National Universities Commission

New

Core Curriculum and Minimum Academic Standards for the Nigerian University System (CCMAS)

Basic Medical Sciences

2022

Ten Unique Features

1. The philosophy and objectives of the programmes are well articulated and are in line with the sustainable development goals (SDG).
2. The programmes in the discipline are re-designed with a core curriculum component that has courses that are globally rated and also allow universities to add other courses that are relevant to their local needs.
3. The core curriculum is enriched with new courses that will equip the students with the knowledge and skills to enable them face the challenges of the 21st century.
4. All the courses in the discipline are taught along with a set of learning objectives.
5. Minimum academic standards are well defined for the programmes in the discipline so as to enable all Nigerian Universities conform to it.
6. The programmes in the discipline are re-designed to ensure teamwork, digital literacy and effective communication.
7. The programmes are also re-designed to confer on the students critical thinking abilities and enhanced analytical approaches to problem solving.
8. To enhance the professional development of students, the programme contains more practical elements, to develop experimental and data analysis skills which would confer on them a competitive advantage.
9. Graduates of the programme are equipped with entrepreneurial skills to position them for multiple opportunities to explore career options in the full spectrum of the healthcare specialties
10. A strong feature of the progammme is the infusion of various evidence-based and student-centered strategies such as team-based learning (TBL), in order to shift the focus of teaching from knowledge-transmission to knowledge-construction by students

Executive Secretary: Abubakar Adamu Rasheed

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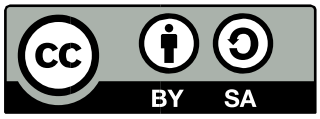

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Foreword

In furtherance of the "change" mantra of the present administration, I published a roadmap to guide my Ministry on ways of addressing the multiple problems that faced the education sector of the country shortly after my assumption of office in 2016. Known as "***Education for Change: Ministerial Strategic Plan – 2016-2019"*** (updated to 2018-2022), the content of the document reaffirms government's commitment to strengthening institutional structures and establishing innovative approaches that would quickly revamp the education sector.

The nations' universities hold a pride of place in the execution of such a strategy, being at the peak of the educational system and charged in an overall manner, with the responsibility of catalysing the sustainable and inclusive growth and prosperity that the "change" mantra envisions. Thus, a "rapid revitalization of the Nigerian university system", which is proceeding apace, became imperative. Improvement in research, teaching and learning facilities, deepening ICT penetration and the provision of enhanced power supply in our university campuses are some of the areas receiving stringent attention. In the same vein, the need was felt to radically review the curricula which universities had used for more than a decade so as to put in place one that would more directly address local issues, meet international standards and is fit for purpose for the training of 21st century graduates.

The National Universities Commission has concluded the review of the former *Benchmark Minimum Academic Standards (BMAS)* of 14 disciplines into those of Core *Curriculum and Minimum Academic Standards (CCMAS)* of 17 disciplines. I am therefore pleased to present these documents to the universities, the general public and the international community as I am sure that their application would tremendously uplift scholarship in our universities. I thank all and sundry who worked assiduously to bring this seminal enterprise to fruition.

Malam Adamu Adamu
Honourable Minister of Education

Preface

Section 10 (1) of the Education (National Minimum Standards and Establishment of Institutions) Act, Cap E3, Laws of the Federation of Nigeria 2004, empowers the National Universities Commission to lay down minimum standards for all universities and other degree awarding institutions of higher learning in the Federation and the accreditation of their degrees and other academic awards. The earliest efforts at giving effect to this legal framework in the Nigerian University System (NUS) started in 1989 following the collaboration between the Commission and Nigerian Universities, which led to the development of the Minimum Academic Standards (MAS) for all programmes in Nigerian universities. The MAS documents were subsequently approved by the Federal Government for use as a major instrument for quality assurance in the Nigerian University System (NUS). The documents were employed in the accreditation of programmes in the NUS for over a decade.

In 2001, the Commission initiated a process to revise the documents because the said MAS documents were essentially content-based and merely prescriptive. In 2004, the Commission developed outcome-based benchmark statements for all the programmes through a workshop that allowed for exhaustive deliberations by relevant stakeholders. Following comments and feedback from the universities to the effect that the Benchmark-style Statements were too sketchy to meaningfully guide the development of curriculum and inadequate for the purpose of accreditation, the Commission, in 2007 put in place a mechanism for the merger of the Benchmark-style Statements and the revised Minimum Academic Standards, which birthed the Benchmark Minimum Academic Standards (BMAS). The resultant BMAS, an amalgam of the outcome-based Benchmark statements and the content-based MAS clearly articulated the Learning Outcomes and competencies expected of graduates of each academic programme in Nigerian Universities without being overly prescriptive while at the same time providing the requisite flexibility and innovativeness consistent with institutional autonomy. In all, the BMAS documents were developed for the thirteen existing disciplines namely, **Administration and Management, Agriculture, Arts, Basic Medical Sciences, Education, Engineering and Technology, Environmental Sciences, Law, Medicine and Dentistry, Pharmacy, Sciences, Social Sciences and Veterinary Medicine.**

The Commission, in 2016, in its sustained commitment to make the NUS adaptable to global trends in higher education, constituted a group of relevant academic experts to develop a BMAS in **Computing**, thus increasing the number of disciplines in Nigerian Universities to fourteen.

In keeping with its mandate of making university education in Nigeria more responsive to the needs of the society, the National Universities Commission commenced the journey to restructure the BMAS in 2018, introducing in its place, the **Core Curriculum and Minimum Academic Standards (CCMAS),** to reflect the 21st Century realities, in the existing and new disciplines and programmes in the Nigerian University System.

The new CCMAS is a product of sustained stakeholder interactions over two years. The composition of each panel took into consideration, the triple helix model, as a unique feature. This involved a blend of academic experts, academies, government (represented by NUC), professional bodies and of course, the private sector represented by the Nigerian Economic Summit Group (NESG). In order to enrich the draft documents, copies of each discipline were forwarded to all critical stakeholders including the relevant academic units in Nigerian Universities, the private sector, professional bodies and the academies for their comments and input. These inputs along with the curriculum of programmes obtained from some foreign

and renowned universities served as major working materials for the various panels constituted for that purpose.

Bearing in mind the need to adhere to covid-19 protocol as prescribed by the National Centre for Disease Control (NCDC), the Commission was compelled by prevailing circumstances to finalize the curriculum virtually. General Assemblies were also held via Zoom, comprising, the NUC Strategic Advisory Committee (STRADVCOM), Chairpersons/Co-Chairpersons of the various disciplines and Panel Members of the respective programmes. Each Discipline and Programme had NUC representatives who assisted panellists with all the tools and working materials. Several online meetings were held at programmes level, where the real business of developing the CCMAS took place. The products of the various programme-based virtual meetings were submitted to the corresponding discipline group and then to the National Universities Commission. These documents were further scrutinized and fine-tuned by a smaller group of versatile subject matter specialists and relevant private sector practitioners.

In line with the dynamism in higher education provisioning, the Commission took cognizance of complaints by the universities on the high number of General Studies (GST) courses in the BMAS, and was subsequently streamlined. Entrepreneurship courses such as Venture Creation and Entrepreneurship, and innovation found generous space. In addition, the new curriculum unbundled the Bachelor of Agriculture, Bachelor of Science in Mass Communication and the Bachelor of Architecture Programmes, while establishing some emerging specializations in these fields as obtained globally. This is in furtherance of the goal of producing fit for purpose graduates. The Allied Health Sciences was also carved out as a new Discipline from the existing Basic Medical Sciences discipline.

Preceding the completion of the curriculum review content and language editing, a 3-day validation workshop (face-to-face mode) involving critical stakeholders, including STRADVCOM, Vice-Chancellors and Directors of Academic Planning of Nigerian Universities, as well as the Nigerian Economic Summit Group (NESG) was organized by the Commission to validate the CCMAS documents, and to engender ownership for ease of implementation.

Consequent upon the afore-mentioned processes, seventeen CCMAS documents were produced for the following academic disciplines in the NUS:

1. Administration and Management
2. Agriculture
3. Allied Health Sciences
4. Architecture
5. Arts
6. Basic Medical Sciences
7. Computing
8. Communication and Media Studies
9. Education
10. Engineering and Technology
11. Environmental Sciences
12. Law
13. Medicine and Dentistry
14. Pharmacy
15. Sciences
16. Social Sciences
17. Veterinary Medicine

The CCMAS documents are uniquely structured to provide for 70% of core courses for each programme, while allowing universities to utilise the remaining 30% for other innovative courses in their peculiar areas of focus. In addition to the overall Learning Outcomes for each discipline, there are also Learning Outcomes for each programme and course. In general, programmes are typically structured such that a student does not carry less than 30 credit units or more than 48 credit units per session.

Consequently, the Commission is optimistic that the 2021 CCMAS documents will serve as a guide to Nigerian Universities in the design of curriculum for their programmes with regards to the minimum acceptable standards of input and process, as well as, measurable benchmark of knowledge, 21st century skills and competences expected to be acquired by an average graduate of each of the academic programmes, for self, national and global relevance.

Professor Abubakar Adamu Rasheed, *mni, MFR, FNAL, HLR*
Executive Secretary

List of Reviewers

Title	Surname	First Name	Institution	Programme
Professor	ALOAMAKA	Peter	Delta State University, Abraka	**Chairman**
Professor	MOHAMMED	Aliyu	Ahmadu Bello University, Zaria	Physiology
Professor	MALAMI	Sani	Abubakar Tafawa Balewa University, Bauchi	Anatomy

NUC Representative

Title	Surname	First Name	Programme
Mrs.	IORSHE	Sylvia	Anatomy and Physiology

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Introduction

Two Acts provide the legal framework for the quality assurance and regulatory mandates of the National Universities Commission. The first is the **National Universities Commission Act No. N81 Laws of Federation Nigeria (L.F.N.) 2004**.

This Act sets up the National Universities Commission as a body corporate charged with the responsibility of advising the Federal and State Governments of all aspects of university education and the general development of universities in Nigeria. The second, **Education (National Minimum Standard and Establishment of Institutions) Act No. E3 L.F.N. 2004**, *empowers the National Universities Commission to lay down minimum standards for all universities and other institutions of higher learning in the Federation and the accreditation of their degrees and other academic awards in formal consultation with the universities for that purpose, after obtaining prior approval therefor through the Minister, from the President.*

Following the enactment of NUC Act No. E3 L.F.N. 2004, the National Universities Commission developed the first set of Minimum Academic Standards (MAS) in 1989 for all the academic programmes existing in the Nigerian University System (NUS) at that time under the 13 major disciplines of Administration, Agriculture, Arts, Education, Engineering and Technology, Environmental Sciences, Law, Medicine and Dentistry, Management Sciences, Pharmacy , Science, Social Sciences and Veterinary Medicine. The Minimum Academic Standard served as the reference documents for the first accreditation of programmes conducted in NUS in 1990.

In its bid to review the Minimum Academic Standard documents, which was predicated on the fact that they were prescriptive, the Commission decided to develop the outcome-based Benchmark Statements for all programmes in the Nigerian University System in line with contemporary global practice in 1999. In the first comprehensive review of the Minimum Academic Standards by NUC, which was in 2004, the Commission decided to merge the Benchmark Statements and the revised Minimum Academic Standards into a new document called Benchmark Minimum Academic Standards (BMAS). These documents were approved for use in Nigerian universities in 2007. A second attempt at reviewing the BMAS was in 2011. It must however be noted that stand alone BMAS for new programmes were at different times developed by the Commission on request from some Nigerian universities.

The Current Review of the BMAS

The journey of the current curriculum review efforts commenced in 2018, when the National Universities Commission circulated the 2018 draft BMAS to all Nigerian universities and other stakeholders for their comments. In addition to the harvested comments, the curriculum of different programmes of some world-class universities were downloaded. The draft 2018 BMAS, compiled comments of Nigerian universities and other stakeholders and the downloaded curriculum of some foreign universities served as the working documents for the curriculum review panels. A multi-stakeholder approach was deployed in constituting the panels for the curriculum review exercise. The constituted panels included:

i. Academic Staff of Nigerian Universities;
ii. Representatives of the Academies;
iii. Representatives of Professional bodies/associations
iv. Representatives of the private sector

In addition to the reviewers working individually and in consultation with their subject area peers, over 512 cumulative online meetings of the general assembly (Vice-Chancellors, Discipline Chairmen/Chairpersons, programme-specific reviewers and Heads/representatives of international quality assurance agencies and institutions); Discipline groups; and programme groups were held between March and November, 2021. Physical meetings were also held to finalize the curriculum review exercise.

The reviewers carried out their assignments with a view to producing a curriculum for their respective programmes that will reflect both national and international expectations. Specifically, the reviewers focused on ensuring that the emerging curriculum will be adequate to train Nigerian university students in the 21st Century. By implication and in addition to current trends in the various programmatic areas, the curriculum will be ICT oriented, promote Artificial Intelligence, enhance skills acquisition (including soft skills), inculcate and sharpen entrepreneurship mindset of students and capable of steering the deployment of evolving technologies to deliver its content.

The Core Curriculum and Minimum Academic Standards (CCMAS)
The major highlights of the new curriculum are:

1. Change of nomenclature from **Benchmarks Minimum Academic Standards (BMAS)** to **Core Curriculum and Minimum Academic Standards (CCMAS);**
2. The curriculum provides for 70% minimum core courses requirements for graduation. Nigerian universities are expected to provide the remaining 30%;
3. In consonance with global best practice, the curriculum is to stimulate blended learning in its delivery;
4. Mass Communication has been unbundled to create a distinct discipline of Communications comprising degree programmes in Advertising, Broadcasting, Development Communication Studies, Film and Multimedia, Information and Media Studies, Journalism and Media Studies, Mass Communication, Public Relations and Strategic Communication;
5. Agriculture has been unbundled into programmes in its contributing components of B.Sc Agricultural Economics, B.Sc. Animal Science, B.Sc. Crop Science and B.Sc. Soil Science;
6. The unbundling of Architecture and introduction of Architecture as a new discipline with programmes like Architecture, Architectural Technology, Furniture Design, Interior Architecture Design, Landscape Architecture and Naval architecture;
7. The split of the Basic Medical Sciences discipline into two – Basic Medical Sciences and Allied Health Sciences;
8. Reduction of the General Studies (GST) course from 36 credit units to 12 credit units of 6 courses as follows:
    i. Communication in English;
    ii. Nigerian People and Culture;
    iii. Philosophy, Logic and Human Existence;
    iv. Entrepreneurship and Innovation;
    v. Venture creation; and
    vi. Peace and Conflict resolution.
9. Entrepreneurship has been repackaged with the introduction of programme-specific entrepreneurship;
10. The number of academic disciplines has been increased from 14 to 17 as follows:

    i. Administration and Management
    ii. Agriculture

iii. Allied Health Sciences
iv. Architecture
v. Arts
vi. Basic Medical Sciences
vii. Communications and Media Studies
viii. Computing
ix. Education
x. Engineering and Technology
xi. Environmental Sciences
xii. Law
xiii. Medicine and Dentistry
xiv. Pharmacy
xv. Sciences
xvi. Social Sciences
xvii. Veterinary Medicine

Having reviewed the curriculum of Nigerian universities, the next steps will include training and retraining of academic staff of Nigerian universities to effectively deliver the content of the curriculum.

Glossary of Course Codes

These are the 3-letter codes for the identification of courses offered in the various programmes in the Basic Medical Sciences discipline as well as courses offered in other disciplines covered in the CCMAS for the Nigerian University System. They are in three categories based on the sources of courses involved:

Category A: Course codes for courses offered in programmes outside the Basic Medical Sciences Discipline

Category B: Course codes for courses offered by programmes within the Basic Medical Sciences Discipline.

Category A:

Programme	**Course Code**
Biochemistry	BCH
Biology	BIO
Computing	COS
Chemistry	CHM
Mathematics	MTH
Physics	PHY

Category B:

Programme	**Course Code**
Human Anatomy	ANA
Physiology	PIO

Preamble

The Core Curriculum and Minimum Academic Standards (CCMAS) are designed for the education and training of undergraduate students wishing to obtain first degrees in the different areas of Basic Medical Sciences in Nigerian University System. Presented in this section are the basic operational elements that serve to define the minimum academic standards required to achieve the cardinal goal of producing graduates in Basic Medical Sciences with sufficient academic background to face the challenges of a developing economy in an increasingly globalized economy.

It is pertinent to note that this CCMAS document is expected to guide institutions in the design of curricula for their Basic Medical Sciences programmes by stipulating the minimum requirements. Being such, institutions are encouraged to take due cognizance of the CCMAS while bringing necessary innovation to the content and delivery of their programmes towards achieving the overall goal of Basic Medical Sciences education and training in the country.

Programmes and Degrees

The list of programmes and degrees covered in this current CCMAS document is shown in Table 1.1

Table 1.1 List of Programme(s) and Degree(s)

S/N	Programmes	Degree(s) in View
1	Human Anatomy	B.Sc.
2	Physiology	B.Sc.

Philosophy of the Discipline

The training towards the degrees in Basic Medical Sciences are geared to respond to the recognition of life as a bio-psycho-socio-cultural entity in which continuous and rapid changes are the norm. They are designed to provide the graduates with a fundamental body of knowledge to make them sufficiently versatile to understand these changes and contribute meaningfully to the health sciences knowledge industry.

Objectives of the Discipline

The discipline is designed to contribute to the health and socioeconomic well-being of the nation through the following objectives:

1. prepare students with sufficient theoretical scientific knowledge base and practical skills that enable them assume professional positions.
2. develop students in the relevant practical and technological competence in practice at primary, secondary and tertiary levels of health care.
3. assist students in the development of interpersonal skills necessary to function as members of the health team.

Admission Requirements

There are two different pathways by which candidates can be admitted into the programmes in the discipline: the Unified Tertiary Matriculation (UTME) for a four-year degree programme and the Direct Entry.

Four Year Degree Programme
The minimum academic requirement is credit level passes in five subjects at Senior Secondary Certificate (SSC) including English Language, Mathematics, Physics, Chemistry and Biology at not more than two (2) sittings in addition to the UTME requirements.

Direct Entry
Candidate seeking admission through this mode should in addition to the UTME requirements possess either:

1. Credit pass in Physics, Chemistry and Biology or Zoology at the Higher School Certificates or Advanced Level of General Certificate Examination or its equivalent; OR
2. An acceptable First Degree in relevant Biological Sciences Discipline.

Duration of the Programmes
For candidates admitted through the UTME mode, the duration of programmes under the discipline is a minimum of 4 and a maximum of 6 academic sessions based on the specification of each programme. For candidates admitted through Direct entry the duration of the programmes is a minimum of 3 and a maximum 5 academic sessions based on the specification of the programme.

Course System
Credits are weights attached to a course. One credit is equivalent to one 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 should be understood to mean a quantitative system of organization of the curriculum in which subject areas are broken down into unit courses which are examinable and for which students earn credit(s) if passed. The courses are arranged in progressive order of 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. HIS 105, ZOO 203, ARCH 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 one hour of lecture or one hour of tutorial per week per semester. For other forms of teaching requiring student teacher contact, the following equivalents may apply: two hours of seminar, three 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 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. 2 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.

Table 1:3 Calculation of GPA or CGPA

Course	Units	Grade Point	Units x Grade Point (UGP)
C_1	U_1	GP_1	U_1 x GP_1
C_2	U_2	GP_2	U_2 x GP_2
-	-	-	-
-	-	-	-
C_i	U_i	GP_i	U_i x GP_i
-	-	-	-
-	-	-	-
C_N	U_N	GP_N	U_N x GP_N
TOTAL	**TNU**		**TUGP**

$$TNU = \sum_{i=1}^{N} U_i \qquad TUGP = \sum_{i=1}^{N} U_i * GP_i \qquad CGPA = \frac{TUGP}{TNU}$$

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) and Third Class Honours (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
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.
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 given 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:

1. Continuous Assessment
2. Examinations

Continuous Assessment
Continuous assessment shall be done through essays and tests. Scores from continuous assessment shall normally constitute 30-40 per cent of the full marks for courses which are primarily theoretical.

Examinations
In addition to continuous assessment, final examinations should normally be given for every course at the end of each semester. All courses shall be graded out of a maximum of 100 marks comprising:
Final Examination: 60% - 70%

Continuous assessment (Quizzes, Homework, Tests and Practical): 30% - 40%

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 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.

B.Sc. Human Anatomy

Overview
Human Anatomy is the study of the structures of the human body and it is one of the cornerstones of medical education. Knowledge of the structure of the human body from what can be seen with the unaided eye (gross anatomy) down to the molecular level is fundamental to understanding bodily function and how both structure and function are modified by disease. An understanding of anatomy is therefore key to the practice of medicine.

The B.Sc. Human Anatomy Core Curriculum and Minimum Academic Standards (CCMAS) is the new curriculum approved by the National Universities Commission (NUC) for use in all Nigerian universities after an extensive review of the former B.Sc. Anatomy Benchmark Minimum Academic Standards (BMAS). The B.Sc. Human Anatomy programme is one of the Basic Medical Sciences programmes tailored to equip the graduates with the knowledge and skills to function effectively in the 21st century as a member of the healthcare team, researcher, academics or become self-employed. The B.Sc. programme runs for three or four sessions depending on the mode of entry. The structure of the B.Sc. programme is composed of didactic lectures, whole body dissection (in small groups), practical training skills, group work, tutorials, industrial attachment in a health-related facility, entrepreneurship training and a final year research project on a health-related issue.

Philosophy
The philosophy of the programme is borne out of the need to provide knowledgeable and efficient personnel who should possess the right type of knowledge and skills in human anatomy necessary for the training of health personnel in the various fields of health sciences, research, complement ancillary laboratory medical services and develop entrepreneurial expertise in related disciplines.

Objectives
The programme will be sufficiently broad-based to lead to the production of graduates who will be able to perform the following functions:

1. teach Human Anatomy courses to B.Sc. Human Anatomy, Medical, Dental, Nutrition, Nursing, Physiotherapy, Pharmacy, Medical Laboratory Sciences students and those of other related disciplines;
2. acquire competence in the use of basic laboratory equipment;
3. to be able to use manual dexterity in palpating the surface anatomy of the normal living subject, the position, extent and functional integrity of organs and systems;
4. identify the position of normal anatomic structures in radiographs, contrast studies, air studies, angiograms and osteology materials; and
5. promote anatomy as a subject through research that will lead to the acquisition of higher qualifications (M.Sc. and Ph.D.).

Employability skills
1. **Analytical skills**
   Students have to analyse their quantitative data using appropriate statistical tests. They also have to consider the best way to present that data verbally, through prose and in graphic form.
2. **Group/team work**
   Students should work in small groups to answer scientific questions through dissection, analysis of CT images, histological slides, collecting and analysing morphometric data, etc.

3. **Innovation/creativity**
   Students are given a project outline. After that it is up to them to come up with scientific questions and devise ways to answer them through research.
4. **Leadership**
   The mini-projects are intended to be collaborative efforts for groups of two to four students. Nevertheless, some students may embrace a leadership role while undertaking them.
5. **Project management**
   Students should evolve research questions and manage time, direction and methodology appropriately to answer the questions during the mini-projects.
6. **Oral communication**
   Students should be able to communicate scientific research questions, experimental designs and research findings.
7. **Problem solving**
   Students have to ask scientific questions and work out how to collect repeatable data to answer them, how to test the data, how best to analyse the, and how to interpret their findings.
8. **Research**
   Students should carry out mini-projects which allow them to come up with and test scientific questions using methodologies appropriate to anatomical research including dissection, landmark analyses, etc.
9. **Written communication**
   They should be able to communicate scientific research, questions, experimental designs and research findings.
10. **Others**
    They should be capable of carrying out blunt and sharp dissection; perform morphometric analyses; interpret CT scans; investigate pathologies using histology; develop an understanding of ergonomics; and answer evolutionary questions using anatomical data.

21st Century Skills

1. Critical thinking, problem solving, reasoning, analysis, interpretation, synthesizing information.
2. Research skills and practices, interrogative questioning.
3. Creativity, artistry, curiosity, imagination, innovation, personal expression.
4. Perseverance, self-direction, planning, self-discipline, adaptability, initiative.
5. Oral and written communication, public speaking and presenting, listening.
6. Leadership, teamwork, collaboration, cooperation, facility in using virtual workspaces.
7. Information and communication technology (ICT) literacy, media and internet literacy, data interpretation and analysis, computer programming.

Unique features of the programme

There are certain features which are unique to the revised programme.

1. The course contains strong practical elements, to be delivered in each semester throughout the years of training, which will enable the students to develop basic experimental and data analysis skills.
2. Teaching and learning will be delivered using a variety of methods. A typical week will comprise of interactive / active learning lectures, tutorial sessions, laboratory classes, independent or self-directed study, etc.
3. At the 300 level, the Research Methodology module (semester 1) will enable students to develop experimental skills, which are closely aligned to the degree programme, as well

as provide an opportunity for them to learn key experimental skills and design and analyse simple experiments relevant to the degree.
4. The course can be assessed by a variety of methods, each appropriate and tailored to the topic being assessed. These methods include coursework exercises, written examinations, oral examinations, presentations and practical demonstrations. Students will also have more opportunities for self-assessment using tutorial exercises.
5. The number of General Studies courses have been drastically reduced to create room for more core Anatomy courses.
6. Each course is preceded by a set of learning outcomes appropriate for the course.

Admission requirements

Admission into the B.Sc. Human Anatomy degree programme is open to Nigerian and foreign candidates. There are two modes by which candidates can be admitted into the programme, which are the Unified Tertiary Matriculation Examination (UTME) and Direct Entry.

Four Year Degree Programme

In addition to the UTME requirements, candidates seeking admission into the Human Anatomy degree programme must possess a minimum of five credit passes in Senior Secondary Certificate (SSC) to include English Language, Mathematics, Physics, Chemistry and Biology at not more than two (2) sittings.

Direct Entry

Admission through Direct Entry is into 200 level of the programme. Candidates seeking admission through this mode should, in addition to the UTME requirement possess either:
1. Credit passes in Physics, Chemistry and Biology or Zoology at the Advance Level of the Cambridge Advance Level Examination, Interim Joint Matriculation Board Examination (IJMB), the Joint Universities Preliminary Examination Board (JUPEB) and their nationally recognized equivalent examinations, OR
2. An acceptable first degree in relevant biological science disciplines.

Graduation Requirements

The following regulations shall govern the conditions for the award of the B.Sc. (Hon) degree in Human Anatomy.
1. Candidates admitted through the UTME mode shall have registered for a minimum of 120 units.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 90 units of courses during a 3– year degree programme.

A student shall qualify for the award of a degree when the student has completed and passed all the courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the University but not less than 1.00 and earned the minimum credit units of not less than 120 for those that entered through UTME and 90 through Direct Entry.

Duration of the Programme

For candidates admitted through the UTME mode, the duration of the programme is a minimum of 4 and a maximum of 6 academic sessions. For candidates admitted through Direct entry the duration of the programme is a minimum of 3 and a maximum of 5 academic sessions.

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	-
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
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 (Mechanics)	2	C	30	-
PHY 102	General Physics II (Electricity and Magnetism)	2	C	30	-
PHY 107	General Physics Practical I	1	C	-	45
PHY 108	General Physics Practical II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
COS 101	Introduction to Computing Sciences	3	C	30	45
	Total	**26**			

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
ANA 201	Anatomy of Upper & Lower Limbs	3	C	30	45
ANA 202	Histology of Basic Tissues	1	C	-	45
ANA 203	General and Systemic Embryology	2	C	30	-
ANA 204	Anatomy of Thorax, Abdomen, Pelvis & Perineum	3	C	30	45

PIO 201	Introduction to Physiology and Blood	2	C	30	-
PIO 218	Introduction to Laboratory Physiology I	1	C	-	45
BCH 201	General Biochemistry I	2	C	30	-
BCH 203	General Biochemistry Practical I	1	C	-	45
BCH 202	General Biochemistry II	2	C	30	-
BIO 208	Biostatistics	2	C	30	-
	Total	**23**			

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
ANA 301	Gross Anatomy of Head & Neck	3	C	30	45
ANA 302	Neuroanatomy	2	C	30	
ANA 312	Radiological Anatomy and Techniques	1	C	-	45
ANA 322	Histochemistry	2	C	-	90
ANA 341	Human Genetics	2	C	30	-
ANA 351	Laboratory Techniques for Light Microscope	1	C	-	45
ANA 352	Research Methodology	2	C	30	-
ANA 399	Students industrial work experience	2	C	-	90
ANA 307	Anatomy Entrepreneurship	2	C	30	-
	Total	**21**			

400 level

Course Code	Course Title	Unit(s)	Status	LH	PH
ANA 411	Surface and Living Anatomy	2	C	15	45
ANA 412	Electron Microscopic Technique and Ultra-structure	2	C	30	-
ANA 421	Anatomical and Museum Techniques	1	C	-	45
ANA 422	Seminar	1	C	15	-
ANA 432	Laboratory Work Experience	1	C	-	45
ANA 441	Skeletal Biology and Anthropology	1	C		45
ANA 499	Final Year Project	6	C	-	270
	Total	**14**			

Course Contents and Learning Outcomes

100 Level

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

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

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, letters, curriculum vitae, report writing, note making, etc. 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 and report writing.

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

Learning Outcomes

At the end of the course, students should be able to:

1. analyse the historical foundation of the Nigerian culture and arts in pre-colonial times;
2. list and identify the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political unit;
4. analyse the concepts of trade, economic and self-reliance status of the Nigerian peoples towards national development;
5. enumerate the challenges of the Nigerian state towards nation building;
6. analyse the role of the judiciary in upholding people's fundamental rights;
7. identify acceptable norms and values of the major ethnic groups in Nigeria; and
8. list and suggest possible solutions to identifiable Nigerian environmental, moral and value problems.

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 the 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 Nigerian 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 Nigerian 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 – Reconciliation, Reconstruction and Rehabilitation; 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.

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

Learning Outcomes

At the end of lectures, students should be able to:

1. explain cell structure and organizations;
2. summarize functions of cellular organelles;
3. characterize living organisms and state their general reproduction;
4. describe the interrelationship that exists between organisms;
5. discuss the concept of heredity and evolution; and
6. enumerate habitat types and their characteristics.

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 (2 Units C: LH 30)

Learning Outcomes

At the end of the lectures in, students should be able to;

1. list the characteristics, methods of identification and classification of viruses, bacteria and fungi;
2. state the unique characteristics of plant and animal kingdoms;
3. describe ecological adaptations in the plant and animal kingdoms;
4. explain nutrition, respiration, excretion and reproduction in plants and animals; and
5. describe growth and development in plants and animals.

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)

Learning Outcomes

At the end of the lectures in, students should be able to:

1. outline common laboratory hazards;
2. provide precautions on laboratory hazards;
3. state the functions of the different parts of microscope;
4. use the microscope and describe its maintenance;
5. draw biological diagrams and illustrations; and
6. apply scaling and proportion to biological diagrams.

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.

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

Learning Outcomes

At the end of this course, the students should be able to:

1. define atom, molecules and chemical reactions;
2. discuss the Modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. justify the trends of atomic radii, ionization energies, electronegativity of the elements based on their position in the periodic table;
5. identify and balance oxidation – reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridized orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;

8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

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)

Learning Outcomes
At the end of this course, the students should be able to:
1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

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)

Learning Outcomes
At the end of the course students should be able to:
1. describe the general laboratory rules and safety procedures;
2. collect scientific data and correctly carrying out Chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. tell the differences between primary and secondary standards;
5. perform redox titration;

6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

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)

Learning Outcomes

At the end of this course, the students should be able to:
1. identify the general laboratory rules and safety procedures;
2. collect scientific data and correctly carrying out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which includes ignition, boiling point, melting point, test on known and unknown organic compounds;
5. execute solubility tests on known and unknown organic compounds;
6. execute elemental tests on known and unknown compounds; and
7. conduct functional group/confirmatory test on known and unknown compounds which could be acidic / basic / neutral organic compounds.

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)

Learning Outcomes
On completion, student should be able to:
1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

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)

Learning outcomes
At the end of the course, students should be able to:

1. describe the electric field and potential, and related concepts, for stationary charges;
2. calculate electrostatic properties of simple charge distributions using Coulomb's law, Gauss's law, and electric potential;
3. describe and determine the magnetic field for steady and moving charges;
4. determine the magnetic properties of simple current distributions using Biot-Savart and Ampere's law;
5. describe electromagnetic induction and related concepts and make calculations using Faraday and Lenz's laws;
6. explain the basic physical of Maxwell's equations in integral form;
7. evaluate DC circuits to determine the electrical parameters; and
8. determine the characteristics of AC voltages and currents in resistors, capacitors, and Inductors.

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)

Learning outcomes
At the end of the course, students should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course contents
This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. 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 (1 Unit C: PH 45)

Learning Outcomes
At the end of the course, students should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

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.

MTH 101: Elementary Mathematics (2 Units C: LH 30)

Learning outcomes
At the end of the course students should be able to:

1. explain basic the definition of set, subset, union, intersection, complements and use of venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

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.

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

Learning outcomes
At the end of the course, students should be able to:
1. explain basic components of computers and other computing devices;
2. describe the various applications of computers;
3. explain information processing and its roles in the society;
4. describe the Internet, its various applications and its impact;
5. explain the different areas of the computing discipline and its specializations; and
6. demonstrate practical skills on using computers and the internet.

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 smartboards. Practical demonstration of the Internet and its various applications. Illustration of browsers and search engines. How to access online resources.

200 Level

Courses to be taught at this level should include Basic Medical Sciences courses in Anatomy, Physiology and Biochemistry, as well as GST and Entrepreneurship.

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

Learning Outcomes

A student who has successfully gone through this course should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically assess the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

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.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation, and risk taking
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment, and financial independence
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;

6. describe stages in enterprise formation, partnership and networking including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

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 (biograpies 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.

ANA 201: Anatomy of Upper/Lower Limbs (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. define fundamental anatomical terminology and discuss the anatomical position;
2. describe the anatomy of the musculoskeletal system, including the axial skeleton; appendicular skeleton, appendicular and axial muscles, and arthrology;
3. describe the general features of the bones of the upper and lower limbs;
4. identify the major muscles of the upper and lower limbs;
5. explain the types and structure of the joints of the upper and lower limbs;
6. correlate between the attachment of the muscles and their functions on the different joints;
7. identify the major nerves of the upper and lower limbs;
8. describe the functional components of each of the major nerves and its distribution;
9. identify and describe the course of the major superficial veins of the upper and lower limbs; and
10. name the major arteries of the upper and lower limbs.

Course Contents

Descriptive terms, plans and terms of relationship of the human body, terms of comparison, attachment of muscles, types of muscles, movements of joints. Osteology, principles of kinesiology, general organization of body system. Cutaneous innervation of the upper limb; pectoral region; breast; axilla; shoulder region; arm and cubital fossa; flexor compartment of forearm; extensor compartment of forearm; hand; venous and lymphatic drainage of the upper limb. Applied anatomy of nerves; blood supply of the upper limb. Cutaneous innervation of the lower limb; femoral triangle; adductor canal and medial side of the thigh; gluteal region; back of the thigh, popliteal fossa; extensor compartment of the leg and dorsum of the foot; peroneal and flexor compartment of the leg; sole of the foot, arches of the foot; mechanism of walking; venous and lymphatic drainage of the lower limb; applied anatomy of the nerves and blood supply to the lower limb.

ANA 202: Histology of Basic Tissues (1 Unit C: LH 15)

Learning Outcomes
At the end of the course, students should be able to:

1. name common current histological techniques;
2. enumerate the principles, techniques and functional applications of Histology;
3. define and explain the cell in relation to its environment, surface components and content;
4. understand the interrelationship and interdependency between cell structures and functions; and
5. identify the microscopic appearance of tissues such as muscle, cartilage, etc in relation to their staining**.**

Course Contents
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 hybridization 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.

ANA 203: General and Systemic Embryology (2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. explain how the embryo forms from the zygote;
2. discuss the role of cleavage and gastrulation in animal development;
3. demonstrate; understanding of embryology and significance of prenatal diagnostic methods;
4. describe structural features of primordia in tissue and organs at different developmental stages;
5. define risk periods in histo- and organogenesis; and
6. analyse the most often observed developmental anomalies.

Course Contents
Spermatogenesis, oogenesis; ovarian follicles; ovulation; corpus luteum; menstruation; uterine cycle; hormonal control of uterine cycle; fertilization; cleavage; implantation; reproductive technologies-IVF/surrogacy/embryo transfer; embryo manipulation & potency/twinning; molecular embryology and transgenesis; gastrulation; notochord, neurulation; derivatives of the germ layers; folding of the embryo; fetal membranes; placenta; development of limbs and teratology. Growth and perinatology; congenital malformations – general introduction. The cardiovascular system, skin, structure of the nails and hair. Macrophagic system; cellular immunology; lymphoid organs; glands – endocrine and exocrine. Respiratory system. Digestive system. Urinary and genital systems. Electron micrograph studies of each organ.

ANA 204: Anatomy of Thorax, Abdomen, Pelvis & Perineum (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. identify the bones and bony markings of the thorax, abdomen, pelvis and perineum;
2. list the nine regions and four quadrants and the principal organs and structures that lie deep to them and which can be palpated in those regions;
3. describe the muscular components of the anterior abdominal wall, blood supply and innervation of the anterior abdominal wall;
4. identify the arteries, veins and lymphatics of the thorax, abdomen, pelvis and perineum; be able to list the main branches of the aorta and their territories; and describe the disposition of the main veins in the abdomen;
5. describe the parts, position, vertebral levels and surface markings of the stomach and duodenum as well as the position, vertebral levels and surface markings of the pancreas, spleen, liver and gall bladder;
6. describe the greater and lesser omenta and the lesser sac;
7. describe the disposition of the jejunum and ileum; describe the surface anatomy of the caecum, ascending colon, transverse colon, descending colon and sigmoid colon;
8. describe the anatomy of the pelvic diaphragm, its midline raphe, perineal body, attachment points and the structures passing through it in males and females;
9. describe the anatomy of the ischio-anal fossa;
10. describe the anatomy and relations of the ovary, uterine tubes, uterus, cervix and vagina, including their peritoneal coverings;
11. describe the anatomy and neurovascular supply of the clitoris, vulva and vagina; the anatomy of the urogenital diaphragm and perineal 'pouches';
12. describe the origin, course and distribution of the pudendal nerves and the sites of pudendal nerve block;
13. describe the lymphatic drainage of the foregut, pelvic and perineal organs;

Course Contents

Introduction to the trunk; thoracic cage; intercostal space; thoracic cavity; pleural cavities; lungs; mediastinum general; anterior & superior mediastinum; middle; mediastinum – heart and pericardium; heart – applied anatomy; posterior mediastinum. General anatomy of abdomen and abdominal regions; anterior abdominal wall muscles; inguinal canal – inguinal and femoral hernias; peritoneal cavity and spaces; abdominal oesophagus, stomach, duodenum, spleen, small intestine, large intestine, appendix; portal venous system; portocaval anastomoses; liver and gallbladder. Pancreas and biliary apparatus; kidneys, suprarenal glands, and ureters; diaphragm; posterior abdominal wall; aorta and inferior vena cava; posterior abdominal wall muscles; lumbosacral plexus; bony and ligamentous pelvis; pelvic diaphragm (floor); male reproductive organs; female reproductive organs; male and female external genitalia; perineum; rectum and anal canal; pelvic blood vessels; abdomino-pelvic nervous system.

PIO 201: Introduction to Physiology and Blood (2 Units C: LH 30)

Learning Outcomes

On completion of this course, students should be able to;

1. describe the composition of a cell membrane;
2. explain how a potential difference across a membrane will influence the distribution of a cation and an anion;

3. describe how transport rates of certain molecules and ions are accelerated by specific membrane transport proteins;
4. distinguish between active (primary and secondary) transport, facilitated diffusion, and passive diffusion based on energy source and carrier protein involvement;
5. identify the mechanisms and role of selective transporters for amino acids, neurotransmitters, nutrients, etc;
6. understand the general concepts of homeostasis and the principles of positive and negative feedback in physiological systems;
7. identify the site of erythropoietin production, the stimulus for its release, and the target tissue for erythropoietin action;
8. discuss the normal balance of red blood cell synthesis and destruction, including how imbalances in each lead to anemia or polycythemia;
9. list and differentiate the various types of leukocytes;
10. describe the role of thrombocytes in haemostasis; and
11. list clotting factors and the discuss the mechanism of anti-coagulants.

Course Contents

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.

PIO 218: Introduction to Laboratory Physiology I (1 Unit C: PH 45)

Learning Outcomes

On completion of this course, students should be able to;

1. acquaint themselves with the proper handling of laboratory equipment;
2. dissect laboratory animals and mount isolated organs for a specific experiment;
3. use human subjects for some of the experiments like blood grouping, etc; and
4. take recordings of an experiment and interpret the results accordingly.

Course Contents

Laboratory sessions on basic physiology experiments, especially those related to the frog sciatic nerve, smooth muscles and blood physiology.

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

Learning Outcomes

At the end of the course, students should be able to:

1. explain the structure of different macromolecules in biological system;
2. identify types of chemical reactions involving these macromolecules;
3. explain the various methods of isolation of these macromolecules;
4. estimate the effects of acids and alkalis on the macromolecules;
5. describe how to purify the macromolecules; and
6. discuss quantification of the various macromolecules.

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)

Learning Outcomes
At the end of the course, students will be able to:
1. explain the structure of the cell including its components;
2. discuss the interrelationship between different organelles of the cell;
3. recognize the differences between plant and animal cells;
4. isolate the various organelles of both plant and animal cells; and
5. describe the influence of hydrogen ion concentration on cellular function.

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 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 I (1 Unit C: PH 45)

Learning Outcomes
At the end of the course, students will be able to understand the various laboratory procedures used in the study of various biochemical processes described in BCH 201 and 202.

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

BIO 208: Biostatistics (2 Units C: LH 30)

Learning Outcomes
At the end of the lectures in this course, students should be able to:
1. differentiate between continuous and discontinuous data;
2. explain sampling procedures in biology;
3. summarize and present biological data;
4. describe measures of central tendency and probability theory; and
5. conduct ANOVA, Chi-square, t-tests and F-tests and state their importance.

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.

300 Level
Courses to be taught at this level should include: Neuroembryology, Neuroanatomy, Neurohistology, Histochemistry, Human genetics, light microscopic techniques, Biostatistics and Entrepreneurship.

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

Learning Outcomes
At the end of the course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

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/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 Nigerian 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)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors regardless of geographical location;
3. state how original products, ideas, and concepts are developed;
4. develop business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. Implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market. 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 and 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).

ANA 301: Gross Anatomy of Head & Neck (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. recognize anatomical structures correctly and comprehend the topographic anatomy of the head and neck region;
2. identify major musculoskeletal elements of the skull, face, ear, nasal cavity, pharynx, larynx, oral cavity, and cervical and thoracic regions;
3. identify the major blood vessels which supply the features of the head and neck; and
4. describe in particular the course and distribution of the facial and trigeminal cranial nerves.

Course Contents

Cervical vertebrae, bones of the skull; interior of the cranium mandible; scalp temple and face I; scalp temple and face II; side of the neck-posterior triangle; anterior triangle of neck; cranial cavity, deep dissection of neck including thyroid and parathyroid glands; deep dissection of blood vessels & nerves of neck paravertebral region. Orbit and lachrymal apparatus; side of

neck/posterior triangle; anterior triangle of the neck; parotid, temporal & infratemporal regions; submandibular region; mouth, pharynx and soft palate; nasal cavity/paranasal sinuses; larynx/tongue/eyeball; external, middle and internal ear.

ANA 301: Neuroanatomy (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. describe the anatomy of the central and peripheral nervous systems;
2. gain an overview of the topography and structural organization of the brain and spinal cord;
3. describe the basic features of development of the nervous system and to understand how and why common malformations occur in the nervous system;
4. describe the structure and function of the brain, spinal cord, neural pathways and cranial nerves;
5. explain the ultrastructure of neurons and glia and the major cytoarchitectural features of the brain and spinal cord;
6. describe the blood supply and venous drainage of the nervous system
7. identify the major features of the brain and spinal cord using prosected specimens, models and cross-sectional images; and
8. describe the structural and functional relationships between these structures and to apply this knowledge to further research and clinical studies.

Course Contents

Neuroembryology; introduction to the central nervous system; spinal cord morphology; spinal cord-tracts; lower medulla-pyramids; decussation, tubercles; upper medulla-olive, pons-basis pontis and middle cerebellar penduncle; pons tegmentum; midbrain-tectum; midbrain-tegmentum; cerebellum; diencephalon-thalamus; diencephalon-hyphothalamus; epithalamus, subthalamus; ascending pathways and descending pathways, ventricles; pyramidal system; cerebral hemispheres, sulci and gyri, internal structure of cerebrum, basal ganglia; cortex-cytoarchitectonics, brodman areas, limbic system blood supply to the brain and spinal sord; meninges, venous sinuses, hypophysis cerebri, cranial nerves; autonomic nervous system; Applied Anatomy.

ANA 312: Radiological Anatomy and Techniques (1 Unit C: PH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. identify the anatomy of the skeleton and body systems from planar and cross-sectional radiographic images;
2. describe the radiographic appearance, location, vertebral levels and anatomical relationships of major organs, vessels and structures;
3. identify anatomical positions;
4. identify basic planes and their relations with each other;
5. recall various important anatomical terminologies; and
6. describe different radiographic positions.

Course Contents

Basic principles of radiological imaging of human tissue, radiological identification of major body structures, introduction to modern imaging techniques, precautionary measures.
Anatomical position: viewing radiograph, sagittal, coronal, axial, anterior, posterior, dorsal, ventral, supine, prone, erect, medial, lateral, superior, inferior, cranial, caudal, flexion,

extension, abduction, adduction, circumduction, rotation, proximal, distal, oblique, decubitus, superficial, deep, palmar, plantar, inversion, eversion. apical, foramen, condyle, fossa, process and other important cross sectional anatomical terminology. Posteroanterior, anteroposterior, RAO, LAO, RPO, LPO, dorsal decubitus, ventral decubitus, lateral decubitus. OF, OM.

ANA 322: Histochemistry (2 Units C: PH 90)

Learning Outcomes

The students should, at the end of the course, be able to:

1. describe the relationship between the morphology and the chemistry of a cell;
2. explain the methods, principles and techniques used in tissue culture;
3. demonstrate important enzymes presence in the cells and tissues;
4. discuss the activities of enzymes and presence of macromolecules and metabolites in normal cells and tissues;
5. describe the application and validity of histochemical and cytochemical techniques in basic, applied and clinical research;
6. demonstrate the usefulness of histological techniques in the field of cellular biology;
7. demonstrate various types of staining techniques used for culture tissue; and
8. explain the various chemical composition of the tissue using special dye.

Course contents

Principles and techniques of histochemistry, commonly used histochemical techniques and their applications in diagnosis and research, tissue components covered will include nucleic acids, mucins and other carbohydrates, pigments and biogenic amines, lipids, proteins and enzymes the nature of amyloid, the occurrence of amyloid and its demonstration in tissue sections, immunocytochemical techniques, tissue preparation, physical and chemical effects of fixation, limitations of chemical fixation and alternatives to chemical fixation, cryotechniques in histochemistry, embedding techniques, special treatment of mineralised tissue, histological staining structure of dyes, binding of dyes to tissues, mechanisms of selective staining, effects of non-staining components of dye solutions on staining, metachromasia, metallic impregnation techniques, cytological techniques, advantages of exfoliative cytology, methods of cell collection and smear preparation, morphology of cells found in normal smears with emphasis on gynaecological and sputum specimens, changes in smears with age and menstrual cycle.

ANA 341: Human Genetics (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. discuss the different methods available to study genetics;
2. describe genes structure, chromosomes and proteins;
3. describe genes structure, chromosomes and proteins;
4. describe the different methods of genetic testing;
5. demonstrate Knowledge and practical skills of molecular genetic analysis of genetic diseases;
6. construction of pedigrees and analysis of pattern of inheritance in the families;
7. performing of polymerase chain reaction, cloning and transformation;
8. explain the chromosome structure of human and structural mutation of chromosome, categorize human chromosomes and relate chromosome mutations and genetic diseases;
9. explain the organization of the DNA in human genome; and
10. illustrate autosomal and gonosomal genetic diseases.

Course Contents
Fundamental human genetic principles and variation in gene expression in man, classical and molecular genetics including Mendelian inheritance, linkage, nucleic acids, gene expression, recombinant DNA, genomics, immunogenetics, and regulation: patterns of inheritances in families (autosomal dominant, autosomal recessive, X-linked dominant, X-linked recessive, Y-linked and sex influenced), cytogenetics, types and classification of human chromosomes, methods of preparation of human chromosomes and karyotyping, types of numerical and structural chromosome aberrations and their causes, gene hybridization, human genomic studies.

ANA 351: Laboratory Techniques for Light Microscopy (1 Unit C: PH 45)

Learning Outcomes
At the end of the course, students should be able to:
1. discuss the basic principles and practical aspects of light microscopy;
2. demonstrate the use of the microscope with artificial or natural light;
3. explain the need for sample preparation and be able to mount and stain a specimen on a slide and prepare it for microscope viewing;
4. identify parts of a compound microscope and operate it effectively;
5. compare the terms magnification, contrast, and resolution;
6. make proper biological drawings of both and an animal and plant cell;
7. outline the processes involved in the preparation of tissue sections and explain the purpose of each of these processes;
8. review the principles of light microscopy and identify the major parts of the microscope; and
9. use the microscope to view slides of several different cell types, including the use of the oil immersion objective lens.

Course Contents
History of microscopy, composition of the microscope, contrast and resolution concepts, the practical step by step method of tissue processing for light microscope study shall be taught and demonstrated, transmitted light microscopy: brightfield, phase contrast, dark field, DIC and polarization microscopy, koller illumination, image acquisition, digital image acquisition, cameras, binning gain, principles of fluorescence microscopy, emission and excitation spectrum, stokes shift, basic techniques of optics, light & fluoresence microscopy - fluorescence filter cubes acquisition of simple and complex images, principles of confocal microscopy, the principles and techniques for the use of advance light microscopes will be taught and where possible demonstrated i.e. polarizing microscope, phase contrast microscope, interference microscope, dark-field Microscope, and Ultraviolet Microscope. Spectral microscope/spectral unmixing Sample preparation for microscopy: fixation, permeabilization, reducing auto fluorescence, making samples transparent, image processing.

ANA 352: Research Methodology (2 Units C: LH 30)

Learning Outcomes
On completion of this course, the students should be able to:

1. state the basic concepts of research and its methodologies;
2. describe theories and methods in ethics and research ethics;
3. apply theories and methods in ethics and research ethics;

4. enumerate important issues in research ethics, including responsibility for research, ethical vetting, and scientific misconduct;
5. describe the different types of research designs;
6. discuss the various types of referencing systems;
7. identify the various sources of information for Literature review;
8. enumerate the different sampling methods with their merits and demerits;
9. compare and contrast between parametric and non-parametric statistics;
10. identify the regulatory bodies for research ethics and their mandates;
11. list the fundamentals of research ethics;
12. discuss the use of computer packages in research;

Course Contents
Introduction to biomedical research, definitions, types of research designs, preparatory stages: literature review, identification of research gaps and referencing styles, protocol development, sampling and sampling techniques, questionnaire design and validation, methods for acquisition of data, data analysis and presentation, basics of data processing, report/manuscript presentation, human and animal ethical issues: ethics in biomedical research, use of computer packages in research and presentations.

ANA 399: Students' Industrial Work Experience (SIWES) (2 Units C: PH 90)

Learning Outcomes
At the end of the course, students should be able to:
1. exhibit basic practical knowledge of the anatomy course;
2. describe the skills acquired during industrial attachment; and
3. list the entrepreneurial potentials of the skills acquired.

Course Contents
Students will be posted to recognized and relevant placement areas of their choice during the industrial training. The twelve weeks will be spent in laboratories offering exposure to skills relevant to human cell and structural biology. Continuous assessment of students will be undertaken jointly by their industrial-based supervisors, ITF officials and institutional supervisors. Finally, students on returning to the institution will present a seminar on major duties performed and skills acquired during the training. Grades are allotted according to ITF directives.

ANA 307: Anatomy Entrepreneurship (2 Units C: LH 30)

Learning Outcomes
At the completion of this course, students should be able to:
1. combine science with business skills, which is a key driver of employability;
2. combine entrepreneurship and/or anatomical skills in a range of ways including innovation work, biotech and marketing;
3. display a distinct advantage in the growing field of bioscience research collaborations;
4. identify a wide range of sectors, including jobs as researchers and business leaders in academia and industry, as well as into lab-based careers;
5. offer a range of services with focus primarily on health promotion, management consultancies and educators

Course Contents
The course exposes students to basic definitions, objectives, theories and practices, market surveys and business plans, exploration of opportunities and possibilities, as well as financing a business. Introduction to business, enterprise and entrepreneurial skills in anatomy. Attitudes and characteristics of Medical Entrepreneurs. Models of entrepreneurship and enterprise activity. Principles of business innovation. Getting Started - financing the start-up of business. Marketing: public relations and advertising. Insurance coverage, licenses and permits. Consultancy services – an option for the self-employed entrepreneur. Ethical issues associated with business enterprise.

400 Level
Courses to be taught at this level should include surface and living anatomy, anatomical and museum techniques, electron microscopy, skeletal biology and anthropology, biometry and human growth. Students are to do a research project.

ANA 411: Surface and Living Anatomy (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of the course, students should be able to:
1. comprehend and demonstrate surface and living anatomy of the human body;
2. describe all movements available at all joints;
3. describe sensations, integumentary condition, muscle mass, limb length, and limb girth;
4. describe and analyse human movement using a range of models;
5. identify, joints, ligaments and muscles (with their neural supply) and describe how they contribution to movement, stability and posture and gait;
6. describe the basic mechanical principles that underpin human motor skills and posture; and
7. interpret data gathered on the sensation, integumentary condition, muscle mass, limb length, and limb girth.

Course Contents
Structural anatomy of bones, joints, and muscle attachments, anatomical terminology used in surface anatomy, an introduction to analysis of human movement. The focus is on functional musculoskeletal anatomy and the physical laws that control motion. The unit focuses both on the application of kinesiology to physical activities of daily living and exercise. Practical cum demonstration exercises to map out surface representations of major internal organs of the body. Recognition and demonstration of major visible anatomical features of the living human subject.

ANA 412: Electron Microscopic Technique and Ultrastructure (2 Units C: LH 30)

Learning Outcomes
After the course, the student should:
1. demonstrate familiarity with the physical and technical principles of electron microscopes;
2. describe the basic methods used for sample preparation in electron microscopy;
3. explain how molecules can be localized in biological samples using antibodies and other probes;
4. explain how electron microscopes can be used to acquire three-dimensional images of biological samples;

5. discuss the basics on how electron microscopy can be applied in structural biology, element analysis, and characterization of materials;
6. demonstrate experience in using electron microscopes and in image interpretation; and
7. discuss examples on how electron microscopy has been applied in research.

Course Contents
Specimen preparation methods: tissue sample acquisition techniques, tissue processing and examination, physical and technical principles of different electron microscopes, localization of molecules by immunoelectron microscopy, special techniques for localization of molecules in electron microscopy, occupational safety in electron microscopy laboratory work, localization of elements by electron microscopy, electron tomography, correlative light and electron microscopy, image processing and interpretation, Cryo electron microscopy, techniques for material characterization by electron microscopy, demonstrations on transmission and scanning electron microscopy of biological samples, examples of application of electron microscopy in biomedical research. The practical aspects shall be demonstrated.

ANA 421: Anatomical and Museum Techniques (1 Unit C: PH 45)

Learning Outcomes
At the end of the course, students should be able to:
1. recognize the purpose and ethics of embalming;
2. summarize the technical steps taken in embalming;
3. outline the various embalming methods;
4. discuss the use of the different embalming fluids;
5. describe the different anatomical and museum techniques used preparing specimens for study and other purposes; and
6. demonstrate ability to carry out embalming.

Course Contents
Techniques for the preservation of gross anatomical tissues for teaching and research. These will include embalming and cadaver preservation, wet and dry specimen preparation techniques for the museum set up and maintenance, principles of embalming, museum pot making, principles of plastination, techniques in plastination, and advantages of plastination.

ANA 422: Seminar (1 Unit C: LH 15)

Learning Outcomes
At the end of the course, students should be able to:
1. demonstrate the ability to make oral and written presentations of papers;
2. analyse primary literature including the evaluation of experimental techniques, the use of controls and hypothesis testing by published authors;
3. criticize primary articles both chosen by the instructors and by the students themselves;
4. synthesize professional knowledge, skills, and attitudes; demonstrate entry level competencies for professional employment; and
5. demonstrate skills for lifelong learning.

Course Contents
This course focuses on the synthesis of professional knowledge, skills, and attitudes in preparation for professional employment and lifelong learning.
Topics in areas related to gross anatomy, embryology, histology and histochemistry, molecular biology, skeletal biology and anthropology, human growth, etc. Seminars shall be developed and presented orally.

ANA 432: Laboratory Work Experience (1 Unit C: PH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. experience laboratory organisation;
2. build laboratory work relationship and communication;
3. practice laboratory work simplification techniques;
4. highlight and experience laboratory management process;
5. demonstrate gross and molecular techniques; and
6. acquire trouble-shooting skills which will be stressed in classes and laboratories.

Course Contents

Students shall be attached to relevant diagnostic laboratories and research laboratories to provide opportunities for acquisition of practical on-the-job experience in line with the objectives of entrepreneurial studies. They should be involved in the analysis of vocational education programme, programme planning and implementation.

ANA 441: Skeletal Biology and Anthropology (1 Unit C: PH 45)

Learning Outcomes

On completing the course, students should be able to:

1. demonstrate an understanding of the concept and importance of Anthropometry;
2. demonstrate practical experience in collecting anthropometric data and the applications of anthropometry;
3. discuss the main principles of skeletal biology, including main skeletal tissues, cell types, their origin and development;
4. discuss the human skeletal system, including the nature and function of bone, the identification of bone and bony fragments in an anthropological context, and the interpretation of morphological features of bone for research in biological anthropology and human biology;
5. discuss the identification and analysis of human bone, and an understanding of how these data are utilized to answer significant anthropological research questions;
6. display understanding of the ethical treatment of human remains in light of major moral and legal dilemmas facing the scientific study of humans today;
7. describe an exposure to an anthropological approach to the study of the skeletal structure of humans;
8. demonstrate an evaluation of new research in the field of human skeletal biology; and
9. Demonstrate an understanding of fingerprint techniques and their use in forensic anthropology.

Course Contents

Lectures cum practical study of major features of bones of the human skeleton, a detailed consideration of the basic properties of bone growth, development, and function in the human body, an examination of all major skeletal structures and the morphological features associated with them. The focus will be on the functions of these structures within the body as well as the identification of fragmentary remnants of them in a forensic or archaeological context. Major techniques used in biological anthropology to analyse human bone, such as estimation of age at death, estimation of biological sex and stature. Evaluation of major research studies involving analysis of human bone. Consideration of ethical issues in the collection and curation of human bone. Measurement of bone parameters and their application to human identification. The practical is integrated in the lectures for better understanding of

anthropometry. Dermatoglyphics, fingerprints techniques and their use in forensic anthropology.

ANA 499: Final Year Project (6 Units C: PH 270)

Learning Outcomes
At the end of the course, the students should be able to:

1. demonstrate an ability to work independently or as part of a group/team as required (research group, for example) to address a particular scientific question or topic;
2. search for and critically review the literature in a particular field and relate their own research to that in the existing literature;
3. develop critical and creative thinking skills (develop ideas, data analysis and evaluation skills, be able to form judgements);
4. display experience in the scientific method and develop problem solving skills; for example, how to design experiments or develop strategies to test hypotheses and/or evaluate the output;
5. develop communication skills;
6. write a scientific reviews and project reports (or equivalent);
7. develop oral presentation skills (tutorial talk); and
8. liaise with supervisor, other staff and students, as appropriate.

Course Contents
Introduction to methods and techniques of research. Topics include basic terminology of research, qualitative and quantitative methods, basic research designs, and data analysis techniques. Other topics are problem development, literature review, data analysis techniques and interpretation, institutional review boards, and communicating results. Application of knowledge and skills acquired in research methods, statistics and evaluation in identifying and proffering solutions to problems, working independently under the guidance of a project supervisor.

Students will undertake research projects on simple problems in areas of their interest and guided by their supervisors. In addition to experimental work, students will be required to learn how to search and compile literature review, collect, arrange and present bibliography. Planning and execution of a well-conceptualized research and presenting a written report on the study conducted.

Minimum Academic Standards
Equipment

Histology laboratory

1. Binocular microscope 1 per 3 students
2. Automatic tissue Processor
3. Microtome rotary
4. Epidiascope
5. Slide projectors
6. Fume cupboard
7. Autoclave

8. Bunsen burner & tripod
9. Hot plate stirrer
10. Oven
11. PH meter digital
12. Freezer
13. Plastic slide boxes
14. Water bath
15. Top loading balance (digital)
16. Manesty water distiller
17. Laptop computer

Gross anatomy laboratory

1. Dissection table 1 per 6 students
2. Trolleys
3. Projector
4. Anatomage (Virtual Dissection Table)

Biological and Biomedical equipment for the following techniques

1. Polymerase Chain Reaction
2. DNS Sequencing
3. Immunol florescence microscopy

Museum

1. Articulated skeleton
2. Unarticulated skeleton
3. Embryo (models)
4. Charts (body systems)
5. Soft Brain Neuro-models
6. Wet and dry museum specimens

Autopsy room

1. Immersion Tank
2, Mortuary cabinet
3. Aspirators

Anatomy PG dissection room

E-Classroom

1. Internet server control

2. Computers 1 PC per 2 students

3. Projectors

4. E-learning tools-for online lecture notes, podcasts, and discussion boards

Staffing
Staff of the programme can be categorized into two; academic and non-teaching staff. The non-teaching staff can be further categorized into four: senior technical, senior administrative, technical and non-technical junior staff.

Academic staff
Academic staff requirements are in terms of three criteria: number, structure, and qualifications (appointments and promotions). It is expected that all academic staff should possess PhD degrees. However, the proportion of academic staff with PhD degrees should not be less than 70%.

Staff-student ratio
The approved staff-student ratio for the programme is 1:15.

Staff – mix by rank
Academic staff in the universities are broadly classified into three categories:

professorial (professor/reader) senior lectureship and lecturers grade I and below.

The professorial cadre should constitute a maximum of 20 per cent of the staff strength while the remaining two categories should constitute 35 and 45 per cent respectively.

Academic support personnel
Teaching assistants/demonstrators to help lecturers in the conduct of tutorials, practicals and fieldwork.

Senior administrative staff
The department shall have the following senior administrative staff that shall be responsible to the Head of Department:
A confidential secretary
A computer operator
The services of the administrative support staff are indispensable in the proper administration of a department. It is important to recruit competent and computer literate senior staff.

Technical support personnel
The services of technical support staff which are indispensable in the proper running of laboratories are required. It is important to recruit competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance.

Junior staff
The department should have non-teaching junior support staff such as clerical officers, cleaners, office assistants and drivers who shall be answerable to the departmental secretary

Library and information resources
The department should have well-stocked library with internet facilities and up to date journals and books. There should be a computer-based information services with PC audio-visual aids e.g. CD-ROM, DVD.

Classrooms, laboratories and office spaces

Classroom

The standard requirement of 0.65m^2 per full-time student should be maintained. Thus the minimum total space requirement for a faculty or department shall be the product of its total full time equivalent student enrolment (FTE) and the minimum space requirement per full-time equivalent i.e. (FTE) 0.65m^2.

Office

In this respect, each academic staff should have an office space of at least 25 square metres taking into cognisance the status/cadre of the staff

In addition, there should be for the Faculty, a Dean's office and for each Department a Head of Department's office with attached offices for their supporting staff as specified below in m^2:

Professor's office	-	18.50m^2
Head of Department's office	-	18.50 m^2
Tutorial teaching staff's office	-	13.50 m^2
Other teaching staff space	-	7.00 m^2
Technical staff space	-	7.00 m^2
Secretarial space	-	7.00 m^2
Staff research laboratory	-	16.50 m^2
Seminar Space/per student	-	1.85 m^2
Laboratory space (per student)	-	7.50 m^2

Laboratories and equipment

To achieve the benchmark statements for the programme, there should be:

1. a minimum number of identifiable laboratories for the programme that should be in accordance with the recommended space requirements and in addition adequately equipped.
2. at least one large and reasonably equipped central laboratory for teaching and research.

B.Sc. Physiology

Overview

Physiology is the study of the normal functions of the human body and the knowledge of the subject is essentially applicable to health-related disciplines. The B.Sc. Physiology Core Curriculum and Minimum Academic Standards (CCMAS) is the new curriculum approved by the National Universities Commission (NUC) for use in all Nigerian universities after an extensive review of the former B.Sc. Physiology Benchmark Minimum Academic Standards (BMAS).

The B. Sc. Physiology programme is one of the basic medical sciences programmes tailored to equip the graduates with the knowledge and skills to function effectively in the 21st century as a member of the health care team, researcher, academic or become self-employed. The B.Sc. programme runs for three or four academic sessions depending on the mode of entry. The structure of the programme is composed of didactic lectures, practical training skills, industrial attachment in a health-related facility, entrepreneurship training and a final year research project on a health-related issue.

Philosophy

The philosophy of the undergraduate Physiology programme is to train students in theoretical, practical and applied Physiology and make such graduates suitable to utilize the basic knowledge for future problem solving and other applications – like practice of medicine, nursing, pharmacy, physiotherapy and other health related fields. The graduates should be able to function in the public service or be self-employed.

Objectives

The programme should be able to train graduates who:

1. should be grounded in basic knowledge of physiological principles;
2. should acquire sufficient practical knowledge and practical skills in experimental physiology;
3. should be able to apply the knowledge of physiology in medicine, pharmacy, nursing, veterinary medicine and allied health sciences;
4. should be able to apply the knowledge of physiology to various life situations including entrepreneurship; and
5. would desire to proceed for further studies in physiology and other related fields.

Unique features of the programme

1. New courses were introduced to further strengthen the students to face the emerging challenges of the 21st century.
2. Emphasis is now placed on practical training skills, a mandatory industrial attachment in a health-related facility and acquisition of entrepreneurial skills in Physiology.
3. Furthermore, all the core courses of the programme have learning outcomes as a guide to both the student and the lecturer.
4. The number of GST courses has been reduced to give room for more core courses
5. The curriculum provides for the use of innovative methods in teaching and assessing students which emphasises interactive and self-learning approaches.

Entrepreneurial/employability Skills

1. The new programme has entrepreneurial components tailored towards empowering the graduates to be self-employed.

2. The graduates can also be employed as part of health care team in health care units meant for diagnostic services like audiometry, spirometry, EEG, ECG, neurological nerve stimulation, etc.
3. The graduates of the new programme are also better equipped to work as research scientist in health-related research institutions or the academia.

21st century skills emphasized

1. Critical thinking, problem solving, reasoning, analysis, interpretation, synthesizing information.
2. Research skills and practices, interrogative questioning.
3. Creativity, artistry, curiosity, imagination, innovation, personal expression.
4. Perseverance, self-direction, planning, self-discipline, adaptability, initiative.
5. Oral and written communication, public speaking and presenting, listening.
6. Leadership, teamwork, collaboration, cooperation, facility in using virtual workspaces.
7. Information and communication technology (ICT) literacy, media and internet literacy, data interpretation and analysis, computer programming.

Admission and graduation requirements

Admission into the B.Sc. Physiology degree programme is open to Nigerian and foreign candidates. There are different modes by which candidates can be admitted into the programme, which are the Unified Tertiary Matriculation Examination (UTME) and Direct Entry.

Unified tertiary matriculation examination (UTME)

In addition to the UTME requirements, candidates seeking admission into the Physiology degree programme must possess a minimum of five credit passes in Senior Secondary Certificate (SSC) to include English Language, Mathematics, Physics, Chemistry and Biology at not more than two (2) sittings.

Direct entry

Admission through Direct Entry is into 200 level of the programme. Candidates seeking admission through this mode should, in addition to the UTME requirement possess either:

1. Credit passes in Physics, Chemistry and Biology or Zoology at the advance level of the Cambridge Advance Level Examination, Interim Joint Matriculation Board Examination (IJMB), the Joint Universities Preliminary Examination Board (JUPEB) and their nationally recognized equivalent examinations, OR
2. An acceptable first degree in relevant biological science disciplines.

Graduation Requirements

The following regulations shall govern the conditions for the award of the B.Sc. (Hon) degree in Physiology.

1. Candidates admitted through the UTME mode shall have registered for a minimum of 120 of courses during the 4 – year degree programme.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 90 units of courses during a 3– year degree programme.

A student shall qualify for the award of a degree when the student has completed and passed all the courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the University but not less than 1.00 and earned the minimum credit units of not less than 120 for those that entered through UTME and 90 through Direct Entry.

Duration of the Programme

For candidates admitted through the UTME mode, the duration of the programme is a minimum of 4 and a maximum of 6 academic sessions. For candidates admitted through Direct entry the duration of the programme is a minimum of 3 and a maximum of 5 academic sessions.

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	-
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	-
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
MTH 101	Elementary Mathematics I	2	C	30	-
COS 101	Introduction to Computing Sciences	3	C	30	45
	Total	**27**			

200 level

Course Code	Course Title	Unit	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	15	45
PIO 201	Introductory Physiology & Blood	2	C	30	-
PIO 203	Physiology of Excitable Tissues	2	C	30	-
PIO 212	Renal & Body fluids Physiology	2	C	30	-
PIO 214	Introduction to Cardiovascular & Respiratory Physiology	3	C	45	-
PIO 216	Gastrointestinal Physiology	2	C	30	-
PIO 218	Introduction to Laboratory Physiology I	1	C	-	45
ANA 203	General and Systemic Embryology	2	C	30	-
BCH 201	General Biochemistry I	2	C	30	-

BCH 202	General Biochemistry II	2	C	30	-
BCH 203	General Biochemistry Practical I	1	C	-	45
BIO 208	Biostatistics	2	C	30	-
Total		**25**			

300 level

Course Code	Course Title	Unit	Status	LH	PH
ENT 312	Venture Creation	2	C	15	45
GST 312	Peace and Conflict Resolution	2	C	30	-
PIO 301	Reproduction	2	C	30	-
PIO 303	Endocrinology	2	C	30	-
PIO 305	Neurophysiology I	2	C	30	-
PIO 307	Neurophysiology II	2	C	30	-
PIO 309	Practical Physiology II	1	C	-	45
PIO 302	Physiology Entrepreneurship	2	C	30	-
PIO 399	Students' Industrial Work Experience	3	C	-	135
PHA 301	General Principles of Pharmacology	2	C	15	45
Total		**20**			

400 level

Course Code	Course Title	Unit	Status	LH	PH
PIO 401	Seminar presentation I	1	C	15	-
PIO 403	Research Methodology	2	C	30	-
PIO 414	Cardiopulmonary Physiology	2	C	30	-
PIO 416	Exercise & Sports Physiology	2	C	30	-
PIO 499	Research Project	5	C	-	225
Total		**12**			

Course Contents and Learning Outcomes

100 level courses

Courses to be taught at this level should include basic sciences courses in Biology, Chemistry, Physics, Mathematics, Introduction to Computer Science and General Studies.

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

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple technical reports.

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, letters, curriculum vitae, report writing, note making, 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, the art of public speaking and listening, and report writing.

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

Learning Outcomes
At the end of the course, students should be able to:
1. analyse the historical foundation of Nigerian culture and arts in pre-colonial times;
2. list and identify the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political unit;
4. analyse the concepts of trade, economic and self-reliance status of the Nigerian peoples towards national development;
5. enumerate the challenges of the Nigerian state towards nation building
6. analyse the role of the judiciary in upholding people's fundamental rights
7. identify acceptable norms and values of the major ethnic groups in Nigeria; and
8. list and suggest possible solutions to identifiable Nigerian environmental, moral and value problems.

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; the nationalist movement and struggle for independence), Nigeria and challenges of nation building (military intervention in Nigerian politics; the Nigerian civil war), the 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 Nigerian 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 – reconciliation, reconstruction and rehabilitation ; 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.

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

Learning Outcomes
At the end of lectures in Plant Biology, students should be able to:
1. explain cells structures and organisations;
2. summarize functions of cellular organelles;
3. characterize living organisms and state their general reproduction;
4. describe the interrelationship that exists between organisms;
5. discuss the concept of heredity and evolution; and
6. enumerate habitat types and their characteristics.

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)

Learning Outcomes
At the end of the lectures, students should be able to:
1. List the characteristics, methods of identification and classification of Viruses, bacteria and fungi;
2. state the unique characteristics of plant and animal kingdoms;
3. describe ecological adaptations in the plant and animal kingdoms;
4. explain nutrition, respiration, excretion and reproduction in plants and animals; and
5. describe growth and development in plants and animals.

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)

Learning Outcomes
At the end of this course students should be able to:
1. outline common laboratory hazards;
2. provide precaution on laboratory hazards;
3. state the functions of the different parts of microscope;
4. use the microscope and describe its maintenance;
5. draw biological diagrams and illustrations; and
6. apply scaling and proportion to biological diagrams.

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)

Learning Outcomes
At the end of this course, students should be able to:
1. describe the anatomy of flowering plants;
2. differentiate types of fruit 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.

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)

Learning Outcomes
At the end of this course, the students should be able to:
1. define atom, molecules and chemical reactions;
2. discuss the Modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. justify the trends of atomic radii, ionization energies, electronegativity of the elements based on their position in the periodic table;
5. identify and balance oxidation – reduction equation and solve redox titration problems;
6. illustrate shapes of simple molecules and hybridized orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

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)

Learning Outcomes
At the end of this course, the students should be able to:
1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. describe rules guiding nomenclature and functional group classes of organic chemistry;
6. determine rate of reaction to predict mechanisms of reactions;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of Transition metals.

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)

Learning Outcomes
At the end of this course, the students should be able to:
1. describe the general laboratory rules and safety procedures;
2. collect scientific data and correctly carrying out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. tell the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

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)

Learning Outcomes
At the end of this course, the students should be able to:
1. identify the general laboratory rules and safety procedures;
2. collect scientific data and correctly carrying out Chemical experiments;
3. identify the basic glassware and equipment in the laboratory;

4. identify and carry out preliminary tests which includes ignition, boiling point, melting point, test on known and unknown organic compounds;
5. execute solubility tests on known and unknown organic compounds;
6. execute elemental tests on known and unknown compounds; and
7. conduct functional group/confirmatory test on known and unknown compounds which could be acidic / basic / neutral organic compounds.

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)

Learning outcomes
At the end of the course, students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity;
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

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)

Learning Outcomes
At the end of the course, students should be able to:
1. describe the electric field and potential, and related concepts, for stationary charges;
2. calculate electrostatic properties of simple charge distributions using Coulomb's law, Gauss's law, and electric potential;
3. describe and determine the magnetic field for steady and moving charges;
4. determine the magnetic properties of simple current distributions using Biot-Savart and Ampere's law;

5. describe electromagnetic induction and related concepts and make calculations using Faraday and Lenz's laws;
6. explain the basic physical of Maxwell's equations in integral form;
7. evaluate DC circuits to determine the electrical parameters;
8. determine the characteristics of AC voltages and currents in resistors, capacitors, and Inductors.

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)

Learning Outcomes

At the end of the course, students should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. 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 (1 Unit C: PH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data;
6. prepare and present practical reports.

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.

MTH 101: Elementary Mathematics I (2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. explain basic definition of set, subsets, union, intersection, complements and use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Content
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.

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

Learning Outcomes
At the end of the course, students should be able to:
1. explain basic components of computers and other computing devices;
2. describe the various applications of computers;
3. explain information processing and its roles in the society;
4. describe the Internet, its various applications and its impact;
5. explain the different areas of the computing discipline and its specializations; and
6. demonstrate practical skills on using computers and the internet.

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 smartboards. Practical demonstration of the Internet and its various applications. Illustration of browsers and search engines. How to access online resources.

200 level courses
Courses to be taught at this level should include basic medical sciences courses in Physiology, Anatomy, Biochemistry as well as Biostatistics, Entrepreneurial and General Studies.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation, and risk taking;
2. state the characteristics of an entrepreneur; analyze the importance of micro and small businesses in wealth creation, employment, and financial independence;
3. engage in entrepreneurial thinking;
4. identify key elements in innovation;
5. describe stages in enterprise formation, partnership and networking including business planning;
6. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
7. state the basic principles of e-commerce.

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 join ventures), contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office, networking), entrepreneurship in Nigeria (biographies of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship)and basic principles of e-commerce.

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

Learning Outcomes

A student who has successfully gone through this course should be able to:

1. identify the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. describe the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

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.

PIO 201: Introductory Physiology and Blood (2 Units C: LH 30)

Learning Outcomes

On completion of this course, students should be able to:

1. describe the composition of a cell membrane;
2. explain how a potential difference across a membrane will influence the distribution of a cation and an anion;
3. describe how transport rates of certain molecules and ions are accelerated by specific membrane transport proteins;
4. distinguish between active (primary and secondary) transport, facilitated diffusion, and passive diffusion based on energy source and carrier protein involvement;
5. identify the mechanisms and role of selective transporters for amino acids, neurotransmitters, nutrients, etc.;
6. understand the general concepts of homeostasis and the principles of positive and negative feedback in physiological systems;
7. identify the site of erythropoietin production, the stimulus for its release, and the target tissue for erythropoietin action;
8. discuss the normal balance of red blood cell synthesis and destruction, including how imbalances in each lead to anemia or polycythemia;
9. list and differentiate the various types of leukocytes;
10. describe the role of thrombocytes in haemostasis; and
11. list clotting factors and the discuss the mechanism of anti-coagulants.

Course Contents

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.

PIO 203: Physiology of Excitable Tissues (2 Units C: LH 30)

Learning outcomes

On completion of this course, students should be able to:

1. list the steps in excitation-contraction coupling in skeletal muscle;
2. describe the structure of the neuromuscular junction;
3. list some intracellular factors that can cause muscle fatigue;
4. describe the distinguishing characteristics of multi-unit and unitary smooth muscles;
5. explain the steps in the excitation-contraction coupling mechanism in cardiac muscle and compare with skeletal muscle including different mechanisms for sarcoplasmic reticulum calcium release;
6. explain how the resting membrane potential is generated

7. state the Nernst equation, and indicate how this equation accounts for both the chemical and electrical driving forces that act on an ion;
8. discuss the mechanisms by which an action potential is propagated along both nonmyelinated and myelinated axons;
9. describe the principle of the voltage clamp and how it is used to identify the ionic selectivity of channels; and
10. discuss the disorders that can occur at the neuromuscular junction.

Course Contents
Structure and functions of nerves, cardiac muscle, smooth muscle and skeletal muscle, Muscles: structure, excitation, theories of excitation-contraction. Membrane potentials. Nerve generation and conduction of impulse and its physiological properties. Synapses and synaptic transmission

PIO 212: Renal and Body Fluids Physiology (2 Units C: LH 30)

Learning Outcomes
On completion of this course, the student should be able to;
1. sketch a cross section of a kidney; identify the renal cortex, renal medulla, renal calycies, medullary pyramids, renal pelvic space, renal artery, renal vein, and ureter;
2. describe renal blood flow, renal plasma flow, glomerular filtration rate, and filtration fraction and list typical values;
3. explain the concept of renal clearance. Use the clearance equation and an appropriate compound to estimate the glomerular filtration rate, renal plasma flow, and renal blood flow;
4. describe the effects of reductions in GFR on plasma creatinine concentrations and plot the relationship;
5. discuss the role of the ascending limb of the loop of Henle in producing a high renal interstitial fluid osmolality. From the loop of Henle, contrast the tubular fluid and interstitial fluid osmolality changes that allow either a dilute or a concentrated urine to be produced and excreted;
6. describe processes that lead to acid-base disturbances and list the common causes;
7. identify major routes and normal ranges for water intake and loss, and predict how changes in intake and loss affect the distribution of total body water.
8. list the various body fluid compartments and their ionic compositions
9. describe the methods used in measuring the body fluid compartments and
10. discuss the role of the kidney in maintaining homeostasis of body fluids

Course Contents
Macroscopic, microscopic and ultra-structure of the kidney. Elements of renal functions. Glomerular filtration. Concept of clearance. Tubular reabsorption and secretion. Renal blood flow. Body fluid and electrolyte balance. Buffer mechanism and pH regulation. Counter-current system. Micturition. Abnormalities of renal functions. Composition and estimation of body fluid compartments. Concept of water and electrolyte balance. Role of the kidney in body fluid homeostasis.

PIO 214: Introduction to Cardiovascular and Respiratory Physiology (3 Units C: LH 45)

Learning Outcomes

On completion of this course, students should be able to:

1. state Starling's law of the heart and describe the application of the law in keeping the output of the left and right ventricles equal;
2. describe how ionic currents contribute to the four phases of the cardiac action potential;
3. explain the ionic mechanism of pacemaker automaticity and rhythmicity, and identify cardiac cells that have pacemaker potential and their spontaneous rate;
4. identify neural and humoral factors that influence their rate;
5. describe the various phases of ventricular systole and ventricular diastole;
6. describe the timing and causes of the four heart sounds;
7. explain why the ECG tracing looks different in each of the 12 leads;
8. explain the principles underlying cardiac output measurements using the Fick principle, dye dilution, and thermodilution methods;
9. list the factors that shift laminar flow to turbulent flow;
10. describe the relationship between velocity, viscosity, and audible events, such as murmurs and bruits;
11. describe how arterial systolic, diastolic, mean, and pulse pressure are affected by changes in a) stroke volume, b) heart rate, c) arterial compliance, and d) total peripheral resistance;
12. define the Starling equation and discuss how each component influences fluid movement across the capillary wall;
13. list the anatomical components of the baroreceptor reflex;
14. explain three positive feedback mechanisms activated during severe hemorrhage that may lead to circulatory collapse and death;
15. define compliance and identify two common clinical conditions in which lung compliance is higher or lower than normal;
16. list the factors that determine total lung capacity, functional residual capacity, and residual volume;
17. define surface tension and describe how it applies to lung mechanics, including the effects of alveolar size and the role of surfactants;
18. explain how the shape of the oxyhemoglobin dissociation curve influences the uptake and delivery of oxygen;
19. list the forms in which carbon dioxide is carried in the blood; and
20. identify the regions in the central nervous system that play important roles in the generation and control of normal respiration.

Course Contents

The heart; events of the cardiac cycle. Control of cardiac contractility. Cardiac electrophysiology. Properties of cardiac muscles. Cardiac output - measurement and control. Haemodynamics of circulation. Arterial blood pressure and its regulation. Cardiovascular reflexes. Peripheral resistance and local control of the circulation. Regional blood flow. Cardiovascular changes in exercise, haemorrhage and shock. Respiratory physiology – functions of upper respiratory tract. Mechanics of respiration including compliance. Surfactant. Lung volume and capacities. Pulmonary gas exchange. Blood gas transport. Pulmonary function tests. Nervous and chemical control of respiration. Response to hypoxia, high altitude, exercise and artificial respiration.

PIO 216: Gastrointestinal Physiology (2 Units C: LH 30)

Learning Outcomes

On completion of this course, students should be able to:

1. compare and contrast the regulation of gut function by nerves, hormones, and paracrine regulators;
2. identify the cell type and anatomical location of the endocrine cells secreting major GI hormones, such as gastrin, secretin, cholecystokinin (CCK), GLP-1, GLP-2, leptin, and motilin;
3. list the physiological functions of the components of saliva;
4. describe the role of HCl in the gastric digestion of carbohydrates and protein, and how pepsinogen is activated;
5. list the mechanisms contributing to gastric mucosal defense and how they can be compromised by drugs or pathogens;
6. list the stimuli that release secretin and CCK and explain the route by which these regulatory peptides stimulate the pancreas;
7. describe the cellular mechanisms for the hepatic uptake, conjugation, and secretion of bile salts and bilirubin;
8. describe the sequential digestion of ingested starch by enzymes of the salivary glands, pancreas, and the intestinal apical membrane;
9. describe the mechanisms and molecules mediating the solubilization and digestion of lipids in the small intestine; and
10. describe the disorders of motility that can lead to gastroparesis, achalasia, diarrhea, constipation, megacolon and irritable bowel syndrome.

Course Contents

Physiologic anatomy of the gastrointestinal tract, Review of smooth muscle function, Secretions in the G.I.T. and their control, Movements of the gastrointestinal tract, Digestion and absorption of various food substances, Physiologic anatomy of the liver and biliary system including their functions, Disorders of G.I.T, The gut as an endocrine organ. Nutrition: energy and other dietary requirements. Basal metabolic rate. Nitrogen balance. Amino acid deficiency. Hormonal control of nutritional needs, vitamins, mineral mechanisms. Food value of local foodstuffs. Diet sheets and nutritional deficiency states.

PIO 218: Introduction to Laboratory Physiology I (1 Unit C: PH 45)

Learning Outcomes

On completion of this course, students should be able to:

1. acquaint themselves with the proper handling of laboratory equipment;
2. dissects laboratory animals and mount an isolated organs for a specific experiment;
3. use human subjects for some of the experiments like blood grouping, etc.;
4. take recordings of an experiment and interpret the results accordingly; and
5. understand basic laboratory management techniques and safety measures.

Course Contents

Laboratory sessions on basic physiology experiments, especially those related to the frog sciatic nerve, smooth muscles and blood physiology.

ANA 203: General and Systemic Embryology (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of the course, students should be able to:
1. explain how the embryo forms from the zygote;
2. discuss the role of cleavage and gastrulation in animal development;
3. demonstrate an understanding of embryology and significance of prenatal diagnostic methods;
4. describe structural features of primordia in tissue and organs at different developmental stages; and
5. define risk periods in histo- and organogenesis, and to analyse the most often observed developmental anomalies.

Course Contents
Spermatogenesis, oogenesis; ovarian follicles; ovulation; corpus luteum; menstruation; uterine cycle; hormonal control of uterine cycle; fertilization; cleavage; implantation; reproductive technologies-IVF/surrogacy/embryo transfer; embryo manipulation & potency/twinning; molecular embryology and transgenesis; gastrulation; notochord, neurulation; derivatives of the germ layers; folding of the embryo; fetal membranes; placenta; development of limbs and teratology, growth and perinatology; congenital malformations – general introduction, the cardiovascular system, skin, structure of the nails and hair, macrophagic system; cellular immunology; lymphoid organs; glands – endocrine and exocrine, respiratory system, digestive system, urinary and genital systems,and electron micrograph studies of each organ.

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

Learning Outcomes
At the end of the course, students should be able to:
1. explain the structure of different macromolecules in biological system;
2. identify types of chemical reactions involving these macromolecules;
3. explain the various methods of isolation of these macromolecules;
4. estimate the effects of acids and alkalis on the macromolecules;
5. describe how to purify the macromolecules; and
6. discuss quantification of the various macromolecules.

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)

Learning Outcomes
At the end of the course, students will be able to:
1. describe the structure of the cell including its components;

2. discuss the interrelationship between different organelles of the cell;
3. recognize the differences between plant and animal cells;
4. isolate the various organelles of both plant and animal cells; and
5. discuss the influence of hydrogen ion concentration on cellular function.

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 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 I (1 Unit C: PH 45)

Learning Outcomes
At the end of the course, students will be able to understand the various laboratory procedures used in the study of various biochemical processes described in BCH 201 and 202.

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

BIO 208: Biostatistics (2 Units C: LH 30)

Learning Outcomes
At the end of the lectures in this course, students should be able to:
1. differentiate between continuous and discontinuous data;
2. explain sampling procedures in biology;
3. summarize and present biological data;
4. describe measures of central tendency and probability theory; and
5. conduct ANOVA, Chi-square, t-tests and F-tests and state their importance.

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.

300 Level Courses
Courses to be taught at this level should include courses in Physiology, Pharmacology, Entrepreneurial studies, General Studies and Industrial Attachment.

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

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors regardless of geographical location;
3. state how original products, ideas, and concepts are developed;
4. develop business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

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 Ddscovery 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).

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

Learning Outcomes

At the end of the course, students should be able to:

1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe roles of international organisations, media and traditional institutions in peace building.

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/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 Nigerian 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 and the role of NGOs in post-conflict situations/crisis.

PIO 301: Reproduction (2 Units C: LH 30)

Learning Outcomes

On completion of this course, students should be able to;

1. describe developmental changes in the male and female reproductive systems, including the mechanisms responsible for these changes, during *in utero* development, and in childhood through puberty;
2. list the physiological functions of the major components of the male reproductive tract;
3. discuss the biosynthesis, mechanism of transport within the blood, metabolism and elimination of testosterone and related androgens;
4. list the causes and consequences of over-secretion and under-secretion of testosterone for a) prepubertal and b) postpubescent males;
5. explain the roles of FSH, LH, estradiol, and inhibin in oogenesis and follicular maturation;
6. list the actions and cellular mechanisms of estrogens;
7. list the actions and cellular mechanisms of progesterone and other progestins;
8. describe the development and the major physiological functions of the placenta;
9. discuss the neuroendocrine regulation of milk secretion and milk ejection; and
10. explain the physiological basis of steroid hormone contraception.

Course Contents

Fertilization. Structures of ectodermal, mesodermal and endodermal origins and embryogenesis of different organs. Medical genetics. Physiologic anatomy of male reproductive system. Spermatogenesis. Male sexual act-nervous co-ordination. Male sexual hormones. Cryptochidism. Physiological anatomy of the female reproductive system. The female sex hormones. Oestrous and menstrual cycles. Physiology of pregnancy, parturition and lactation. Pregnancy tests. Contraception and physiological basis of infertility.

P10 303: Endocrinology (2 Units C: LH 30)

Learning Outcomes

On completion of this course, students should be able to:

1. list the hypothalamic factors that control the secretion of each of the anterior pituitary hormones and describe their route of transport from the hypothalamus to the anterior pituitary;
2. list the 3 major families of the anterior pituitary hormones and their biosynthetic and structural relationships;

3. describe the posterior pituitary lobes with respect to cell types, vascular supply, development, and anatomical function relative to the hypothalamus;
4. identify the steps in the biosynthesis, storage, and secretion of tri-iodothyronine (T_3) and thyroxine (T_4) and their regulation;
5. describe the regulation of parathyroid hormone secretion and the role of the calcium-sensing receptor;
6. identify the major hormones secreted from the endocrine pancreas, their cells of origin, chemical nature and physiological actions;
7. list the functional zones (one medullary and three cortical zones), innervation, blood supply, principal hormones secreted from each zone of the adrenal glands;
8. identify the major physiological actions and therapeutic uses of glucocorticoids;
9. list the major mineralocorticoids and identify their biological actions and target organs or tissues; and
10. identify the chemical nature of catecholamines, their biosynthesis, mechanism of transport within the blood, and how they are degraded and removed from the body.

Course Contents

Nature of hypothamo-hypophyseal relationship. Synthesis, storage and release of the neurohypophyseal and adenohypophyseal hormones. Functions of the hypothalamus to include regulation of body temperature, thirst appetite and food intake. Regulation of adenophypophyseal function and higher autonomic control. Functions and control of the secretions of the pituitary, thyroid, parathyroid, pancreas and adrenal glands. Abnormalities of endocrine functions. Normal integration in the control of calcium and glucose metabolism.

PIO 305: Neurophysiology 1 (2 Units C: LH 30)

Learning Outcomes

On completion of this course, students should be able to:

1. explain how inhibitory and excitatory post-synaptic potentials can alter synaptic transmission;
2. list the major receptor classifications and representative receptor agonists;
3. describe the cutaneous and proprioceptive mechanoreceptors and their function;
4. describe formation and reabsorption of cerebral spinal fluid (CSF), including the anatomy and function of the choroid plexus;
5. compare and contrast the barrier mechanisms between the blood brain barrier and the blood CSF barrier and the consequences of barrier break down;
6. describe the major areas of the cerebral cortex and their roles in perception and motor coordination. Identify the Brodmann areas for visual, auditory, somatosensory, motor, and speech areas;
7. discuss the pathways for pain/temperature/coarse touch system and its connections to the cerebral cortex;
8. list the neural components of the dorsal column-medial lemniscus system and its trigeminal analogs;
9. describe the functions of the medial and lateral motor pathways and trace their origins and terminations within the spinal cord;
10. describe the physiologic-anatomy of the major ascending tracts (anterolateral and dorsal column-medial lemniscus systems) and descending spinal cord tract (cortico-spinal tract, CST), including crossing of midline;
11. list the functions of the following brainstem reflexes: cardiovascular baroreceptor, respiratory stretch receptor, cough reflex, pupillary light reflex, gag reflex, and blink reflex;

12. explain the role of the brain stem reticular formation in pain perception and modulation, level of consciousness, integration of brainstem reflexes, and the location of noradrenergic, serotoninergic, and dopaminergic nuclei;
13. list the physiological functions of the Hypothalamus;
14. list the three functional divisions of the cerebellum, detailing the input and output connections of each. Describe how these areas are integrated with the lateral and medial motor pathways;
15. discuss the overall functions of the basal ganglia in the initiation and control of movement;
16. describe how the amygdala interacts with the cerebral cortex to produce cognitive emotional behaviours;
17. describe the three states of human brain activity based on EEG, EOG and EMG recordings; and
18. distinguish the major characteristics of the major seizure disorders: grand mal, Absence seizure (Petite mal), simple partial and complex partial seizures, and status epilepticus.

Course Contents

Functional organization of CNS. Autonomic neurotransmitters and autonomic effects. Peripheral nervous system. The reflex arc and general properties of reflexes. Receptors and receptor potentials. Cerebrospinal fluid and the blood-brain barrier. The human brain — cerebrum, brain stem, basal ganglia, thalamus, hypothalamus and cerebella. The limbic system. Electrophysiology of the cerebral cortex, the electroencephalogram. Alertness and sleep. Postural regulation and postural reflexes. Speech, learning and memory. Conditioned reflexes and spinal cord transection.

PIO 307: Neurophysiology II (2 Units C: LH 30)

Learning Outcomes

On completion of this course, students should be able to:

1. describe the gross structure of the eye and basic physiological optics;
2. draw a diagram of the retino-thalamo-cortical pathways;
3. describe the pupillary light reflex and its diagnostic value;
4. discuss the processing of information in the visual cortex and the consequence of a lesion in the higher visual association areas;
5. list the mechanical structures involved in sound detection;
6. draw a diagram of the auditory pathways including all central connections;
7. list the most important vestibular and associated reflexes;
8. list the major types of eye movements;
9. describe the location, structure, and afferent pathways of taste receptors;
10. describe the structure and function of the central taste centers;
11. describe the location, structure, and afferent pathways of smell receptors; and
12. explain how olfactory receptors are activated and the mechanism of olfactory transduction.

Course Contents

Physiology of vision: structure of the eyeball. Optics – eye an optical instrument. Refraction of light and refractive errors. Accommodation. Visual pathways and visual defects. Structure of retina. Biochemistry of vision. Visual acuity, fields of vision and color vision.

Physiology of hearing: Auditory stimulus and sound appreciation. Sound characteristics: pitch, intensity and quality. Auditory pathways, neural basis of audition. Types of deafness and tests of both nerve functions. Audiometry. Vestibular pathway and vestibule-ocular reflex

Physiology of taste: gustatory system receptors – taste buds and sensation of tastes. Afferent pathways. Tests for taste and abnormality of taste.

Physiology of smell: olfactory receptors and pathways. Tests of olfaction. Abnormalities of olfaction and olfactometry.

PIO 309: Physiology Practical II (1 Unit C: PH 45)

Learning Outcomes
On completion of this course, students should be able to:
1. acquaint themselves with the proper handling of laboratory equipment;
2. dissect laboratory animals and mount an isolated organs for a specific experiment;
3. use human subjects for some of the experiments like ECG, etc
4. take recordings of an experiment and interpret the results accordingly.; and
5. understand more laboratory management techniques and safety measures

Course Contents
Laboratory sessions on physiology experiments related to cardiovascular physiology, gastric secretions, respiratory, renal and neurological functions.

PIO 302: Physiology Entrepreneurship (2 Units C: LH 30)

Learning Outcomes
On completion of this course, students should be able to:
1. appreciate the role of entrepreneurship in Physiology in the 21st century;
2. discuss entrepreneurship knowledge, skills and attitudes and their roles for a successful business in Physiology;
3. identify the different entrepreneurial opportunities available in Physiology;
4. identify and discuss the barriers to a successful entrepreneurship in Physiology; and
5. develop at least two (2) different business models in Physiology.

Course Contents
Concepts of entrepreneurship, entrepreneurial knowledge, skills and attitudes needed in the 21st century in the field of Physiology, definition of small business, strengths and weaknesses of small business, trends expected of small businesses, ethics and social responsibility - the role that values play in ethical behaviour and the importance of ethics; ethics versus social responsibility, the business plan in Physiology; the need for a business plan, the steps in the preparation of a business plan and financial plans, location of a business in Physiology; importance of site selection for a business, processes for selecting the right site for a business, financing a business in Physiology; estimating the money needed to launch a new business, ways to raise money for a new business, organizational planning for a business in Physiology; staffing. training and organizational charts.

PIO 399: Students' Industrial Work Experience (3 Units C: PH 135)

Learning Outcomes
On completion of this course, students should be able to:
1. describe the skills acquired during the industrial attachment;
2. relate the skills acquired to physiological principles learnt; and
3. list the entrepreneurial potentials of the skills they have acquired.

Course Contents
Students will be posted to recognized and relevant placement areas of their choice during the industrial training. Continuous assessment of students will be undertaken jointly by their industry-based supervisors, ITF officials and institutional supervisors. Finally, students on

returning to the institution will present a seminar on major duties performed and skills acquired during the training.

PHA 301: General Principles of Pharmacology (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of the course, students should be able to:
1. know the various routes of drug administration and how they influence onset of drug action;
2. know the factors that affect drug absorption, distribution, metabolism and excretion;
3. understand the role of receptors as targets for drug action;
4. understand the fundamental differences between agonists and antagonists; and
5. know the common system parameters in pharmacokinetics and their measurements.

Course Contents
Introduction: history of Pharmacology and relationship of Pharmacology to other pharmaceutical and clinical subjects, pharmacology textbooks and journals, definition and sources of drugs, routes of drug administration, drug absorption, distribution, elimination and factors affecting them, enzyme induction and enzyme inhibition, mechanisms of drug action – receptor and non-receptor theory, drug dosage and dose response curves, and measurement of some pharmacological parameters.

400 Level Courses
Courses to be taught at this level should include courses in Physiology, seminar presentation and a final year research project.

PIO 401: Seminar presentation I (1 Unit C: LH 15)

Learning Outcomes
On completion of this course, students should be able to:
1. identify a topic of current interest in advancing the knowledge of physiology;
2. search for the appropriate literature in the chosen topic; and
3. prepare and disseminate the knowledge using the appropriate format within a time frame.

Course Content
A seminar on current concepts or advances on a specific topic in Human Physiology. The aim is to develop in the student the ability to search for past and current literature on any given topic.

PIO 403: Research Methodology (2 Units C: LH 30)

Learning Outcomes
On completion of this course, students should be able to:
1. describe the different types of research designs;
2. discuss the various types of referencing systems;
3. identify the various sources of Information for Literature review;
4. enumerate the different sampling methods with their merits and demerits;
5. compare and contrast between parametric and non-parametric statistics;
6. identify the regulatory bodies for research ethics and their mandates;
7. list the fundamentals of research ethics
8. discuss the use of computer packages in research.
9. describe the concept of population; and
10. describe the steps in writing a research project.

Course Contents
Introduction to biomedical research. Types of research designs. Literature review. Identification of research gaps and referencing styles. Sampling and sampling techniques. Questionnaire design and validation. Data analysis and presentation. Ethics in biomedical research. Use of computer packages in research and presentations.

PIO 414: Cardiopulmonary Physiology (2 Units C: LH 30)

Learning Outcomes
1. On completion of this course, students should be able to:describe the historical developments in cardiovascular and respiratory physiology;
2. discuss the progressive changes in maternal blood volume, cardiac output, and peripheral resistance during pregnancy and at delivery;
3. list the functions in utero of the fetal ductus venosus, foramen ovale, and ductus arteriosus. Explain the mechanisms causing closure of these structures at birth;
4. describe the redistribution of cardiac output during various degrees of exercise to the CNS, coronary, splanchnic, cutaneous, and skeletal muscle vascular beds during sustained exercise (distance running). Explain the relative importance of neural and local control in each vascular bed;
5. list the various causes of hypertension and discuss the underlying mechanisms;
6. discuss the direct cardiovascular consequences of the loss of 30% of the circulating blood volume on cardiac output, central venous pressure, and arterial pressure. Describe the compensatory mechanisms activated by these changes;
7. list the factors that determine total lung capacity, functional residual capacity, and residual volume. Describe the mechanisms responsible for the changes in those volumes that occur in patients with emphysema and pulmonary fibrosis;
8. differentiate between the two broad categories of restrictive and obstructive lung disease, including the spirometric abnormalities associated with each category;
9. discuss the physiology of jet lag; and
10. describe the mechanism of Nitrogen narcosis in deep sea diving.

Course Contents
Developmental milestones in cardiovascular and respiratory physiology. Cardiopulmonary function in the fetus and in old age. Cardiopulmonary responses at rest and in moderate to severe stress conditions. Pathophysiology of hypertension, obstructive and restrictive lung diseases. Principles of servomechanism as applied to cardiopulmonary physiology. Aviation, space and deep-sea physiology.

PIO 416: Exercise and Sports Physiology (2 Units C: LH 30)

Learning Outcomes
On completion of this course, students should be able to:
1. define the thermoregulatory set point and describe the negative feedback control of body core temperature and the role of the hypothalamic set point;
2. compare the normal distribution of cardiac output with the distribution of cardiac output during aerobic (sustained) exercise and anaerobic (brief maximal burst) exercise;
3. describe the redistribution of cardiac output during exercise to the CNS, coronary, splanchnic, cutaneous, and skeletal muscle vascular beds during sustained exercise (distance running).4. explain the relative importance of neural and local control in each vascular bed;
4. define VO_{2MAX} and identify situations in which it is limited by cardiac output, pulmonary gas exchange, and skeletal muscle blood flow and oxygen uptake;

5. discuss the changes in renal blood flow and glomerular filtration rate caused by an increase in renal sympathetic nerve activity during exercise;
6. describe the health benefits of exercise training on the cardiovascular, musculoskeletal, endocrine, immune and nervous systems;
7. discuss how exercise training alters insulin action and glucose entry into cells;
8. Define exercise and classify the different forms of exercise;
9. Distinguish between an isometric and isotonic contraction; and
10. List the energy sources of muscle contraction and rank the sources with respect to their relative speed and capacity to supply ATP for contraction and how they are different in the three muscle types.

Course Contents
Definitions of physical exercise and sport. Energy expenditure during physical exercise. Cardiovascular, respiratory and renal adjustments during physical exercise. Thermoregulatory system in exercise. Water and electrolytes balance in exercise. The integrated neural and hormonal control during physical exercise. The health benefits of physical exercise and the role of exercise in the management of various health conditions.

PIO 499: Research Project (5 units C: PH 225)

Learning Outcomes
On completion of this course, students should be able to:
1. prepare the final write-up of the research project using the appropriate format within the stipulated time frame; and
2. present and defend the write-up of the research project.

Course Contents
Independent research findings into selected areas/topics of interest to be supervised by an 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.

Minimum Academic Standards

Equipment

1. Polygraphs /powerLab with accessories
2. Physiographs/dynamometers
3. Jacketed organ baths
4. 2 Channel recorder
5. Electronic balances
6. Assorted glassware
7. Spectrophotometer
8. Soxhlet extractors
9. Animal cages
10. Deep freezer
11. Refrigerators

12. Microscopes (binocular with pointers) 1 per 5 students
13. pH meters
14. Colorimeter
15. Bench centrifuges
16. Water baths
17. Audio Visual equipment
18. Overhead Projector
19. Water Distillers
20. Flame photometer
21. Oven
22. Deionizer
23. Student stimulators1 per 20 students
24. Student kymograph1 per 20 students
25. Transducers1 per 20 students
26. Spirometers1 per 20 students
27. Vitalograph1 per 20 students
28. Peak flow meters1 per 20 students
29. ECG machines 4 per lab.
30. Oscilloscopes 4 per lab.
31. Centrifuges 6 per lab.
32. Haematocrit centrifuges 5 per lab.
33. Haemotocrit readers 20 per lab.
34. Audiometers2 per lab.
35. Water bath (with shaker) 2 per lab.
36. Geiger counter1 per lab.
37. Blood gas analysers1 per lab.
38. An array of test tubes, racks, etc.
39. Consumable of chemical reagents
40. Antisera for blood typing, etc.
41. Snellen's charts
42. Ishihara's charts
43. Treadmill/Bicycle Ergometer
44. Urinometers

45. Sphygmomanometers

46. Stethoscopes

47. Patella hammers

48. Westergreen stand and tubes

49. Isolated mammalian Heart Perfusion apparatus (Langendorf)

50. Weighing scale

51. Stadiometer

52. Haemoglobinometers

53. Tunning forks

Staffing

Staff of the programme can be categorized into two; academic and non-teaching staff. The non-teaching staff can be further categorized into four: senior technical, senior administrative, technical and non-technical junior staff.

Academic staff

Academic staff requirements are in terms of three criteria: number, structure, and qualifications (appointments and promotions). It is expected that all academic staff should possess PhD degree. However, the proportion of academic staff with PhD degree should not be less than 70%.

Staff-Student Ratio

The approved Staff-Student ratio for the programme is 1:15.

Staff – mix by rank

Academic staff in the Universities is broadly classified into three categories; professorial (professor/reader) senior lectureship and lecturers grade I and below. The professorial cadre should constitute a maximum of 20 per cent of the staff strength while the remaining two should constitute 35 and 45 per cent respectively.

Academic support personnel

The department shall have teaching assistants/demonstrators to help lecturers in the conduct of tutorials, practicals and fieldwork.

Senior administrative staff

The department shall have the following senior administrative staff that shall be responsible to the Head of Department:

1. A confidential secretary
2. A computer operator

The services of the administrative support staff are indispensable in the proper administration of Department. It is important to recruit very competent, computer literate senior staff.

Technical support personnel

The services of technical support staff, which are indispensable in the proper running of laboratories. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance.

Junior staff
The department should have non-teaching junior support staff such as cleaners, office assistants and drivers who shall be answerable to the departmental secretary.

Library and information resources
The department should have well-stocked library with Internet facilities and up to date journals and books. There should be a computer-based information services with PC audiovisual aids e.g. CDROM, DVD.

Classrooms, laboratories and office

Spaces

Classroom
The NUC standard requirement of 0.65m^2 per full-time student shall be maintained. Thus the minimum total space requirement of a faculty or department shall be the product of its total full time equivalent student enrolment (FTE) and the minimum space requirement per full-time equivalent i.e. (FTE) 0.65m^2.

Office
In this respect, each academic staff should have an office space of at least 25 square metres taking into cognisance the status/cadre of the staff

In addition, there should be for the Faculty, a Dean's office and for each Department, a Head of Department's office with attached offices for their supporting staff as specified below in m^2:

Professor's office	-	18.50
Head of department's office	-	18.50
Tutorial teaching staff's office	-	13.50
Other teaching staff space	-	7.00
Technical staff space	-	7.00
Secretarial space	-	7.00
Staff research laboratory	-	16.50
Seminar space/per student	-	1.85
Laboratory space per student	-	7.50

Laboratories and equipment
To achieve the benchmark statements for the programme, there should be:
1. A minimum number of identifiable laboratories for the programme that should be in accordance with the recommended space requirements and in addition are adequately equipped.
2. At least one large and reasonably equipped central laboratory for teaching and research.