statistics | 3 | C | 45 | 0 |
| COS - 101 | Introduction to Computing Sciences | 3 | C | 30 | 45 |
| COS - 102 | Introduction to Problem Solving | 3 | C | 30 | 45 |
| COS - 101 | Introduction to Application Packages | 2 | C | 30 | 45 |
| ICT - 102 | Introduction to Information and Communication Technology | 2 | C | 30 | - |
| COS 103 | Introduction to Computer Programming | 3 | C | 30 | 45 |
| **TOTAL** | | **30** | | | |

**200 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST - 212 | Philosophy, Logic And Human Existence | 2 | C | 30 | 0 |
| ENT - 212 | Entrepreneurship and Innovation | 2 | C | 30 | 0 |
| MTH - 201 | Mathematical Methods I | 2 | C | 30 | 0 |
| MTH - 202 | Mathematical Methods II | 2 | C | 30 | 0 |
| COS - 201 | Computer Programming I | 3 | C | 30 | 45 |
| COS - 202 | Computer Programming II | 3 | C | 30 | 45 |
| SEN - 201 | Introduction to Software Engineering | 2 | C | 30 | 0 |
| SEN - 299 | SIWES I | 3 | C | 0 | 135 |
| CSC - 203 | Discrete Structures | 2 | C | 30 | 0 |
| INS - 204 | System Analysis and Design | 3 | C | 30 | 45 |
| IFT - 211 | Digital Logic Design | 2 | C | 15 | 45 |
| IFT - 212 | Computer Architecture and Organisation | 2 | C | 15 | 45 |
| IFT - 201 | Introduction to Web Technologies | 2 | E | 15 | 45 |
| INS - 202 | Human Computer Interactions | 2 | C | 15 | 45 |
| SEN - 203 | Software Engineering Process | 2 | E | 30 | - |
| **TOTAL** | | **34** | | | |

**NOTE: ***SIWES will take place during long vacations of 200 Level and 300 Level.**

**300 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| GST - 312 | Peace and Conflict Resolution | 2 | C | 30 | 0 |
| ENT - 312 | Venture Creation | 2 | C | 15 | 45 |
| SEN - 301 | Object-Oriented Analysis and Design | 2 | C | 15 | 45 |
| SEN - 304 | Software Testing and Quality Assurance | 2 | C | 15 | 45 |
| SEN - 306 | Software Construction | 2 | C | 15 | 45 |
| SEN - 322 | Software Engineering Innovation and New Technology | 2 | C | 15 | 45 |
| SEN - 399 | SIWES II | 3 | C | 0 | 135 |
| CSC - 301 | Data Structures | 3 | C | 15 | 45 |
| CSC - 308 | Operating Systems | 3 | C | 30 | 45 |
| DTS - 301 | Data Management I | 3 | C | 15 | 45 |
| ICT - 302 | Data Communication Systems and Network | 3 | C | 30 | 45 |
| IFT - 303 | Mobile Application Development | 2 | C | 15 | 45 |
| DTS - 304 | Big Data Computing | 2 | C | 15 | 45 |
| MTH - 305 | Introduction to Numerical Analysis | 2 | E | 15 | 45 |
| | **TOTAL** | **33** | | | |

**400 Level**

| Course Code | Course Title | Unit(s) | Status | LH | PH |
|---|---|---|---|---|---|
| COS - 409 | Research Methodology and Technical Report Writing | 3 | C | 30 | 0 |
| SEN - 401 | Software Configuration Management and Maintenance | 2 | C | 15 | 45 |
| SEN - 410 | Software Architecture and Design | 2 | C | 15 | 45 |
| SEN - 497 | Final Year Student's Project I | 3 | C | 0 | 135 |
| SEN - 498 | Final Year Student's Project II | 3 | C | 0 | 135 |
| INS - 401 | Project Management | 2 | C | 30 | 0 |
| SEN - 401 | Software Engineering Professional Practice | 2 | C | 30 | - |
| SEN - 402 | Concepts of Programming Languages | 2 | C | 30 | - |
| SEN - 403 | Open-Source Software Development and Applications | 2 | C | 15 | 45 |
| SEN 404 | Special Topics in Software Engineering: | 2 | C | 15 | |
| SEN - 405 | Software Engineering Economics | 2 | C | 30 | |
| CSC - 406 | Artificial Intelligence | 2 | C | 15 | 45 |
| CYB - 407 | Cloud Computing | 2 | C | 15 | 45 |
| IMT - 408 | Operation Research | 2 | C | 30 | - |
| SEN - 409 | Game Design and Development | 2 | E | 15 | 45 |
| | **TOTAL** | **31** | | | |

**Course Contents**

**100 Level**

**GST 111: Communication in English**
**(2 Units C: LH 15; PH 45)**

**Course Contents**

Sound patterns in English Language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). Sentence in English (types: structural and functional, simple and complex). Grammar and Usage (tense, mood, modality and concord, aspects of language use in everyday life). Logical and Critical Thinking and Reasoning Methods (Logic and Syllogism, Inductive and Deductive Argument and Reasoning Methods, Analogy, Generalisation and Explanations). Ethical considerations, Copyright Rules and Infringements. Writing Activities: (Pre-writing, Writing, Post writing, Editing and Proofreading; Brainstorming, outlining, Paragraphing, Types of writing, Summary, Essays, Letter, Curriculum Vitae, Report writing, Note making etc. Mechanics of writing). Comprehension Strategies: (Reading and types of Reading, Comprehension Skills, 3RsQ). Information and Communication Technology in modern Language Learning. Language skills for effective communication. Major word formation processes. Writing and reading comprehension strategies. Logical and critical reasoning for meaningful presentations. Art of public speaking and listening. Report writing.

**GST 112: Nigerian Peoples and Culture**
**(2 Units C: LH 30)**

**Course Contents**

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and culture; peoples and culture of the ethnic minority groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; Colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; Nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concept of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigeria people; trade, skill acquisition and self-reliance). Social justices and national development (law definition and classification. Judiciary and fundamental rights. Individual, norms and values (basic Nigeria norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts. Cultism, kidnapping and other related social vices). Re-orientation, moral and national values: The 3Rs – Reconstruction, Rehabilitation and Re-orientation; Re-orientation Strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline (WAI), War Against Indiscipline and Corruption(WAIC), Mass Mobilisation for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

**MTH 101: Elementary Mathematics I(Algebra and Trigonometry)**
**(2 Units C: LH 30)**

**Course Contents**

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

**MTH 102: Elementary Mathematics II (Calculus)**
**(2 Units C: LH 30)**

**Course Contents**

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.

**PHY 101: General Physics I (Mechanics)**
**(2 Units C: LH 30)**

**Course Contents**

Space and time; units and dimension, Vectors and Scalars, Differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton laws of motion (Inertial frames, Impulse, force and action at a distance, momentum conservation); Relative motion; Application of Newtonian mechanics; Equations of motion; Conservation principles in physics, Conservative forces, conservation of linear momentum, Kinetic energy and work, Potential energy, System of particles, Centre of mass; Rotational motion; Torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; Circular motion; Moments of inertia, gyroscopes and precession; Gravitation: Newton's Law of Gravitation, Kepler's Laws of Planetary Motion, Gravitational Potential Energy, Escape velocity, Satellites motion and orbits.

**PHY 102: General physics II (Electricity & magnetism) (2 Units C: LH 30)**

**Course Contents**

This is about the forces in nature. Electrostatics (electric charge and its properties, methods of charging). Coulomb's law and superposition. Electric field and potential. Gauss's law. Capacitance. Electric dipoles. Energy in electric fields. Conductors and insulators. DC circuits (current, voltage and resistance. Ohm's law. Resistor combinations. Analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère's laws. Magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz's laws. Step up and step down transformers. Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, and resistance.

**PHY 107: General Practical Physics I**
**(1 Unit C: PH 45)**

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

**PHY 108 - General Practical Physics II**
**(1 Unit C: PH 45)**

**Course Contents**
This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

**STA 111: Descriptive statistics:**
**(3 Units C: LH 45)**

**Course Content**
Statistical data. Types, sources and methods of collection. Presentation of data. Tables chart and graph. Errors and approximations. Frequency and cumulative distributions. Measures of location, partition, dispersion, skewness and Kurtosis. Rates, ratios and index numbers.

**COS 101: Introduction to Computing Sciences**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
Brief history of computing. Description of the basic components of a computer/computing device. Input/Output devices and peripherals. Hardware, software and human ware. Diverse and growing computer/digital applications. Information processing and its roles in society. The Internet, its applications and its impact on the world today. The different areas/programs of the computing discipline. The job specializations for computing professionals. The future of computing.

**Lab Work:** Practical demonstration of the basic parts of a computer. Illustration of different operating systems of different computing devices including desktops, laptops, tablets, smart boards and smart phones. Demonstration of commonly used applications such as word processors, spreadsheets, presentation software and graphics. Illustration of input and output devices including printers, scanners, projectors and smart boards. Practical demonstration of the Internet and its various applications. Illustration of browsers and search engines. How to access online resources.

**COS 102: Problem Solving**
**(3 Units C: LH 30; PH 45)**

**Course Contents**

The course is about the core concepts of computing. Identification of problems. Types of problems (routine problems and non-routine problems). Problem-solving. Methods of solving computing problems. Algorithms and heuristics. Solvable and unsolvable problems. Solution techniques of solving problems; abstraction; analogy; brainstorming; trial and error; hypothesis testing; reduction; literal thinking; means-end analysis. Method of the focal object; morphological analysis; research; root cause analysis; proof; divide and conquer. General Problem-solving process. Solution formulation and design; flowchart; pseudocode; decision table; decision tree. Programming in any language.

**Lab Work:** Use of simple tools for algorithms and flowcharts; writing pseudocode; writing assignment statements, input-output statements and condition statements; demonstrating simple programs using any programming language (Visual Basic, Python, C)

**COS 101 Computer Application Packages.**
**(2 Unit; Core; LH=15, PH=45)**

**Course Contents**

This is an introduction to Computer Application; what are computer application packages, types of computer application packages Overview of popular computer application packages. Microsoft Office Suite Microsoft Word; Creating, editing, and formatting documents, working with tables, graphics, and charts, collaborating on documents. Microsoft Excel; Creating, editing, and formatting spreadsheets, working with formulas and functions, creating charts and graphs Microsoft PowerPoint; Creating, editing, and formatting presentations, adding multimedia elements, Delivering presentation.

**ICT 102 Introduction to Information and Communication Technology.**
**(2 Unit; Core; LH=30)**

**Course Content**

The course is about the basic principle of computers. Computer "backbone". Data transmission. Random Access Memory. Permanent Memory. Graphic processing. Communication Ports. Input and Output Devices. Software types. Accessibility options. Computer types. Portable digital devices. Network Types. Internet. Instant messaging. Voice over Internet Protocol. Really Simple Syndication. Network communication. Internet data transfer. Data rate units. Internet access. Virtual (online) communities. Computer in the workplace. Telecommuting (telework)

**COS-103 Introduction to computer programming.**
**3 Unit, Core, LH=30, PH=45**

**Course Content**

Vital Python – Math, Strings, Conditionals, and Loops. Vital Python. Numbers: Operations, Types, and Variables. To Open a Jupyter Notebook. Python as a Calculator. Standard Math Operations. Basic Math Operations. Order of Operations. Spacing in Python. Number Types: Integers and Floats. Complex Number Types. Errors in Python. Variables. Variable Assignment. Changing Types. Reassigning Variables in Terms of Themselves. Variable Names. Multiple Variables. Comments. Docstrings. Theorem in Python. Strings: Concatenation, Methods, and input(). String Syntax. Escape Sequences with Quotes. Multi-Line Strings. The print() Function. String Operations and Concatenation. String Interpolation. Comma Separators. Format. The len() Function. String Methods. Casting. The input() Function. String Indexing and Slicing. Indexing. Slicing Strings and Their Methods. Booleans and Conditionals. Booleans. Logical Operators. Comparison Operators. Comparing Strings. Conditionals. The if Syntax. Indentation. if else. The elif Statement. Loops. The while Loops. An Infinite Loop. break.

Programs. The for Loop. The continue Keyword. Python Structures. The Power of Lists. List Methods. Accessing an Item from a List. Adding an Item to a List. Dictionary Keys and Values. a List and a Dictionary. Zipping and Unzipping Dictionaries Using zip(). Dictionary Methods. Tuples. A Survey of Sets. Set Operations. Choosing Types. Executing Python – Programs. Algorithms, and Functions Introduction. Python Scripts and Modules.

## 200 Level

### GST 212: Philosophy, Logic and Human Existence
**(2 Units C: LH 30)**

**Course Contents**

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

### ENT 211: Entrepreneurship and Innovation
**(2 Units C: LH 30)**

**Course Contents**

Concept of Entrepreneurship (Entrepreneurship, Intrapreneurship/Corporate Entrepreneurship,). Theories, Rationale and relevance of Entrepreneurship (Schumpeterian and other perspectives, Risk-Taking, Necessity and opportunity-based entrepreneurship and Creative destruction). Characteristics of Entrepreneurs (Opportunity seeker, Risk taker, Natural and Nurtured, Problem solver and change agent, Innovator and creative thinker). Entrepreneurial thinking (Critical thinking, Reflective thinking, and Creative thinking).

Innovation (Concept of innovation, Dimensions of innovation, Change and innovation, Knowledge and innovation). Enterprise formation, partnership and networking (Basics of business plan, forms of business ownership, business registration and forming alliances and joint ventures). Contemporary Entrepreneurship Issues (Knowledge, Skills and Technology, Intellectual property, Virtual office, Networking). Entrepreneurship in Nigeria (Biography of inspirational Entrepreneurs, Youth and women entrepreneurship, Entrepreneurship support institutions, Youth enterprise networks and Environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

**MTH 201: Mathematical Methods 1**
**(2 Units C: LH 30)**

**Course Contents**
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 and three variables. Partial derivatives chain rule, extrema, lagrangian multipliers. Increments, differentials, and linear approximations. Evaluation of line, integrals. Multiple integrals.

**MTH 202: Mathematical Methods II**
**(2 Units C: LH 30)**

**Course Contents**
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.

**COS 201: Computer Programming I**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
Essentials of computer programming. Types of programming: Functional programming, Declarative programming, Logic programming, object-oriented programming. Scripting languages, structured programming principles. Basic data types, variables, expressions, assignment statements, and operators. Basic object-oriented concepts: abstraction, objects, classes, methods; parameter passing; encapsulation. Class hierarchies and programme organisation using packages/namespaces. Use of API – use of iterators/enumerators, List, Stack, Queue from API. Searching; sorting; Recursive algorithms. Event-driven programming: event-handling methods; event propagation; exception handling. Introduction to Strings and string processing. Simple I/O; control structures; Arrays. Simple recursive algorithms, inheritance, polymorphism.

**Lab Work**: Programming assignments; design and implementation of simple algorithms e.g. average, standard deviation, searching and sorting. Developing and tracing simple recursive algorithms. Inheritance and polymorphism.

**COS 202: Computer Programming II**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
Review and coverage of advanced object-oriented programming - polymorphism, abstract classes and interfaces; Class hierarchies and program organisation using packages/namespaces; Use of API – use of iterators/enumerators, List, Stack, Queue from API; Searching; sorting; Recursive algorithms; Event-driven programming: event-handling methods; event propagation; exception handling. Applications in Graphical User Interface (GUI) programming.

**Lab work**: Programming assignments leading to extensive practice in problem solving and program development with emphasis on object-orientation. Solving basic problems using static and dynamic data structures. Solving various searching and sorting algorithms using iterative and recursive approaches. GUI programming.

**SEN201: Introduction to Software Engineering**
**(2 units C: LH 30)**

**Course Contents**
Software Engineering concepts and principles. Design, development and testing of software systems. Software processes: software lifecycle and process models. Process assessment models. Software process metrics. Life cycle of software system. Software requirements and specifications. Software design. Software architecture. Software metrics.

Software quality and testing. Software architecture. Software validation. Software evolution: software maintenance; characteristics of maintainable software; re-engineering; legacy systems; software reuse. Software Engineering and its place as a computing discipline. Software project management: team management; project scheduling; software measurement and estimation techniques; risk analysis; software quality assurance; software configuration management. Software Engineering and law.

**CSC 203: Discrete Structures**
**(3 Units C: LH 45)**

**Course Contents**
Propositional Logic, Predicate Logic, Sets, Functions, Sequences and Summation, Proof Techniques, Mathematical induction, Inclusion-exclusion and Pigeonhole principles, Permutations and Combinations (with and without repetitions), The Binomial Theorem, Discrete Probability, Recurrence Relations.

**INS 204: Systems Analysis and Design**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
Structured approach to analysis and design of information systems for businesses. Software development life cycle. Structured top-down and bottom-up design. Dataflow diagramming. Entity relationship modelling. Computer aided software engineering. Input and output, prototyping design and validation. File and database design. Design of user

interfaces. Comparison of structured and object-oriented design.

**Lab Work**: system requirements gathering techniques;data modelling techniques (entity relationship modelling);process modelling techniques (data flow diagram); use of UML diagrams; system architectural design; user interface design.

**IFT 211: Digital Logic Design**
**(3 Units C: LH 15; PH 45)**

**Course Contents**
This is an introduction to information representation and number systems. Boolean algebra and switching theory. Manipulation and minimisation of completely and incompletely specified Boolean functions. Physical properties of gates: fan-in, fan-out, propagation delay, timing diagrams and tri-state drivers. Combinational circuits design using multiplexers, decoders, comparators and adders. Sequential circuit analysis and design, basic flip-flops, clocking and timing diagrams. Registers, counters, RAMs, ROMs, PLAs, PLDs, and FPGAs.

**Lab Work:** Simple combinational gates (AND, OR, NOT, NAND, NOR); Combinational circuits design using multiplexers, decoders, comparators and adders. Sequential circuit analysis and design using basic flip-flops (S-R, J-K, D, T flip-flops); Demonstration of registers, counters, RAMs, ROMs, PLAs, PLDs, and FPGAs.

**IFT 212: Computer Architecture and Organisation**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
Instruction format and types, memory and I/O instructions, dataflow, arithmetic, and flow control instructions, addressing modes, stack operations, and interrupts. Data path and control unit design. RTL, microprogramming, and hardwired control. Practice of assembly language programming. Memory hierarchy, cache memory, virtual memory. I/O fundamentals. Interrupt structures.

**Lab work:** Programming assignments to practice MS-DOS batch programming, Assembly Process, Debugging, Procedures, Keyboard input, Video Output, File and Disk I/O and Data Structure. Instruction and arithmetic pipelining, superscalar architecture. Reduced Instruction Set Computers. Parallel architectures and interconnection networks.

**SEN 299: Students Industrial Work Experience Scheme I**
**(3 Units C: PH 135)**

**Course Contents**
Students would be attached to private and public organisations for a period of three months during the second year session long break with a view to making them acquire practical experience and to the extent possible, develop skills in all areas of Software Engineering. Students are supervised during the training period and shall be expected to keep records designed for the purpose of monitoring their performance. They are also

expected to submit a report on the experience gained and defend their reports.

**IFT-201 Introduction to Web Technologies.**
**(2 Unit; Core; LH=15, PH=45)**

**Course Content**
Introduction to framework-based web development using a contemporary language like PHP and ASP.net. Principles of web pages (dynamic and static) and website design. The tool used in web development of Client-side and server-side languages Creation of interactive, dynamic websites using a common web architecture and object-based database access Design, implementation, and testing of web-based applications including related software, databases, interfaces, and digital media Standard object models, and the use of server-side programmes for database and file access; testing, software quality assurance; and the process of publishing Web sites Hands-on PHP and Python programme using open-source software (Apache, PHP, Python, JavaScript, and MySQL)Programming for web development includes control structures, objects, functions, and the use of composite data types Deploying dynamic content using Java Script Designing and developing dynamic web pages and creating, validating, transforming, and formatting data using PHP.

**SEN-203 Software Engineering Process**.
**(2 Unit; Core; LH=30)**

**Course Content**
Software process definition – software process management and infrastructure, Software life cycles – categories of software processes, software life cycle models, software process adaptation, practical considerations; Software process assessment and improvement – software process assessment methods, software process improvement models, and continuous and staged software process rating; Software measurement – software process and product measurement, quality of measurement results, and software process measurement techniques; Software engineering process tools

**INS 202 Human-Computer Interaction.**
**(2 Unit; Core; LH=15, PH=45)**

**Course Content**
Foundations of HCI. The concept underlying the design of HCI. Principles of GUI. GUI toolkits. System design methods. User conceptual models and interface metaphors. Human cognitive and physical ergonomics. Human-centered software evaluation and development. GUI design and programming.

**300 Level**

**GST 312: Peace and Conflict Resolution**
**(2 Units C: LH 30)**

**Course Contents**

Concepts of Peace, Conflict and Security in a multi-ethnic nation. Types and Theories of Conflicts: Ethnic, Religious, Economic, Geopolitical Conflicts; Structural Conflict Theory, Realist Theory of Conflict, Frustration-Aggression Conflict Theory. Root causes of Conflict and Violence in Africa: Indigene and settlers Phenomenon; Boundaries/boarder disputes; Political disputes; Ethnic disputes and rivalries; Economic Inequalities; Social disputes; Nationalist Movements and Agitations; Selected Conflict Case Studies – Tiv-Junkun; Zango Kartaf, Chieftaincy and Land disputes etc. Peace Building, Management of Conflicts and Security: Peace & Human Development. Approaches to Peace & Conflict Management --- (Religious, Government, Community Leaders etc.). Elements of Peace Studies and Conflict Resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and Terrorism. Peace Mediation and Peace Keeping. Peace & Security Council (International, National and Local levels) Agents of Conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution, ADR. Dialogue b). Arbitration, c). Negotiation d). Collaboration etc. Roles of International Organisations in Conflict Resolution. (a). The United Nations, UN and its Conflict Resolution Organs. (b).

The African Union & Peace Security Council (c). ECOWAS in Peace Keeping. Media and Traditional Institutions in Peace Building. Managing Post-Conflict Situations/Crisis: Refugees. Internally Displaced Persons, IDPs. The role of NGOs in Post-Conflict Situations/Crisis

**ENT 312: Venture Creation**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
Opportunity Identification (Sources of business opportunities in Nigeria, Environmental scanning, Demand and supply gap/unmet needs/market gaps/market research, Unutilised resources, Social and climate conditions, and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, microfinance, personal savings, small business investment organisations, and business plan competition). Entrepreneurial marketing and e-commerce (Principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, first mover advantage, e-commerce business models and successful e-commerce companies,). Small business management/family business: Leadership & Management, basic bookkeeping, nature of family business and family business growth model. Negotiation and business communication (Strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (the concept of market/customer

solution, customer solution, and emerging technologies, business applications of new technologies- Artificial Intelligence (AI), Virtual/Mixed Reality (VR), Internet of Things (IoT), Blockchain, Cloud Computing, renewable energy, etc. digital business and e-commerce strategies).

**SEN 301: Object-Oriented Analysis and Design**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
Object-oriented approach is mainly to information system development, particularly in reference to the earlier stages of analysis and design. Importance of modelling, principles of modelling, object-oriented modelling, conceptual model of the Unified Modelling Language (UML), architecture, software development life cycle. The principles and basic concepts of object orientation and the different aspects of object-oriented modelling as represented by the UML technique. Case study of a typical UML-based CASE tool.

**Lab Work:** Practical exercises on different requirements specification and design activities; developing problem statements, SRS documents and Use Case Diagrams; designing UML Activity diagrams, UML Class diagrams and State Chart diagrams; drawing partial layered, logical architecture diagram with UML package diagram notation; Designing Component and Deployment diagrams.

**SEN 304: Software Testing & Quality Assurance**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
The course involves the importance of Software Testing. Understanding Verification and Validation. How to assure it and verify it, and the need for a culture of quality. Avoidance of errors and other quality problems. Inspections and reviews. Testing, verification and validation techniques. Process assurance vs. Product assurance. Quality process standards. Product and process assurance. Problem analysis and reporting. Statistical approaches to quality control

**Lab Work:** Debugging tools; unit testing – black box and white testing techniques; integration and system testing tools; other testing tools – performance testing, load testing, stress testing, regression testing, security testing; manual testing vs automated testing.

**SEN 306: Software Construction**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
Definition of Software Construction; Its importance; Key construction decisions – choice of programming language, selection of major construction decisions. Design in construction – Key design concepts, levels of design, design heuristics. Abstract Data Types (ADTs). Working Classes. High Quality Routines. The Pseudo Code Programming Process. Fundamental Data Types – Numbers, Characters and Strings, Boolean Variables, Arrays, Tables. Types of

Statements – Straight Line Code, Loops, Control Structures; Developer Testing and Debugging. Software Craftsmanship – Layout and Style, Documentation, Personal Character.

**Lab Work:** Practical's on the most common tools to ensure good software construction. The features include static code analysers to check that code follows coding conventions, special code searching and editing, collaboration support to allow multiple programmers working simultaneously, support for proper code documentation. Practice with IDEs (such as Visual Study Code, Net Beans and Eclipse) on debugging, compilation, running of code, auto completion and version control.

**SEN 322: Software Engineering Innovation and New Technology**
**(2 Units C: LH 15)**

**Course Contents**

Software entrepreneurial process. Principles of software business ownership. Identifying software market opportunities. Entrepreneurial software marketing. Software business communication and negotiation techniques. Feasibility analysis. Entrepreneurial financing. Legal issues. Software business plan development. Risk management.

**SEN 399: Students Industrial Work Experience Scheme II (3 Units C: PH 135)**

**Course Contents**

Students would be attached to private and public organisations for a period of three months during the third year session long break with a view to making them acquire additional practical experience in all areas of Software Engineering over and above what is gained in SEN 299. Students are supervised during the training period and shall be expected to keep records designed for the purpose of monitoring their performance. They are also expected to submit a report on the experience gained and defend their reports.

**CSC 301: Data Structures**
**(3 Units C: LH 30, PH 45)**

**Course Contents**

The course introduces students to 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.

**Lab work:** Writing C+/C++ functions to perform practical exercises and implement using the algorithms on arrays, records, string processing, queues, trees, pointers and linked structures.

**CSC 308: Operating Systems**
**(3 Units C: LH 30; PH 45)**

**Course Contents**
This is about the fundamentals of operating systems design and implementation, history and evolution of operating systems, Types of operating systems; Operating system structures; Process management: processes, threads, CPU scheduling, process synchronization; Memory management and virtual memory; File systems; I/O systems; Security and protection; Distributed systems; Case studies.

**Lab work:** Practical hands-on engagement to facilitate understanding of the material taught in the course. All the process, memory, file and directory management issues will be demonstrated under the LINUX operating system. Also UNIX commands will be briefly discussed. Alternatively, hands-on exposure may be through the use of operating systems developed for teaching, like TempOS, Nachos, Xinu or MiniOS. Another possibility is through programming exercises that implement and simulate algorithms taught. Simulation of CPU scheduling algorithms, producer-consumer problem, memory allocation algorithms, file organisation techniques, deadlock algorithms and disk scheduling algorithms.

**DTS-301 Data Management I.**
**(2 Unit; Core; LH=15, PH=45)**

**Course Content**
Information Management Concepts. Information storage & retrieval. Information management applications. Information capture and representation. Analysis and indexing -search, retrieval, information privacy. Integrity and security. Scalability, Efficiency and Effectiveness. Introduction to database systems. Components of database systems. DBMS functions. Database architecture and data independence. Database query language. Conceptual models. Relational data models. Semi-structured data models. Relational theory and languages. Database Design. Database security and integrity. Introduction to query processing and optimisation. Introduction to concurrency and recovery

**ICT-302 Data Communication Systems and Network I.**
**(2 Unit; Core; LH=15, PH=45)**

**Course Content**
Types and sources of data. Simple communications network. Transmission definitions, one way transmission, half duplex transmission, transmission codes, transmission modes, parallel transmission, serial transmission, bit synchronisation, character synchronisation, synchronous and asynchronous transmission. Introduction to network protocol. Seven Layer ISO-OSI standard protocols and network architecture. Transport protocols, session services protocols, and other

protocols. Institute of Electrical and Electronics Engineering 802 standards. Error control and Data Compression: Forward Error Control; error detection methods; parity checking; linear block codes, cyclic redundancy checking; feedback error control, data compression, Huffman coding. Local Area Networks: medium access control techniques; fibre distributed data interface, and metropolitan area network. Peer-to-peer, Client Server. Client-Server Requirements: GUI design standards, interface and platform independence, transaction processing, backup, and recovery mechanisms. Features and benefits of major recovery mechanisms. Network OS: INTERNET: Definition, architecture, services, internet addressing. Internet protocol, IPv4, IPv6

**IFT-303 Mobile Application Development.**
**(2 Unit; Core; LH=15, PH=45)**

**Course Content**

Introduction to developing mobile applications. Mobile operating systems capabilities, application architecture, and major components, such as activities, services, broadcast receivers, etc. Development of interactive applications using widget libraries, web-based services. Basic concepts of 2D graphics and animation. An SQL database engine, and multithreading. Multiplatform mobile application development. Mobile application basics and features; Android application basics, UI design Data storage; networking application design. Advanced application design (sensors, camera, GPS, Audio, etc.), graphics and games, web-based hybrid application design. Design and implement a simple mobile application for a given mobile platform. Metrics and methods to evaluate the performance of mobile applications. Mobile application perspectives and impact.

**DTS 304 Big Data Computing.**
**(2 Unit; Core; LH=15, PH=45)**

**Course Content**
The course is about Installation: Cloudera VM, Jupyter server. Big data retrieval and relational querying: Postgres databases, NoSQL data, MongoDB, Aerospike, and Pandas for data aggregation and working with data frames. Big Data Integration: Splunk and Datameer. Big Data Processing: Apache Spark, Hadoop, Spark Core (Spark MLlib and GraphX. Big Data Applications (Graph Processing). Big Data Streaming Platforms for Fast Data. **Lab Work:** Analysing Twitter Data using Spark and MongoDB. Learn Big Data analytics Skills Practical procedure for the crafting of an enterprise-scale cost-efficient. Big Data and machine learning solution to uncover insights and value from data. Hands-on exposure to Hadoop and Spark (or any of the BD tools), build machine learning dashboards using R and R Shiny, and create web-based apps using NoSQL databases.

**MTH 305 Introduction to Numerical Analysis.**
**(2 Unit; Core; LH=15, PH=45)**

**Course Content**

Solution of algebraic and transcendental equations. Curve fitting. Error analysis. Interpolation and approximation. Zeros of non-linear equations 'in one variable'. Systems of linear equations. Numerical differentiation and integration. Initial value problems in ordinary differential equation.

**400 Level**

**COS 409: Research Methodology and Technical Report Writing**
**(3 Units C: LH 45)**

**Course Contents**

The course involves foundations of Research. Types of Research. Research Approaches. Significance of Research. Research Methods and Methodology. Research Process. Criteria and Strategy for Good Research. Principles of Scientific Research. Scientific investigation. Problem of Formulation and Its Techniques. Developing Research Proposal and Research Plan. Formulation of Research Questions and Hypothesis Testing. Developing Research Proposal and Research Plan. Literature Review. Procedure for Reviewing Related and Relevant Literature . Methods for Collection of Primary and Secondary Data. Elicitation Techniques - Questionnaires, Interviewing, Ethnography, etc. Guidelines for Constructing Data Instruments. Methods of AnalysingData in Computing and Related Disciplines.System Design: Architectural design, input design, process design, output design. Use case analysis, sequence diagram, activity diagram, deployment diagram, etc.Types of Reports. Technical Report Writing. Layout and Mechanics of Writing a Research Report. Standard Techniques for Research Documentation. Interpretation and Presentation of Results. How to Cite Referenced Works and Prepare References and Bibliography.

**SEN401: Software Configuration Management & Maintenance**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
The course exposes the Management of the software configuration management process – organisation context for software configuration management, constraints and guidance for software configuration management process. Planning for software configuration management, software configuration management plan, and surveillance of software configuration management. Software configuration identification and software library. Software configuration control – requesting, evaluating and approving software changes, implementing software changes, and deviations and waivers. Software configuration status accounting – software configuration status information and reporting. Software configuration auditing. Key issues in software maintenance – technical issues, management issues, maintenance cost estimation, and software maintenance measurement. Maintenance process – maintenance processes and activities. Techniques for maintenance – program comprehension, re-engineering, reverse engineering, migration, and retirement.

**Lab Work:** Practical demonstration of software configuration management processes. Working with software configuration management software. Illustration of software maintenance processes and activities. Working with software maintenance software. Illustration of software re-engineering and reverse engineering techniques.

**SEN 410: Software Architecture and Design**
**(2 Units C: LH 15; PH 45)**

**Course Contents**
This is a an in-depth look at software design. Continuation of the study of design patterns, frameworks, and architectures. Survey of current middleware architectures. Design of distributed systems using middleware. Component based design. Measurement theory and appropriate use of metrics in design. Designing for quality attributes such as reliability, performance, safety, security, reusability, etc. Measuring internal qualities and complexity of software. Evaluation and evolution of designs.

**Lab Work:** Practical demonstration of the use of design patterns, frameworks and architectures. Practical simulation of distributed systems. Illustration of component based design. Working with software design software. Use of software metrics measuring software.

**SEN 497: Final Year Project I**
**(3 Units C: PH 135)**

**Course Contents**
An independent or group investigation to address a Software Engineering problem under the supervision of a lecturer. Before registering, the student must submit a written proposal to the supervisor for review. The proposal should give a brief outline of the project, estimated schedule of completion, and computer resources needed. A formal written report is

essential and an oral presentation may also be required. At the end of the semester, the introduction, literature review and methodology employed should be submitted for grading.

**SEN 498: Final Year Project II**
**(3 Units C: PH 135)**

**Course Contents**
This is a continuation of SEN 497. This contains the implementation and the evaluation of the project. A formal written report (chapters 4-5) has to be approved by the supervisor. A final report comprising chapters 1-5 will be submitted to the department for final grading. An oral presentation is required.

**INS 401 Project Management**
**(2 Units C: LH 30)**

**Course Contents**
Introduction to Project Management. The Project Management Lifecycle. Project management and systems development or acquisition. The project management context, technology and techniques of supporting the project management lifecycle, and Project management processes. Managing Project Teams: Project team planning, Motivating team members, Leadership, power and conflict in project teams, and Managing global project teams. Managing Project Communication and enhancing team communication. Managing Project Scope: Project initiation, how organisations choose projects, activities, and developing the project charter. Managing Project Scheduling: Common problems in project scheduling,

and Techniques for project scheduling. Managing Project Resources: Types of resources (human, capital, time), and techniques for managing resources. Project quality and tools to manage project quality. Managing project risk and tools for managing project risk. Managing Project Procurement: Alternatives to systems development, External acquisition, Outsourcing-domestic and offshore, Steps in the procurement process, and Managing the procurement process. Project Execution, Control and Closure: Managing project execution, monitoring progress and managing change, Documentation and communication, and Common problems in project execution; Managing Project Control and Closure: Obtaining information, Cost control, Change control, Administrative closure, Personnel closure, Contractual closure and Project auditing

**SEN-401 Software Engineering Professional Practice**
**(2 Unit; Core; LH=30)**

**Course Content**
Software development life cycle: various phases involved in software development, such as planning, requirements analysis, design, coding, testing, and maintenance. Software project management: project planning, scheduling, estimation, risk management, and quality assurance. Software testing: unit testing, integration testing, system testing, and acceptance testing. Software quality assurance: code reviews, static analysis, and automated testing. Software configuration management: version control, release management, and change management. Software documentation: requirements documents, design documents, user manuals, and technical

specifications. Software ethics: privacy, security, and intellectual property. Professionalism: effective communication, teamwork, and continuous learning

**SEN 402 Concepts of Programming Languages**
**(2 Unit; Core; LH=30)**

**Course Content**

Introduction to Programming Languages; what is a programming language? Types of programming languages (procedural, functional, object-oriented, etc.) Syntax and semantics of programming language. History of Programming Languages; Early programming languages, Evolution of programming languages, Influence of hardware and software developments on programming languages. Language Translation; Compilers, interpreters, and virtual machines, Lexical analysis and parsing, intermediate representation. Data Types and Variables; Basic data types, User-defined data types, Variables and constants. Control Structures; Sequence, selection, and iteration, Conditionals and loops, Exception handling. Functions and Procedures; Definition and calling of functions, Parameter passing mechanisms, Scope and lifetime of variables. Object-Oriented Programming; Classes and objects, Inheritance and polymorphism, Interfaces and abstract classes. Functional Programming; Lambda calculus, Higher-order functions, Immutable data structures. Language Design and Implementation; Language syntax and semantics, Language features and trade-offs, Language implementation and optimization. Current Trends in Programming Languages; New programming languages (Rust, Kotlin, Swift, etc.), Domain-specific languages (DSLs), Web programming languages (JavaScript, TypeScript, etc.

**SEN 403 Open-Source Software Development and Applications**
**(2 Unit; Core; LH=15, PH=45)**

**Course Content**
Introduction to open-source software development: What is open-source software development is and why is it important. Open-source licensing: different types of open-source licenses and their implications. Tools and technologies: This covers the various tools and technologies used in open-source development such as version control systems, issue trackers, and collaborative platforms. Building and contributing to the open-source projects: how to find and contribute to existing open-source projects as well as how to start your own. Best practices for open-source development: code reviews, testing, documentation, and communication. Community management: to manage an open-source community and how to handle conflicts that may arise. Open-source business models: Business models that can be used for open-source software development such as support and services, dual licensing, and open core.

**SEN 404 Special Topics in Software Engineering**
**(2 Unit; Core; LH=30)**

**Course Content**
Introduction to Advanced Software Engineering; Overview of Software engineering principles and methodologies, emerging

trends in Software development, Introduction to advanced Software Engineering concepts. Agile Software Development; Principles of agile software development, agile methodologies and practices. Managing agile projects. Cloud Computing and Micro services; Cloud computing concepts and architectures, Micro services and service-oriented architectures, Designing and implementing micro services. Emerging Technologies in Software Engineering; Blockchain and distributed ledger technology, Artificial intelligence and machine learning in software engineering, Quantum computing and its potential impact on software development. Research papers and journal that are published in special topics areas. Open discussion on current and research and industry trends related to the special topic area. Case Studies and Project Presentations.

**SEN 405 Software Engineering Economics**
**(2 Unit; Core; LH=30)**

**Course Content**
Introduction; Overview of Software Engineering Economics, Importance of Software Engineering Economics in Software Development, Basic concepts and terminologies. Software Development Process Models; Waterfall Model, Agile Development, Hybrid models, Comparison of models in terms of cost, time and quality. Software Cost Estimation; Cost drivers, Cost estimation techniques (e.g., COCOMO, Function Points), Uncertainty and risk management. Comparison of techniques and their limitations. Software metrics. Software Economics and Decision Making; Time value of money, Return on investment (ROI),Net present value (NPV) and

discounted cash flow analysis**,** Cost-benefit analysis**,** Software project selection

**CSC 406 Artificial Intelligence**
**(2 Unit; Core; LH=30)**

**Course Content**
Introduction to Artificial Intelligence: overview of what AI is, its history, and the various types of AI. Problem Solving using AI: various AI techniques to solve problems such as search algorithms, optimization algorithms, and constraint satisfaction. Machine Learning: basic concepts of machine learning, including supervised and unsupervised learning, decision trees, and neural networks. Natural Language Processing: parsing, semantic analysis, and sentiment analysis. Computer Vision: basics of computer vision, including image processing, feature extraction, and object recognition. Robotics: basics of robotics, including kinematics, control systems, and sensors. Ethics and Future of AI: discuss the ethical considerations around AI and its impact on society.

**CYB 407 Cloud Computing and Security**
**(2 Unit; Core; LH=15, PH=30)**

**Course Content**
Introduction to cloud computing. Objectives, challenges, application domains, advantages. Computational and storage cloud architectures; Service level agreements, service lifecycle Management. Elasticity and scalability Techniques; Information, Account and Billing Management. Cloud service model, service provisioning and access models.

Cloud Service Models: Software as a Service Layer; Platform as a Service layer; Infrastructure as a Service layer. Virtualization and Resource Management. Distributed object storage clouds. Data storage and retrieval based on content. Computational tasks execution in storage clouds. Quality of service approaches; Requirements and parameters classification, Monitoring and control mechanisms, Quality of service guarantees Security in the Cloud: Cloud threats; Threat Mitigation, Cloud and Security Risk.

**IMT 408 Operation Research**
**(2 Unit; Core; LH=15, PH=30)**

**Course Content**

This entails Introduction to Operation Research: overview of OR, its applications, and its history. Linear Programming: formulation and solution of linear programming problems, graphical solution methods, simplex method, duality theory, sensitivity analysis, and transportation problems. Network Analysis: critical path method (CPM) and the program evaluation and review technique (PERT), which are used to analyze complex projects and identify the critical path. Integer Programming: formulation and solution of integer programming problems, branch and bound algorithm, and cutting plane methods. Nonlinear Programming: gradient-based methods, Newton's method, and constrained optimization. Game Theory: zero-sum games, non-zero-sum games, and cooperative games. Decision Analysis. Network error.

**SEN 409 Game Design and Development**
**(2 Unit; Core; LH=15, PH=45)**

**Course Content**
Introduction to Game Design and Development; What is Game Design? History of Video games. **An** Overview of a game development process, Roles in game development. Game Design Fundamentals; Game mechanics and rules, Game balance and difficulty, Game flow and pacing, Game narratives and storytelling, Game genre and target audience. Game Design Tools and Techniques; Paper prototyping and playtesting, Digital prototyping and game engines, Level design and game assets creation, User experience and interface design, Sound and music in games. Game Programming Basics, Programming languages and frameworks, Object-oriented programming, Game physics and collision detection, Artificial intelligence and game logic. Game Development Process; Project management and planning, Agile and Scrum methodologies, Iterative development and testing, Debugging and optimization. Advanced Game Design and Development Topics; Multiplayer game design and networking, Mobile game development, Virtual reality and augmented reality games, Game monetization and marketing, Game analytics and data-driven design. Final Project and Presentation