FEDERAL REPUBLIC OF NIGERIA

NATIONAL COMMISSION FOR COLLEGES OF EDUCATION ABUJA

NIGERIA CERTIFICATE IN EDUCATION
MINIMUM STANDARDS
FOR
SCIENCES

2012 Edition

TETF PROJECT, 2012

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FOREWORD

The National Commission for Colleges of Education, NCCE, was established by an Act in 1989 as the third leg of the tripod of excellence in the supervision of tertiary education in Nigeria. Its mandate includes, inter alia, the laying down of Minimum Standards for all programmes of teacher education and accrediting their certificates and other academic awards. Since its inception, my Ministry has been pursuing very doggedly and supporting the Commission's goals of **quality assurance**. We shall not relent in our match towards the realization of the set goals of producing quality teachers for our rapidly expanding basic education sector.

In response to the transformation agenda of the present administration and the widespread criticism that the existing NCE programme is tunnel visioned, the NCCE has revised and updated the existing **NCE Minimum Standards** documents. New programmes have been added to address the existing teacher needs at the basic education level.

The new programmes are now more focused toward the attainment of **Education for All (EFA)** demands and **the Millennium Development Goals (MDGs)**. In addition to the existing two subjects' combination in NCE programme, which is suited for the preparation of the B.Sc. (Ed)/B.A (Ed) degree programmes, the new Minimum Standards document is now targeted at producing specialist teachers for:

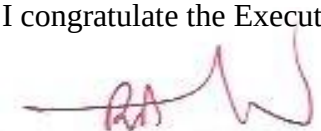
(i) Pre-Primary Education or Early Childhood & Care Education,
(ii) Primary Education,
(iii) Junior Secondary Education,
(iv) Adult and Non-Formal Education,
(v) Special Needs Education.

Thus, for those who are aspiring to go further, the new programmes are suited for B.Ed degrees. The new programmes are level specific. This simply means that we are beginning to prepare specialized teachers for each of the five levels of basic education listed above.

In view of the fundamental changes in teacher education that the above new programmes represent, an **Implementation Framework** to guide NCE-awarding institutions has been produced to accompany the revised and expanded Minimum Standards documents. The Framework sets standards for curriculum practice. It provides the background that has informed the development of the new teacher education programmes and also gives practical guidelines as to what is expected to be done by administrators, teachers and students in the process of implementing the curriculum. It is believed that this, along with other innovative ideas that have been woven in, will ensure that there is uniformity in practice across all the NCE-awarding institutions.

I commend the efforts of NCCE in its timely response to challenges and its bid to raise the quality of our pre-service teachers.

I congratulate the Executive Secretary and his staff for accomplishing this national assignment.



Prof. (Mrs.) Ruqayyatu A. Rufa'I, OON **February, 2013**
Honourable Minister of Education
Federal Republic of Nigeria

INTRODUCTION

In the last five years, the NCCE has been involved in a number of activities (including conferences, workshops, critiquing sessions, etc.) to address the discrepancy between teacher certified qualifications and the quality of their on-the-job performance. It has become clear that a major part of the problem has been an observed dislocation of the existing NCE programme from its service sector.

The mandate of the teacher training programme at the NCE level, which is the recognized minimum teaching qualification in Nigeria, is to produce quality teachers for the Basic Education sub-sector. The Basic Education sub-sector encompasses the following categories of education:

(i) Pre-Primary Education or Early Childhood & Care Education,
(ii) Primary Education,
(iii) Junior Secondary Education,
(iv) Adult and Non-Formal Education,
(v) Special Needs Education.

Each of these categories of education has an approved national curriculum which is distinctive and extensive in addition to those of the Senior Secondary Education (which remain content specific). Thus, if the NCE is to remain relevant to the sub-sector it is intended to serve, it must do more than it is presently doing. It must prepare teachers with knowledge and skills required to teach effectively at the different levels and areas of the basic education programme, without being oblivious of the needs for higher education of the beneficiaries. The new Minimum Standards document is the output of the thinking in this regard.

The emergent Minimum Standards documents, especially those for the Vocational and Technical education programmes, are accompanied with Curriculum Implementation Guidelines to assist institutions and especially the educators, in the implementation of the new ideas.

While the debates on the focus of the new Minimum Standards document were going on, the Commission was also engaged in a number of related activities. A separate group was engaged in the review of the methods of instruction. Another looked at how to provide an enabling child/learner friendly environment for our teachers and yet another reviewed the minimum professional standards for teacher educators.

The minimum standards for teacher educators define the minimum the educators should know and be able to do as well as their expected minimum dispositions towards their work, if they are to remain/progress in their career.

The need to review our system of evaluation to align with the new thinking was also recognized. Therefore, a new instrument, **Quality Assurance Toolkit**, that would address institutional evaluation as well as the needs of educators in the performance of their tasks, has been developed and circulated.

The revised Minimum Standards document has taken cognizance of these developments and has thus been expanded to meet the identified needs. It has also taken the advantage of the review exercise to update the minimum contents, using those provided in the Basic Education Curriculum. The document retains the present 2-subject combinations to allow for the

preparation of would-be teachers in the senior secondary school and as entry qualification into the B.Sc. (Ed)/B.A (Ed) programmes.

As can be inferred, considerable hard work has gone into these various documents and particularly, into the putting together of all these into the revised Minimum Standards documents.

I wish to acknowledge the contributions of our Development Partners. The COL and DFID, through the ESSPIN programme provided the initial impetus, technical assistance as well as materials that aided the development of the new Quality Assurance Toolkit. The Commonwealth of Learning (COL) also, assisted the Commission in mainstreaming the principles and methods of child-friendly schools into the NCE curriculum as well as built capacities of teacher educators in ICT. UNICEF must be commended for its assistance in the development of the curriculum for Early Childhood Care and Education (ECCE).

I also acknowledge the efforts of the Academic Programmes Department of the NCCE, which coordinated the various activities that led to the emergence of the revised NCE Minimum Standards documents for Colleges of Education and their sister institutions. In particular, I commend all those who contributed to the planning, writing, debating and critiquing of the documents. I should also thank the FCE (T) Potiskum that served as a guinea pig during the trial-testing stage of the Quality Assurance/ Accreditation Instrument.

Special thanks are also due to the Provost of FCE Zaria where the final review workshops for the new Minimum Standards for NCE and Pre-NCE programmes were held.

The production of these new Minimum Standards documents would not have been possible without the assistance of TET fund. This intervention is very much appreciated.

Finally, I appreciate the efforts of the Federal Government of Nigeria through the Honourable Minister of Education, **Prof. (Mrs.) Ruqayyatu A. Rufa'I, OON** for providing the much needed 'Federal Might' for the transformation of the education sector.

It is my fervent hope that all teacher training institutions for the Basic Education sub-sector will avail themselves with the opportunities offered by this revised **NCE Minimum Standards document.** With the provision of this document, the NCCE would henceforth be guided in its assignment, as the Commission goes round the Colleges of Education to ensure quality delivery and accreditation of our institutions and programmes.

Prof. M. I. Junaid **February, 2013**
Executive Secretary
National Commission for Colleges of Education

ACKNOWLEDGMENT

The development and publication of this Specialist NCE Minimum Standards Document would not have been possible without the support and contributions of a number of individuals and organizations. The restructuring process, which entails a series of activities including experts meeting, stakeholders' consultative workshop and critique workshops were supported by funds provided by the Federal Government of Nigeria in our regular capital projects. The Department would like to acknowledge the importance of this support.

The Department would also like to acknowledge the contributions of the numerous resource persons who participated at the various stages of the restructuring process, and commend them for job well done. In the same vein, we acknowledge the support of the Provost of the Colleges of Education who either participated personally in the activities that culminated into this edition of the Specialist NCE Minimum Standards or sponsored their staff to make presentations and inputs during the development and critique exercise.

Finally, the Department would like to appreciate the efforts and support of the Management of the Commission under the leadership of the Executive Secretary, Prof. M.I. Junaid who provided us with academic leadership for restructuring and expanding NCE Minimum Standards in line with basic education programmes.

Dr. A.Y. Abdulkareem **February, 2012**
Ag. Director
Academic Programmes Department

NCE BIOLOGY

1. PHILOSOPHY

The curriculum is designed to produce knowledgeable, highly motivated, professionals and effective teachers of biology who will be able to develop in students an appreciation

and understanding of biological process and principles. The programme is also designed to develop confidence in the biology teacher and enhance his ability to adapt to the changing situations in science and the technologically oriented society.

2. OBJECTIVES

At the end of the programme, the N.C.E. teacher will be able to:

i) view biology as a process of inquiry into the living world;
ii) critically analyse the activities of living things in their environment;
iii) demonstrate practical skills in handling scientific apparatus;
iv) demonstrate excellence and professional competence in teaching biology;
v) include positive scientific attitudes and values in the society and promote positive disposition towards biological science and the scientific enterprise;
vi) apply concepts and methods acquired in the course in new areas of study and in everyday situations;
vii) make a successful career in biology teaching;
viii) Successfully qualified to undertake a B.Ed/B.Sc (Ed) degree programmes.

3. GENERAL ADMISSION REQUIREMENTS

GENERAL ADMISSION REQUIREMENTS

a) Senior Secondary School Certificate of WAEC or NECO or any other equivalent Certificate from recognized examination bodies with credit passes in four (4) subjects including English Language and Mathematics at not more than two sittings. Two of the credits must be in the subjects making up the combinations the candidates wish to offer.
b) A Grade II Teacher's Certificate (TC II) with credit or merit in four (4) subjects, two of which must be relevant to the course the candidate wishes to offer. Credits/Merits in English Language and Mathematics are required for candidates wishing to study Biology.
c) A pass in Pre-NCE Biology final examination or a pass in IJMB Biology final examination and a pass in JAMB is required for admission.
d) All candidates wishing to be considered for direct admission must enroll for and write the selected examination organized by an accredited body such as JAMB.
e) It should be noted that some colleges may in addition to all the above, administer their own elimination tests and/or interviews for some courses. This is legitimate.

ADDITIONAL REQUIREMENT

Pre-NCE candidates should have a minimum of D grade (2.0) before transiting to read Biology at NCE proper.

4. **FACILITIES**

i) LABORATORY SPACE

There should be at least three general laboratories for each level (of about 7.5m^2), each large enough to accommodate not less than forty students. The following auxiliary facilities should also be provided:

- Biological garden (botanical and zoology);
- Museum;
- Aquarium;
- Herbarium;

There should also be a stock room and preparation room adjacent to the laboratory.

ii) Lecture Hall: There should be at least three lecture halls each of which is large enough to accommodate sixty students. Public address system and an overhead projector should be provided in the large halls.

STAFF OFFICES

The comfort of teaching staff must be taken into consideration. Ideally, there should be an office per lecturer. The office should be equipped with bulletin boards, book shelves, filing cabinet, seats for at least three visitors and standard furniture. There should also be an office for support staff with relevant equipment.

a) Staff Common Room - There should be a big general office with adequate furniture to comfortably accommodate all the staff of the biology department.

b) HOD's Office - This should be fully furnished with adequate convenience and file cabinets.

iv. Books in the Library: There must be enough books to cover all the areas of the subject to the ratio of one student to ten books in the department and college library. In addition, there should be E-library at the departmental level.

v. EQUIPMENT AND MATERIALS

S/№	DESCRIPTION	QUANTITY REQUIRED
a)	Models and charts	
1.	Skeletal System	1
2.	Muscular System	1
3.	Brain and Nervous System	1
4.	Circulatory System	1
5.	Digestive System	1
6.	Eye and Vision	1
7.	Ear	1
8.	Skin and Excretory Organs	1
9.	Genetic Modes	4
S/№	**DESCRIPTION**	**QUANTITY REQUIRED**
b)	EQUIPMENT AND CONSUMABLES	
10.	Hand lenses	40
11.	Microscopes	20
12.	Incubator/Sterilizer	1
13.	Autoclave (Portable)	3
14.	Balances	3
15.	Hot Plates	1
16.	Refrigerator	1
17.	Water Filter	1
18.	Hygrometer	1
19.	Drying Oven ($30^{oc} – 120^{oc}$)	1
20.	Microtone/Stage micrometer	1
21.	Automatic Tissue Processor	1
22.	Centrifuge	1
23.	Herbarium Cabinet	9
24.	Herbarium Index Boxes	2
25.	Air Pumps	6
26.	Photometer	2
27.	Kymograph	10
28.	Dissecting Microscopes	2
29.	Insect Light Traps	1
30.	Insect Box Traps	1
31.	Slide Projector	1
32.	Overhead Projector	2
33.	Steel Frame Aquaria	1
34.	Oxygen Meter	1
35.	Binocular Microscopes	4
36.	Embedding Bath	5
37.	Class distiller	1
38.	Water Bath	1
39.	pH Meter	2

40.	Tissue Grinder	4	
41.	Calorimetre	6	
42.	Auxanometer (electric)	4	
43.	Soil Agar	2	
44.	Plant Press	2	
45.	Soil Treating Kit	1	
46.	Wooden Quadrants	10	
47.	Measuring Tape	5	
48.	Biological Kit/Dissecting Sets	10	
49.	Dissecting Boards/Plate stray	40	
50.	Bunsen Burners		20
51.	Giant Gas Cylinder		2
52.	Prepared and Plane microscope slides (Assorted)		
53.	Consumables: Glass wares, stains, chemicals (Assorted)		
54.	Test tube rack		10
55.	Preserved plant and animals specimens (Assorted)		
56.	Desiccators		3
57.	Gloves		
58.	Safety device (assorted)		

5. PERSONNEL

i) ACADEMIC STAFF

A minimum of 10 academic staff are required to adequately implement the N.C.E. Biology programme. The minimum qualification for academic staff is second class lower for first degree i.e. B.Sc, B Ed, B S.c (Ed). The holder of B.Sc degree must also possess either NCE or PGDE or Technical Teachers' Certificate (TTC) to be professionally qualified.

ii) OTHERS

a) Technologist - Three
b) Technician - One
c) Junior Staff - One each of the following

- Laboratory attendant
- Laboratory assistant
- Gardener/Curator
- Cleaner
- Typist
- Office assistant

6. MODE OF TEACHING

For the broad objectives of teaching the subject to be achieved, the following methods are recommended.

a) Lecture method
b) Practical
c) Project method
d) Field trips and excursions

e) Games and simulations
f) Team teaching
g) Demonstration method
h) Tutorial
i) Concept mapping and computer assisted

7. GRADUATION REQUIREMENTS

i) An average of D in each of the 2 major subjects and education i.e. cumulative Grade point average of 2 points each plus a pass in English and Mathematics including other GSE courses.

ii) Successful completion of Teaching Practice and outdoor Education programmes.

iii) Successful completion of project for the award of NCE Certificate.

All students admitted into biology programme will offer all compulsory courses prescribed.

Biology	-	Minimum	32	Maximum	34	Credits
Second Teaching subjects	-	Minimum	32	Maximum	34	Credits
Education including TP	-	Minimum	36	Maximum	36	Credits
General Study	-	Minimum	18	Maximum	18	Credits
Total	=	**Minimum**	**118**	**Maximum**	**122**	**Credits**

For computation of Grade Point Average (G.P.A.), all compulsory courses should count. For transition from Pre-NCE 1 Biology; the candidate must make a grade not less than D or CGPA of 2.0

8. TEACHING PRACTICE

The whole of 300 level first semester should be devoted to teaching practice i.e. starting from mid September to April. This covers two terms to school year or 26 weeks. Teaching Practice earns 6 credits under Education 311.

9. PROJECT

The final Year project is compulsory for all graduating students. The project may be written or practical, and supervised in any area of the student's chosen subjects and the grade for the Project should be credited to EDU 323. Project carries 2 credits.

10. SUBJECT COMBINATION

Only the accredited subject combination acknowledged by the Commission is acceptable.

ll. **COURSE CODE COURSE TITLE CREDIT UNIT AND STATUS**

NCE 1 FIRST SEMESTER

NCE 1 FIRST SEMESTER			
COURSE CODE	**COURSE TITLE**	**CREDIT**	**STATUS**
BIO 111	Basic Principles of Biology	1	C
BIO 112	Cell-Biology	1	C
BIO 113	Viruses, Bacteria & Lower Plants	2	C
BIO 114	Biology Practical l	1	C
BIO 115	Ecology	2	C
	Total	7C	

NCE 1 SECOND SEMESTER			
COURSE CODE	**COURSE TITLE**	**CREDIT**	**STATUS**
BIO 121	Diversity of Invertebrates	1	C
BIO 122	Diversity, Anatomy and Histology of spermatophytes	2	C
BIO 123	Biology Methods	2	C
BIO 124	Biology Practical II	1	C
	Total	**6C**	

NCE II FIRST SEMESTER			
COURSE CODE	**COURSE TITLE**	**CREDIT**	**STATUS**
BIO 211	Diversity of Chordates	2	C
BIO 212	Research Methods and Biometry	1	C
BIO 213	Population Education	1	C
BIO 214	Plant Pathology	1	E
BIO 215	Animal Histology	1	E
BIO 216	Biology Practical III	1	C
	Total	**5C + 1 E = 6**	

NCE II SECOND SEMESTER			
COURSE CODE	**COURSE TITLE**	**COURSE CREDITS**	**STATUS**
BIO 221	Plant Physiology	2	C
BIO 222	Vertebrate Anatomy & Physiology	2	C
BIO 223	Embryology	1	E
BIO 224	Biology Practical IV	1	C
BIO 225	Evolution	1	E
	Total	5C + 1E = 6	

NCE III FIRST SEMESTER			
EDU 311	TEACHING PRACTICE	6	C

NCE III SECOND SEMESTER			
BIO 321	Laboratory Management	1	C
BIO 322	Applied Biology	2	C
BIO 323	Introductory Parasitology	1	C
BIO 324	Genetics	2	C
BIO 325	Biology Practical V	1	C
	TOTAL	7	

SUMMARY

Study Status	First year credit units	Second year credit units	Third year credit units	TOTAL
Compulsory	13	9	8	30
Elective (Optional)	-	4	-	4
Total	13	13	8	34

C = Compulsory
E = Elective

N.B
Minimum Credit required for Graduation
Compulsory 30 Credits
Elective 2 Credits
Total 32 Credits

12. **COURSE DESCRIPTION**

NCE 1 FIRST SEMESTER

COURSE CODE COURSE TITLE CREDIT UNIT AND STATUS

BIO 111 - BASIC PRINCIPLE OF BIOLOGY 1 Credit. Compulsory

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

i. Apply basis biology principles to everyday life.
ii. Explain steps involved in scientific method.

- Definition, brief history and Importance of science
- Scientific method: - Identifying and defining problem, Raising question, formulating Hypotheses, designing experiments to test hypothesis, collecting data, analyzing data, drawing inference and conclusion.
- Science processes/intellectual skills:
  a) Basic processes: observation, Classification, measurement etc
  b) Integrated processes: Experimentation, prediction, Hypothesis, Communicating, Theory formulation etc
- Science of biology and its subdivisions: Botany, Zoology, Biochemistry, Microbiology, Ecology, Entomology, Genetics, etc.
- The Relevance of Biology to man: Application in conservation, Agriculture, public health, medical sciences etc.
- Relation of Biology to other science subjects
- Principles of classification: Brief history of classification nomenclature, and systematic
- The 5 kingdom system of classification.
- Living and non-living things: General characteristics of living things. Differences between plants and animals.

BIO 112 CELL BIOLOGY 1 Credit Compulsory

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

i. Describe the cell theory
ii. List the cell constituents
iii. Differentiate between mitosis and meiosis.

a) A brief history of the concept of cell and cell theory. The structure of a generalized plant cell and a generalized animal cell, and their comparison

- Protoplasm and its properties. Cytoplasmic Organielles: Definition and functions of ucleus, endoplasmic reticulum, cell membrane, mitochondria, ribosomes, golgi complex, plastids, lysosomes and other cell organelles

b) Chemical constituents of cell – salts, carbohydrates, proteins, fats and oils, nucleic acid.

c) Physical processes of cell: particle size, molecules and ions, suspensions, colloids and true solutions, properties of aqueous system; diffusion, osmosis plasmolysis, turgor, pinocytosis, phagocytosis.

d) Cell Division:
   - Mitosis and meiosis
   - Major stages of mitosis and meiosis
   - Comparison of the two divisions
   - Significance of mitosis and meiosis

BIO 113 VIRUSES, BACTERIA AND LOWER PLANTS. (2Credits) Compulsory

Objectives:

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

i. Illustrate the diversity of lower organism

ii. Explain the economic importance of the organism.

i. Viruses - Classification, size, structure, kinds, replication; role in diseased – human (e.g. STD, HIV –AIDS), plants and domestic animals e.g. (coccidiosis in poultry). Bacteriophages – structure and its biochemical activities

ii. Bacteria - General description: structure; classification based on shape, mode of nutrition, types of flagella, mode of respiration and staining mechanism; life history; nutrition, role in diseases.

iii. Fungi - General description, classification, and relationship with the environment. Study of various representatives of the phycomycetes e.g. Mucor, Rhizopus. Economic importance.

iv. Algae - Classification, range of forms i.e. solitary, colonial, filamentous, etc. Reproduction and economic importance of a named example.

v. Lichens - An example of symbiotic relationship between fungi and algae. General description, classification and importance.

vi. Bryophytes - Musci and Hepaticae. Treatment of each class using common examples in Nigeria – Perlia, Funnaria generations, habits, problems of the terrestrial environment as encountered by bryophytes in transition from water to land.

vii. Pteridophytes - Classification, general description of various classes, alternation of generations. Structure, reproduction and habit of Lycopodium, Sellaginella Dryopteris. Types of stele. Transitional position of pteridophytes among vascular and non vascular plants.

BIO 114 BIOLOGY PRACTICAL I 1 Credit Compulsory

Objectives:

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

i. Identify materials used in biological practical
ii. Explain the rules guiding biological drawings
iii. Explain the techniques in biology practicals.
    i) Requirements for practical classes in biology
    ii) Examining biological specimens using hand lens
    iii) Rules for making biological drawings.
    iv) The microscopes and their uses (including magnification)
    v) Data collection, analysis and presentation of results
    vi) Format for reporting observation in practical biology
    vii) Forms of practical examination in biology (observing and drawing specimens, performing or carrying out experiments, alternative to practical etc)
    viii) Sectioning and staining techniques
    ix) Slide preparation
    x) Principles and practice of sterilization
    xi) Culturing techniques for microscopic organisms such as bacteria and fungi
    xii) Study of plant and animal cells using onion leaf, Rheo discolour or similar plants (for plant cell) and scraping of the inner lining of the cheek to isolate and study animal cells
    xiii) Practical study of mitosis and meiosis
    xiv) Experiments on plasmolysis, osmosis and diffusion
    xv) Preparation and observation of slides of Mucor and Rhizopus
    xvi) Observation, of slides of some pteridophytes
    xvii) Preparation and observation of slides of algae e.g. Spirogyra, Euglena, Chlamydomonas etc
    xviii) Preparation and observation of slides of lichens showing various types and forms
    xix) Collection of Bryophytes and observation under the microscope
    xx) Dissection techniques, practice on dissection of toad and lizard (Agama)
    xxi) Use of dichotomous key to identify organisms.

BIO 115 ECOLOGY 2 Credits Compulsory

Objectives;

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

i. Describe basis concept used in ecology
ii. Explain plant succession and biotic interaction eg. Symbiosis, Commensalism, predation, parasitism, competition etc.

Ecological cycles (carbon, nitrogen, water and oxygen)
Basic terms and concepts of ecology - autecology, syneacology, environment, habitat, niche, ecosystem, adaptation. Ecological factors (their measurement and units in which the values are expressed). Soil studies – soil components, soil properties, beneficial role of soil organisms, soil fertility and its loss. Soil in relation to plant and animal life. Aquatic habitats, terrestrial habitats – their nature, distribution, classification, environmental features, ecological hazards to life and adaptations of plants and animals in these habitats. Microhabitants: cracks on rock surfaces, tree crowns, soil litter on the ground, tree barks savannah micro-habitats: termiteria

Population Studies

- Terminology in population studies (species, population, community, population size, biotic potential, natality, mortality, immigration, emigration, carrying capacity, innate capacity, environmental resistance)
- Methods of assessing the size of population;
- Population growth and population growth curves
- Factors affecting size of populations. Reference should also be made to human population.

Plant Succession
Primary and Secondary succession
Processes involved in plant succession,
Plant succession in selected habitats. Consequences of population changes on the Ecosystem.

Biotic Interactions:
Symbiosis, commensalisms, Predation, parasitism, competition, saprophytism, epiphytism, phoresis. Energy and material relations of organisms. Concept of biological productivity, energy transfer, trophic interactions, methods of expressing trophic interactions.

NCE I SECOND SEMESTER

BIO 121 DIVERSITY OF INVERTEBRATES 1 Credit Compulsory

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

i. State the general characteristics of protozoa, porifera platyhelminthes, nematodes, mollusks and the echinoderms
ii. Describe the life cycle of protozoa porifera coelenterate platyhelminthes, nematodes etc.

Protazoa

- General Characteristics
- Mode of life and life cycle of Sarcodina e.g. Amoeba sp
- Mode of life and life cycle of Mastigophora e.g. Euglena
- Mode of life and life cycle of Sporozoa e.g. Plasmodium
- Mode of life and life cycle of Ciliata, e.g. Paramecium

Porifera

- Characteristics and structure of sponges

Coelenterate

- General Characteristics of major classes
- Mode of life and life cycle of Hydra and Obelia

Platyhelminthes

- General Characteristics
- Mode of life and economic importance of
  CLASS: Tubelaria e.g. Planaria
  CLASS: Trematoda e.g. Fasciola
  CLASS: Cestoda e.g. Taenia
  CLASS: Aphasmidia e.g. Ascertidina

Nematoda

Ascaris- mode of life and economic importance

Annelida

General Characteristics, mention of mode of life, and economic importance
CLASS: Oligochaeta - e.g. Earthworms.
CLASS: Polychaeta e.g. Tubeworm/Sand/Lugworm.
CLASS: Hirudinea – e.g. leech.

Arthropoda

General characteristics of the phylum.
External features of an example of each class:

- Crustacea
- Insecta
- Arachnida
- Myriapoda
- Chilopoda
- Diplopoda

General features, mode of life and life history of the following orders of the class Insecta: Diptera, Lepidoptera, Hemiptera, Hymnoptera.

Mollusca

General Characteristics.
Brief classification and examples of each class.

Echinodermata

General description. Link between invertebrates and chordata.

BIO 122 DIVERSITY, ANATOMY AND HISTOLOGY OF SPERMATOPHYTES
2 Credits Compulsory

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

i. Outline the general characteristics gymnosperms, conifer and angiosperm

ii. Describe the morphology/physiology of angiosperm – stem, leaf, root and their modifications
iii. Describe the different types of tissues and their functions

Introduction to, and general description of, spermatophytes and their subdivisions. General characteristics of gymnosperms and classification.
Similarities and differences with higher cryptogams. Development of seed in gymnosperms and factors responsible for seed development. Structure and life-cycle of a conifer e.g. Pinus. Development of embryo in gymnosperms.
Alternation of generation in plants. Characteristics of different angiosperm families. External morphology of angiosperm-stem; leaf, root and their modifications. Flower – concept of whorls, inflorescence and types. Pollination, fertilization, megasporogenesis and microsporogeneiss, Development of embryo in angiosperms. Seed and fruit formation. Fruits and their classification.
Dispersal of fruits and seeds.
Importance of spermatophytes as sources of food, medicine, shelter, etc

- Cell types, distribution, and structure in relation to function
    - Different types of tissues and their functions
    - Anatomy of root, stem and leaf of monocot and dicot plants
    - Primary and Secondary thickening.

BIO 123 BIOLOGY METHODS 2 Credits Compulsory

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

i. State the Aims and objectives of teaching biology in Secondary Schools
ii. List the resources/strategies used in teaching biology.
    - Aims and Objectives of teaching Biology in Secondary Schools
    - Syllabus, Scheme of work, lesson plan and lesson note.
    - Stating aims and instructional objectives in biology
    - Resources for teaching biology
    - Improvisation in biology teaching
    - Methods/strategies of teaching biology e.g. discussion, Lecturer, demonstration, small group approaches, activity approach, independent study etc.
    - Evaluation of Biology learning outcomes:
      Cognitive: (memory, comprehension and application objectives)
      Affective: (interest, value, receiving, responding, valueing) psyschomotor: how to use hand lens, microscope, etc (manipulative skills)
    - Scientific attitudes – honesty, curiosity, critical/open mindedness etc
    - Micro-teaching
    - Further strategies in biology teaching: questioning, inquiry, discovery, fieldtrips, use of resource persons, tours and excursions, projects etc.

- Classrooms management. Evaluation in biology i.e. types of tests and test construction in biology. Developing tests at the cognitive (all the six levels). Affective and psychomotor domains. Development organization and characterization of test items.
- Further micro-teaching with emphasis on the importance of teaching aids Practical work on improvisation of teaching aids in biology equipment and materials (models, charts, mock ups, realia etc). Preparation of charts and posters on core message of Population/Family life education and Sexually Transmitted diseases (STD)/AIDS.

BIO 124 BIOLOGY PRACTICALS II 1 Credit Compulsory

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

i. Observed/identify and draw, label amoeba, Euglena, paramecium, Hydra, planaria, taenia, class insect, typical gymnosperm and angiosperm

ii. Measure various factors of Ecosystem

AMOEBA:
- Observation of slides of Amoeba with false feet (Pseudopodia), food vacuoles and contractile vacuoles

EUGLENA
- Make temporary slides of specimen collected from a slow flowing stream or pond to identify Euglena with flagellum
- Observe permanent slide of Euglena and study the physical appearance

PARAMECIUM
- Observe the slide of Paramecium to identify the structure (shape, cilia, mega nucleus, micronucleus, star-shaped to contractile vacuole, food vacuole).

HYDRA
- Identify the tentacles, hypostome (mouth), two body walls– Ectoderm and Endoderm separated by mesoglea
- Observe L/S of the body wall.

PLANARIA
- T.S. slide of Planaria to show the three layers or body walls – (ectoderm mesoderm, endoderm)

TAENIA
- Observe slide to Taenia showing suckers and segmentation

LUMBRICUS (EARTHWORM)

- Collect living earthworms and study the physical appearance
- Observe the T.S. of earthworm

ACATINA

- Collect and observe the general appearance of snail.

CRUSTACEA

- Collect and study the structure of crayfish or any other suitable crustacean

MYRIAPODA

- Study the physical appearance of centipedes and millipedes (note many legs of the myriapode).
- Draw and label (use preserved specimen or freshly killed) specimen in chloroform.

ARACHNIDA

- Study the physical appearance of Spider: Note two body divisions, four pairs of legs

INSECTA:

Study the appearance of cockroach – a representative of insect
Note three body divisions, three pairs of jointed legs, two pairs of wings
Note position of wings on thorax (meso and meta thorax)
Note segmented abdomen and spiracles on abdominal segments
Study mouth parts of these insects:
Dipteria: (Housefly, Mosquitoes)
Hymenoptera: (bees, ants)
Lepidoptera: (butterfly and moth)

DIVERSITY OF SPERMATOPHYTES

- External morphology of typical Gymnosperm and Angiosperm
- Preparations of Keys for identifying Angiosperms
- Flowers and inflorescence
- Study placentation of seed in fruits, types of fruits and adaptation for dispersal

ECHINODERMATA – Collect and study general external features of star fish

ECOLOGY

- Habitat studies: on suitable aquatic and terrestrial environments
- Mini project on specific habitat study
- Measurement of physical factors e.g. Temperature, Light intensity, humidity, wind direction and speed, dissolved ages turbidity, depth speed of flow PH in relevant habitats

- Edaphic factors – soil porosity, water holding capacity, soil texture, PH percentage humus, and land slope, soil temperature at various depths and time.

NCE II - FIRST SEMESTER

BIO 211 DIVERSITY OF CHORDATES 2 Credits Compulsory

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

i. Identify and outline the various classes of chordates
ii. Explain the evolutionary advancement classes of chordates
    a) General Characteristics of Chordates
    b) Classification and general distinguishing characteristics of:
        i. Sub phyla protochordata and vertebrata
        ii. Super classes Agnatha and Gnathostomata
        iii. Agnatha - Class Cyclostomata.
        iv. Gnathostomata - Classes: Pisces
            Amphibia
            Reptilia
            Aves
            Mammalia
    c) Evolutionary advancement, adaptive radiation, success and special features of interest in the various groups
    d) i. The transition from water to land and the problem of land life in amphibians
        ii. The development of the cleidoic egg in the Amniota
        iii. The dominance of mammals over other chordates.

BIO 212 RESEARCH METHODS AND BIOMETRY 1 Credit Compulsory

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

i. Describe the procedure involved in conducting a research

- Meaning, Purpose and relevance of Research and Biometry
- Types of Research (Experimental, Survey, Case Study etc)
- Choice of Research Topic
- Hypothesis (Types, Source, Formulation)
- Data Collection (Types and Sources)
- Population, Sample and Sampling techniques
- Data Presentation: Frequency Distribution, Cumulative frequency, graphs (line, histograms)
- Bar Charts, Pie Charts etc)

- Measures of Central tendency (Mean and Median)
- Measures of Dispersion (Mean Deviation, Variance and Standard Deviation)
- Measures of Relationship (Chi square (x^2) Correlation Coefficient, T-test and ANOVA)
- Project reporting.

BIO 213 POPULATION EDUCATION 1 **Credit Compulsory**

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

i. Identify the factors effecting population growth
ii. List the problems associated with over population and the remedies

World Human Population Growth and Problems

- Factors accounting for population growth (causes of population change in Nigeria e.g. socio-culture practices and religious beliefs.
- Population policies and strategies
- Methods and problems of estimating human population (e.g. school community) and interpretation of results
- Population and development of resources
- Solutions to problems of population growth.
- Birth control measures involving male and female reproductive organs controversies and consequences. Reproductive behavior (e.g. early marriage, premarital sex, teenage pregnancy) – consequences.
- Biological, psychological, social and economic readiness of male and female for reproduction.
- Ethical implications of biotechnology.

BIO 214 PLANT PATHOLOGY 1 Credit Elective

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

i. Identify common diseases of crop plants.
ii. Explain basic principles plant protection.

- Meaning of plant pathology and pathogenicity.
- Plant pathology as it affects food production and quality of life.
- Differences between diseases, parasites and pests
- Classes of diseases, modes of transmission of pathogens
- Entry of pathogens in tissues of hosts
- Diseases enhanced by abiotic factors such as adverse weather conditions and mineral deficiencies
- Phenomenon of infection and factors influencing it.
- Features of the major groups of plant pathogens (viruses, algae, fungi bacteria, worms and nematodes)

- Diseases of food crops such as maize, yams, cassava, rice, tomatoes and any other suitable food crops.
- Biology and control of diseases; a few selected diseases (biological control)
- Diseases of cash crops such as tobacco, groundnut, oil palm and any other suitable cash crop.
- General principles of plant protection.

BIO 215 ANIMAL HISTOLOGY 1 Credit Elective

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

i. Describe the various tissues and organs of human body.

- History of various tissues should be studied e.g.
  Epithelia
  Connective tissue
  Muscular Tissue
- **Histology of the following organs**
  Skin
  Liver
  Kidney
  Ovary and testis
- **Histology of the following:**
  Blood
  Bones
  Cartilages
  Muscles
  Nerves

BIO 216 BIOLOGY PRACTICALS III 1 Credit Compulsory

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

i. Prepare and observed slides of different plants pants.
ii. Identify and draw different types of organisms in chordates.

Anatomy and Histology of Plants

- Preparation of temporary slides for T.S. of root, stem and leaf of monocots and dicots
- Observation of permanent slides of root, stem and leaf of dicots and monocots field observation of Primary and Secondary Thickening.

Diversity of Chordates

- Observation of living forms of fishes (bony and cartilaginous e.g. Tilapia and dogfish), observation of Primary and Secondary thickening

- Observation of living forms of birds (Aves) e.g. pigeon/chicken for external and adaptive features in flight.
- Examination of the various types of mammals. Observation of living and preserved specimens of mammals.

NCE II – SECOND SEMESTER

BIO 221 PLANT PHYSIOLOGY 2 Credits Compulsory

Objectives;
At the end of the course, students should be able:

i. Explain basic physiological processes in plants

Water Relations
Absorption of water
Transpiration in details

Mineral Nutrition in plants
The various mineral requirements of plants: sources and roles of each mineral element (including trace elements) in plant metabolism; Nutrient deficiency, diseases in plants.

Photosynthesis
Plants as Primary producers of food for populations. General description of the process. Raw materials and products of photosynthesis, Mechanism of photosynthesis, chloroplast as the site for photosynthesis: light reaction conversion of light energy into energy; photochemical splitting of water, Calvin cycle, Dark reaction.

Translocation of manufactured food. Reduction of nitrates and production of amino acids.

Respiration
General description of aerobic and anaerobic respiration in plants.

Growth and Movements
Growth of plants in length, and its measurement. Movement in plants e.g. tropism, taxism and nastism

Excretion in Plants
Excretion materials and their removal from the plant body.

BIO 222 VERTEBRATE ANATOMY AND PHYSIOLOGY 2 Credits Compulsory
Vertebrate Anatomy

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

i. Out line and explains the various systems of the body.
ii. Describe the functions of the various systems.

- Meaning, scope and description of vertebrate anatomy and physiology
- Study of the following systems in mammals and amphibians
- Digestive system
- Circulatory system
- Respiratory system
- Compare male and female reproductive organs of human being
- Nervous system
- Skeletal system

Nutrition

- Meaning of nutrition, components of food and balanced diet, mineral requirement in animal.

Digestive System and Digestion in Mammals and Amphibians

- Function of liver with emphasis on deamination

Enzymes

- Definition and nature of enzymes
- Main categories of enzymes and the system of naming them
- Factors affecting enzyme activity and the mechanism of enzyme action
- Co-enzymes and Prosthetic groups.

The Circulatory System

- Structure and functions of the circulatory system
- Blood circulation and control of heart beat.
- Structure and functions of blood, mechanism of blood clotting
- Blood transfusion, body resistance and AIDS
- Importance of blood screening (to detect cancer, malaria parasites hepatitis, leukemia etc)

Respiratory System and Respiration

- Structure and functions of respiratory system
- Mechanism of inhalation and exhalation; aerobic and anaerobic respiration, glycolysis and the Kreb's cycle.
- Significance of respiration.

Excretion

- The need for excretion and major metabolic wastes in vertebrates
- Excretory organs and their functions (the skin, lungs, kidneys)
- Processes of excretion (nitrogenous and gaseous excretion)

Nervous System and Co-ordination

- Structure and functions of the central and peripheral nervous system]

- Functions of a nerve cell, nerve impulse, synapse, nervous control and coordination.
- Nervous integration, description of the reflex arc
- Sense organs – eye, ear, skin, tongue, nose etc.

Skeletal and Muscular Systems

- Structure and functions of mammalian skeleton. Mechanism of muscular contraction.

Hormonal Co-ordination

- Meaning, properties and functions of hormones; the pituitary and tropic – hormones (their sources and effects in the body).
- Thyroxin, adrenalin and hormones of the reproductive system (their glands and effects in the body).

Reproductive System and Reproduction

Structure and functions of the male and female reproductive systems in mammals. Fertilization, gestation and birth in a named mammal. A brief mention of menstrual cycle is needed.

BIO 223 EMBRYOLOGY 1 Credit Elective

Objectives:

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

i. Describe the developmental stages of an organism
ii. Explain the process involved in gestation in mammals.

- The concept of embryology
  Fundamental processes in embryonic development: Determination, differentiation, morphogenesis (growth and organogenesis), Gametogenesis (spermatogenesis and oogenesis).
- The structure of spermatozoa and egg cell of a named mammal at the time of fertilization.
- The meaning stages, characteristics, types and significance of cleavage
- Outline of the development of a fertilized ovule and the production of seed and fruit in a dicotyledonous plants
- An outline of the development of an amphibian (frog or toad) or bird, to the neurula stage only.
- Embryonic membranes in birds and mammals
- Functions of the placenta in birds and mammals
- Gestation and abortion: birth in mammals.

BIO 224 BIOLOGY PRACTICALS IV 1 Credit Compulsory

Objectives;

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

i. Conduct simple biological experimental

ii. Dissect

- Experiments to demonstrate that Chlorophyll light and cabondioxide, are necessary for photosynthesis.
- Experiments to show that starch and oxygen are products of photosynthesis
- Experiments to show tropisms in plants
- Examination of various excretory products from plants e.g. trains gums, resins and salts, etc.
- Experiments on Transpiration to show:
- Evidence of transpiration in plants
- Rate of transpiration.
- Factors affecting transpiration rates.
- Study of slides in spermatogenesis and oogenesis.
- Gross and microscopic structures of the kidney.
- Slides of various tissues should be examined under strict supervision and guidance of the teacher.
- Examination of slides of various organs.
- Population studies using sampling techniques.
- Observation of succession in the suitable habitat e.g. plant succession
- Identification of diseases associated with cash crops mentioned in the syllabus. Interpretation of data, where available, on distribution of plant diseases and STDs/AIDS in Nigeria.
- Dentition in herbivores, carnivores and omnivores compared
- Enzyme action of food substances, e.g. action of salivary amylase on starch.
- Factors affecting enzyme action
- Measurement of heart beat and effect of exercise on heart beat.
- Measurement of breathing rate and effect of exercise on breathing rate.
- Determination of various taste sites on the tongue
- Determination of the blind spot on the eye
- Effect of sight on balancing
- Dissection of mammals showing the location of various organs and system.
- Digestive system
- Respiratory system
- Excretory system
- Circulatory system
- Reproductive system
- The system above could also be shown in the frog/toad for comparison.

BIO 225 EVOLUTION 1 Credit Elective

Objectives:

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

i. Discusses the various evidences in favour of evolution.

ii. State Darwin's theory and its implications in modern world.

- Concept of Evolution
- Evidence for Evolution
- The geological timetable
- Trends and theories of Evolution including pre-Darwinism and Neo-Darwinism theories.
- Darwinism theories.
- Darwin's theory of natural selection.
- Competition with particular emphasis on competition for food, space and other resources among human population.
- Competition, variation and survival of the fittest.
- Mutational changes as causes of evolution.
- Adaptive radiation
- Isolating mechanisms
- The origin of life
- Fossils and human evolution.

NCE III FIRST SEMESTER

EDU 311
TEACHING PRACTICE

NCE III 2ND SEMESTER

BIO 321 LABORATORY MANAGEMENT 1 Credit Compulsory

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

i. Outline the procedures in effective laboratory management
ii. Improvise basic materials for biology practical.

- The planning of a biology laboratory
- Location, size, height, spacing and facilities such as windows, doors
- Lighting and other fittings like cupboard and working benches
- Ordering of equipment.
- Inventory, care and maintenance of the equipment
- Common accidents in the Laboratory-fire, acid & alkaline burns, animal bites, stings, inhalation of dangerous gases, cuts, electrical shocks etc.
- Safety in the laboratory.
- Safety devices such as fire-extinguisher, fire blankets and bucket.
- First aid: (first aid kit, first aid measures)
- Knowledge of electrical wiring in the laboratory: fuses, bulbs and fluorescent tubes.

- Improvisation in biology laboratory: importance of local production, basic skills in improvisation and local production of local production, basic skills in improvisation and local production in wood work, glassblowing, brick laying, metal work and electrical/electronics. Such skills should be usable in construction simple biological equipment.
- Biological garden and outdoor laboratory.
- Setting up of a school biological museum and preparation of museum materials, preservation, display etc. (Taxidermy)
- The herbarium – construction and setting up of a herbarium.

BIO 322 APPLIED BIOLOGY 2 Credits Compulsory

Objectives:

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

i. Explain simple health habits
ii. Explain how the activities of man affect his environment.
iii. Identify problems associated with drug abuse

Man's Diseases and Health

Disease – meaning, common tropical diseases, their causes, cure and prevention. Effects of parasites on man e.g. malaria parasite, sleeping sickness parasite etc. Public health and roles of voluntary and international organizations in health control.

Social and health problems of Tobacco consumption and the effect of smoking on the body; Drugs, their uses and abuses (mentioned use of cocaine, hemp and other dangerous drugs)

Family life education. Sexually transmitted diseases /HIV-AIDS.

Other social problems such as: prostitution) sex abuse and the effects on human health and productivity.

- **Ecological Consequences of Agriculture**

  Relationship between monoculture and spread of plant diseases and pests

  Ecological effects of herbicides, pesticides and chemical fertilizers.
- **Ecological Consequences of Urbanization and Industrialization**

  Overpopulation and pressure on social amenities e.g. transportation and housing, undesirable social habits such as delinquency, truancy, prostitution, pollution, conflict in land use.
  - Solution to problems of population growth
  - Birth control measures.
  - Reproductive behavior e.g. early marriage, pre-marital sex, teenage pregnancy, abortion, their prevention and control. Population education in Biology – Preparation of charts and posters on core messages/slogans of effects of uncontrolled population.

- **Effects on Man on his Environment**
  Effects of man on vegetation, atmosphere, soils, water and water resources, other natural resources.

- **Pollution**
  Definition: types of pollution (air pollution, water pollution, land pollution)
  Curses of pollution
  Effects of pollution (effects of air pollution, water pollution and land pollution)
  Control of pollution
  N.B. Special mention should be made to sewage and other forms of urban pollution e.g. noise, radiation and ocean pollution, unburnt gases or smokes from motor cars exhaust pipes or motorcycle silencers.

Conservation of Natural Resources

- Wildlife, minerals, forests, soil, water, atmosphere, fuel (e.g. crude oil) Methods of conservation and preservation of these resources.

Field Trips

Field Trips to game reserves to study rare species in their natural habitats

- Visit to areas of gully and sheet erosion
- Visit to notable areas of pollution e.g. polluted streams; mechanic workshops etc and observe pollution. Watch films on polluted habitats.

N.B. Field trip/Excursion to game reserves or major areas of biological importance is compulsory. Its report is to be presented for accreditation purpose and should form a minimum of 20% of this course.

BIO 323 INTRODUCTORY PARASTOLOGY 1 Credit Compulsory

Objectives:

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

i. Identify various parasites and their life cycles.

Meaning and scope of parasitology
Parasitism: different types of parasitic relationships between organisms e.g. obligate, facultative, parasitic adaptations including change of antigenic structure as in the AIDs virus (HIV)
Adaptation involved in parasitic mode of life and transmission of STDs/AIDS
Parasitic mode of life of the following:
Entamoeba spp, Malaria parasites, (Plasmodium spp) life cycle and control.
Trypanosome spp. Life cycle and control
Trichomonas vaginalis lifecycle, cure and control)
Helminthes such as Fasciola hepatica: Schistosoma spp.
Nematodes such as Ascaris spp

Hookworms such as Ancyclostoma duodenale, Wuchereria bancrofti
(Note: All these organisms' life cycle, cure and control are expected to be treated).

- Plant parasitic nematodes
- Parasitic insects (Structure, adaptive features and control).

BIO 324 GENETICS 2 Credit Compulsory

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

i. Explain various terminologies used in genetics.
ii. Describe the application of genetics in medicine and agriculture.

- Heredity and Environment:
- Mendel's work on peas. Meaning of basic genetical terms (genotype, homozygous, heterozygous, alleles, etc). Mono and dihybird crosses. Concept of dominance, Incomplete dominance.
- The choromosome theory of inheritance and the gene hypothesis, nucleic acid, DNA genetic code. Salivary gland chromosomes, RNA, protein synthesis, formation of amino acids and lipoproteins.
- Sex chromosomes, autosomes, sex determination and linkage.
- Mutations: lethal mutations, Polyploidy: Examples of new varieties of plants and animals arising by mutation and polyploidy: production of mutations by radiation and other means.
- Human heredity e.g. colour blindness, paternity, blood groups, haemophilia.
- Problems in family that relate to sex determination, intelligence, membership resemblance and diseases.
- Genetic Counseling on family characteristics e.g. blood groups, blood types and sickle cell anaemia
- Applied genetics: in agriculture, medicine etc.

BIO 325 BIOLOGY PRACTICAL V 1 Credit Compulsory
Objectives:
At the end of the course, students should be able:

i. Identify various laboratory skills
ii. Illustrate the roles of various biological structures eg. Herbarium, museum and biological gardens.
    - Examination of any fossil material, if available
    - Excursion to zoological garden to study evolutionary trend among animals

Parasitology

- Observation of slides of Plasmodium, Trypanosome, Taenia, Fasciola, Ascaris, Ancyclostoma, Wuchereria etc.
- Observe sterilization techniques in hospitals especially with reference to prevention of HIV infection.
- Observation of structures and adaptive features of some parasitic insects and arachnids e.g. Bed bugs, lice, ticks.

Applied Biology

- Study of population growth in Nigeria
- Town ecology i.e. measurement of pollutants e.g. CO_2, CO, SO_2 at various site in a town.
- Use of lower plants e.g. lichens and mosses as indicators of pollution level.
- Pollutants in a stream e.g. detergents, fertilizer, chemical containers, dyes.
- Effects of various fertilizers and herbicides as pollutants in aquatic habitat on biotic community.
- Estimation of population (school or college)
- Excursion to National Park, Lakes and areas of apparent gully erosion.

Genetics

- Examination of models/charts to illustrate monohybrid and dihybrid crosses in plants and animals.
- Observation of variations (height, weight, finger prints, tongue rolling etc).
- Microscopic examination of the squashed testes of grasshopper or pollen grains for meiosis, other suitable experiments on monohybrid crosses in using suitable plant and animal materials such as maize, guinea pigs and beans.
- Culturing of fruit fly – Drosophila Melanogaster

Laboratory Management

- Students should be guided to practice ordering of equipment for the laboratory.
- Students should be familiar with safety and first aid devices in the laboratory.
- Students should carry out exercises on handling glass wares and chemicals, electrical wiring and fuses.
- Observation should be made on sterilization techniques in hospital especially with reference to prevention of HIV infection.
- Organize special lectures/exhibitions on STDs/AIDS prevention and control.
- Students should be guided to construct biological materials that can be used in the laboratory i.e. improvisation e.g. test-tubes, beakers specimen bottles, etc.
- Preparation of specimens such as herbarium, skeletons, stuffed materials etc.

NCE CHEMISTRY

1. PHILOSOPHY

The intrinsic values as well as the utility values of Chemistry in all spheres of human activity have necessitated its inclusion in the school curriculum. The teaching and learning of Chemistry at the Nigerian Certificate in Education (NCE) level should be such as to produce competent, effective and efficient teachers, who having acquired the requisite skills should be able to impart same to their pupils.

2. OBJECTIVES

The objectives of the chemistry programme at the NCE level are to produce highly qualified middle –level manpower knowledgeable in the processes of Chemistry and capable of inculcating these in the students. Students should have competencies in chemistry teaching including ability to:

i) develop functional knowledge of Chemistry concepts and principles;
ii) observe and explore the chemical environment;
iii) apply the skills and knowledge gained through the study of chemistry to solve day-to-day problems;
iv) explain simple natural phenomena;
v) develop scientific attitudes such as curiosity etc.
vi) manipulate simple apparatus for purposes of demonstration and use; and
vii) improvise simple equipment from available junk in the chemical environment

3. GENERAL ADMISSION REQUIREMENTS

a) Senior Secondary School Certificate of WAEC or NECO or any other equivalent Certificate from recognized examination bodies with credit passes in four (4) subjects including English Language and Mathematics at not more than two sittings. Two of the credits must be in the subjects making up the combinations the candidates wish to offer

b) A Grade II Teacher's Certificate (TC II) with credit or merit in four (4) subjects, two of which must be relevant to the course the candidate wishes to offer. Credits/Merits in English Language and Mathematics are required for candidates wishing to study Chemistry.

c) A pass in Pre-NCE Chemistry final examination or a pass in IJMB Chemistry final examination and a pass in JAMB is required for admission.

d) All candidates wishing to be considered for direct admission must enroll for and write the selected examination organized by an accredited body such as JAMB.

e) It should be noted that some colleges may in addition to all the above, administer their own elimination tests and/or interviews for some courses. This is legitimate.

FACILITIES

a) i. Laboratory (Dimension: 18 x 8 and 20 x 8 sq.metres)

The Department of Chemistry with 50 students or less in each year would need a minimum of one standard laboratory with the following items:

a) Fume cupboard
b) Air conditioned preparatory room attached to the laboratory
c) A balance room
d) Spacious chemical store attached to the preparatory room
e) A bulletin board
f) Two adjoining classrooms each accommodating at least 50 students.

Colleges admitting more than 50 students would need additional laboratories.

ii. Staff Offices

Each Senior Staff should have a comfortably furnished office to himself/herself. There should also be an office for support staff (Typist, Clerks) with relevant equipment e.g. Typewriters, duplicating machine, photocopier, computer and printer.

iii. Books in the Departmental mini - Library

There must be enough books to cover all the areas of Chemistry in the ratio of at least ten books to one (1) student.

b) EQUIPMENT

Apart from the routine standard equipment and materials required for the teaching and learning of chemistry, the following items of equipment are also required:

i) Mettler balance,
ii) top loading balance,
iii) thermostat,
iv) water bath,
v) Centrifuge. (Hand and Electric),
vi) oven, (hot plate/heating mantle),
vii) steam bath,
viii) magnetic stirrer,
ix) suction pump,
x) circulating water pump,
xi) soxlet extractor,
xii) rotator evaporator,
xiii) calorimeter,
xiv) pH meter,
xv) overhead water tank,
xvi) first aid box,
xvii) Victor Meyer's apparatus for measuring vapour density,
xviii) conductivity meter,
xix) water distiller,
xx) spectrophotometer,
xxi) Kjedahl Digestion flask,

xxii) Kjedahl Distribution Apparatus,
xxiii) Chromatograph tank.
xxiv) Film cupboard

c) ESSENTIAL NEEDS

Constant supply of (i) water (ii) electricity and (iii) gas.

d) SUPPLY OF CHEMICALS

Chemistry teaching involves the use of chemicals that would need to be replenished. There is therefore need to provide adequate potent chemicals/reagents for the experiments specified in the curriculum.

5. PERSONNEL

a) Academic Staff

Minimum of eight (8) academic staff with at least the following qualifications is required:
B.Sc (Hons) with Second Class upper plus PGDE
B.Sc (Hons) Second Class Lower plus NCE/PGDE
B.Sc (Ed)……. Second Class Lower

b) The Head of the department should have at least Master Degree and at least of the rank of a senior lecturer

6. SUPPORT STAFF

One qualified Laboratory Technologist (HND), one Laboratory Assistant (OND) and two Laboratory Attendants (SSSC)
One typist and clerical officer, one messenger and cleaner.

7. MODE OF TEACHING

A teacher of chemistry should be aware and familiar with various teaching methods available to him as a teacher. This will enable him/her to use any method or a combination of methods he/she finds appropriate in his special circumstance and setting. A combination of the following methods is recommended.

(i) Discussion
(ii) Activity
(iii) Demonstration
(iv) Lecture
(v) Project
(vi) Tutorial
(vii) Field trips
(viii) Games and simulation
(ix) Concept mapping
(x) Computer Assisted Instruction

8. GRADUATION REQUIREMENT

Chemistry	-	Minimum	32	Maximum	34	Credits
Second Teaching subjects	-	Minimum	32	Maximum	34	Credits
Education including TP	-	Minimum	36	Maximum	36	Credits
General Study	-	Minimum	18	Maximum	18	Credits
Total	=	**Minimum**	**118**	**Maximum**	**122**	**Credits**

9. TEACHING PRACTICE

Teaching Practice is compulsory for **all** students to graduate. Teaching Practice earns 6 credits under Education 311

10. PROJECT

The final year Project is compulsory for all final year students. The project may be written in any of the subjects offered by the students and credited to EDU 323. Project earns 2 credits.

11. CHEMISTRY COURSE CODES, TITLES CREDIT UNITS AND STATUS

NCE YEAR 1 - FIRST SEMESTER

COURSE CODE	COURSE TITLE	CREDIT UNIT	STATUS
CHE 111	General Chemistry	2	C
CHE 112	Introductory Organic Chemistry I	1	C
CHE 113	Chemistry Practicals I	1	C
CHE 114	Chemistry Methodology I	1	C
	Total	**5C**	

NCE YEAR I - SECOND SEMESTER

COURSE CODE	COURSE TITLE	CREDIT UNIT	STATUS
CHE 121	Introductory Physical Chemistry	1	C
CHE 122	Introductory Inorganic Chemistry	1	C
CHE 123	Introductory Organic Chemistry II	1	C
CHE 124	Chemistry Practical II	1	C
CHE 125	Chemistry Laboratory Techniques	1	C
CHE 126	Application of Mathematics to Chemistry II	1	C
	Total	**6C**	

NCE YEAR 2 - FIRST SEMESTER

COURSE CODE	COURSE TITLE	CREDIT UNIT	STATUS
CHE 211	The Gaseous State	1	Elective
CHE 212	Environment and Industrial Chemistry	1	Compulsory
CHE 213	Chemistry Practicals III	1	Compulsory
CHE 214	Nuclear Chemistry	1	Elective
CHE 215	Chemistry of Non-metals	1	Compulsory
CHE 216	Properties of Ionic Compound	1	Compulsory
CHE 217	Liquid State and Colloids	1	Compulsory
	Total	**5C + 1E= 6**	

NCE YEAR 2 - SECOND SEMESTER

COURSE CODE	COURSE TITLE	CREDIT UNIT	STATUS
CHE 221	Organic Chemistry I	2	Compulsory
CHE 222	Metals, Alloys & Transition Elements	2	Compulsory
CHE 223	Chemistry Practicals IV	1	Compulsory
CHE 224	Basic Analytical Chemistry and Research Techniques	1	Compulsory
CHE 225	Chemistry Methodology II	1	Compulsory
	Total	**7 C**	

NCE YEAR III - FIRST SEMESTER

EDU 311 **TEACHING PRACTICE**

NCE III - SECOND SEMESTER

COURSE CODE	COURSE TITLE	CREDIT UNIT	STATUS
CHE 321	Chemical Kinetics	2	Compulsory
CHE 322	Chemistry of Alcohols, Carbonyl Compounds and Mono Carboxylic Acids	2	Compulsory
CHE 323	Natural Products & Amines	1	Elective
CHE 324	Chemical Equilibrium & Thermodynamics	2	Compulsory
CHE 325	Chemistry Practicals V	1	Compulsory
	Total	**7C – 1E = 8**	

SUMMARY

Study Status	First year credit units	Second year credit units	Third year credit units	TOTAL
Compulsory	11	12	7	30
Elective (Optional)	-	2	1	3
Total	11	14	8	33

*The project may be done in the other teaching subject but it will be credited to EDU 323

Minimum Credits Required for Graduation

Compulsory	=	30 Credits
Elective	=	2 Credits
Total	=	32 Credits

NCE I - FIRST SEMESTER

COURSE CODE COURSE TITLE CREDIT UNITS /STATUS

CHE 111 GENERAL CHEMISTRY 2 Credits Compulsory

Objectives:

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

- Define the concepts taught in relation to atoms and molecules
- describe how protons and neutrons were discovered
- explain the principles underlying the periodic table and its properties
- and explain the types of chemical bonding.

Topics:

Concepts of the atom and the molecule
Discharge of electricity through gases
Determination of e/m of cathode rays
Determination of the charge of an electron
Discovery of protons and neutrons
Experiments of Rutherford and Chadwick
Electronic structure of the elements
Isotopes and mass spectrometry
Atomic orbital, Bohr atom, Dual nature of matter
Quantum numbers
Uncertainty principle Hydrogen orbitals
Many electron systems, Electrons spin, principle
Pauli Exclusion Principle, The Periodic Table Valence shell electrons
Ionization Potential Electron Affinity. Atomic and Ionic radii, Electro negativity.

Types of chemical bonds: electrovalent, covalent, dative, hydrogen, metallic and Octet
Lewis Formulae.
Multiple electron-pair bonds. Odd – Electron compounds

CHE 112 INTRODUCTORY ORGANIC CHEMISTRY I 1 Credit Compulsory

Objectives:

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

- State the characteristics of organic compounds and their relationship to other branches of chemistry
- differentiate between pi and sigma bonds in relation to hybridization, bond length, bond energy and bond angle
- state the classes of organic reaction using homolytic and heterolytic fission
- explain the concept of acids and bases.

Topics:
Characteristics of Organic Chemistry and its relationship to other branches of atoms through covalent bonding resulting in chain formation. Review of ground state electronic structures especially **C, H, O, N, S,** etc. Hybridization: Review of atomic orbitals. Sigma – and Pi-bonds Molecular orbitals and their relations to structure. Bond characteristics: length, angle and strength. Electronegativity, polarization and its effects on physical properties. Intermolecular forces and their relationships to physical properties. Classification of reactions as involving hemolytic and heterolytic fission. Cabonium ions and free radicals as reactant intermediates. Acids and Bases. Electrophiles and Nucleophiles. Functional groups and homologous series.

CHE 113 CHEMISTRY PRACTICALS I 1 credit, (3 hours/week) Compulsory

Objectives:

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

- State various safety precautions in the chemistry laboratory,
- Detect the presence of anions and cations using wet, dry and group analysis, carry out simple experiment involving acid-base titration.

Topics:

(a) Safety in the Chemistry laboratory precautions

(b) Qualitative Analysis

i) Detection of Anions: SO_4^{2-}, SO_3^{2--}, SO_3^{2-}, NO_2^-, CO_3^-, HCO_3^- $C1^-$, **Br^-,** and 1^-

ii) Detection of cations: Groups 1-6

(c) Volumetric analysis

i) Weighing
ii) Preparation of standard solutions
iii) pH scale and choice of indicator
iv) Acid – Base titrations: e.g. NaOH/HCI;H_2SO_4/NaOH

CHE 114 CHEMISTRY METHODOLOGY I 1 Credit Compulsory
Philosophical elements of science education:

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

- Explain the nature and structure of science
- explain the issues in science education

Topics:
Nature and structure of science
Role of science, the scientist, the science teacher and society
The concept of integration in science and chemistry

Other issues in Science Education:
Professional growth of the science/chemistry teacher
Science, religion and culture
Science clubs and fairs
Exhibitions in chemistry
Conferences, clubs, seminars, symposia and workshops

NCE 1 - SECOND SEMESTER

CHE 121 INTRODUCTORY PHYSICAL CHEMISTRY 1 Credit Compulsory

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

- Explain the key concepts taught
- solve simple calculation of lattice energies using Born – Haber cycle
- describe simple homonuclear diatomic molecules and ions.

Topics:
Valence bond theory. Molecular orbital approach (qualitative treatment only) Directional character of covalent bonds, hybrid orbitals. Hybridization involving orbitals of complex compounds. Hesenberg's rules, valence shell, electron pair repulsion. Resonance. Delocalized orbital. Bond length. Dipole moments. Partial covalent bond character, electronegativity and hydrogen bonding. Rare gases compounds. Ionic crystals. Madelung constant. Calculations of lattice energies using Born-Haber cycle. The covalent bond. Description of simple homonuclear diatomic molecules and ions including CO and NO. Basic concepts of quantum mechanics.

CHE 122 INTRODUCTORY INORGANIC CHEMISTRY 1 Credit Compulsory

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

- Mention the general properties of the element in relation to the periodic table
- describe the procedure for the extraction of some metals

Topics:
General properties of the elements in relation to the periodic table. Groups/family Periods of elements. Shielding effects. Nuclear charge. Stable configurations.Atomic and ionic radii. Characteristics of transition elements. Occurrence and extraction of the following metals: Aluminum, Sodium and Calcium.

CHE 123 INTRODUCTORY ORGANIC CHEMISTRY II 1 Credit Compulsory

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

- Define concepts
- name organic compounds using IUPAC rules
- differentiate between alkane, alkenes and alkynes from simple chemical reactions
- explain the concepts of isomerism
- able to relate the importance of petroleum to every day life.

Topics:
Introduction to the rules of IUPAC nomenclature as compared with trivial or common names of compounds. Chemistry of the Alkanes: relative inertness, oxidation, halogenations, pyrolysis and catalytic cracking of Alkanes. Mechanism and orientation of halogenations. Chemistry of Alkenes and alkynes. Bond dissociation energy, heat of reaction, energy of activation, rate of reaction and transition state. Isomerism: Structural, geometrical and optical. Applied alkene chemistry: Petroleum chemistry, fuel and petrochemical, energy considerations. Brief elementary introduction to stereochemistry including elements of symmetry and chirality. Optical activity and operation of a polarimeter. Fischer projection and assignment of configuration e.g. D (+) 2,3 – dihydroxypropanal (glyceraldehydes).

CHE 124 CHEMISTRY PRACTICALS II 1 Credit (3 hours/week) Compulsory

QUALITATIVE ORGANIC ANALYSIS

Objectives:
At the end of the course the students should be able to carry out simple experiment to:

- test for unsaturation,
- elemental analysis of organic molecules and
- test of functional groups of organic compound

Topics:

- Test for unsaturation
- Detection of the following elements in organic molecules: **N, S, C1, Br, I, C, H, O.**
- Detection of the following functional groups, carboxyl, hydroxyl, alkanoate, amine, alkanal and alkanone.
- Distinguishing the classes of amines
- Distinguishing alkanals from alkanones
- Distinguishing classes of alkanols

CHE 125 CHEMISTRY LABORATORY TECHNIQUES 1 Credit Compulsory

Objectives:

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

-To assemble, improvise and maintain simple equipment/apparatus

Topics:

(1) Management of the Chemistry laboratory
(2) Maintenance of equipment
(3) Improvisation of simple laboratory apparatus
(4) Setting up apparatus for demonstrating:
    (a) Preparation of gases as in SSCE syllabus
    (b) Preparation of salts
    (c) Simple distillation
    (d) Steam distillation
    (e) Sublimation
    (f) Fractional crystallization
    (g) Paper chromatography
    (h) Heating under reflux
    (i) Using drying agents
(5) Determination of melting and boiling points
(6) Tests for oxidizing and reducing agents

CHE 126. APPLICATION OF MATHEMATICS TO CHEMISTRY 1 Credit C

Objectives:

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

- To apply basic mathematical skills/operation to solve problems in chemistry
- to demonstrate competence in the use of various mathematical principles to facilitate the learning of chemistry

Topics:

Observation and measurement, precision of experimental measurements. SI Units of measurement, e.g. distance, volume, concentration, time, mass, density, etc. Proportion: Application to mole concept, stoichiometry and volumetric analysis. Ratio, percentage, rates and reciprocals. Quadratic equation and indices. Standrd forms and Logarithms, Application to pH calculations.

Graphical solution to simple equations and linear simple simultaneous equations. Application to equilibrium and kinetic calculations. Plotting of graphs and estimating slopes, intercepts, etc. Application to physical chemistry problems.

Simple treatment of differentiation and integration of functions (rational and algebraic functions). Differential equations involving separable variables. Application to kinetic theory of gases, rate law and thermodynamics.

NCE II - FIRST SEMESTER

CHE 211 THE GASEOUS STATE 1 Credit Elective

Objectives:

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

- define the gas laws
- derive the ideal gas equation
- list instruments for measuring gas pressure
- state the fundamental kinetic theory of gases
- derive gas laws from ideal gas equation

Topics

The physical states of matter. Measurement of gas pressure, the barometer and manometer. The gas laws: Boyle's law, Charles' law equation of state, and Dalton's law of partial pressures. Ideal gas equation: $PV = nRT$. Derivation from Boyle's and Charles' laws. Kinetic theory of gases. Derivation of the fundamental kinetic theory equation from the kinetic theory i.e. $PV = mnc^2$.

The distribution of molecular velocities Derivation of gas laws from ideal gas equation. Determination of molecular mass of real gases. The nature of intermolecular forces and deviations from ideal behavior. The mean free path of gas molecules. The heat capacities of gases and the equi-partition of energy.

CHE 212 ENVIRONMENTAL AND INDUSTRIAL CHEMISTRY

1 Credit Compulsory

(**Industrial visit is a major requirement of this course)**

Objectives:

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

- list the different types of pollutants and their effects on the environment
- describe the techniques involve in some industrial processes
- list some of the means of contacting HIV and its preventive measures
- mention some sexually transmitted infections

Topics:

A study of the composition of soil and water. Environmental pollution: air, water and soil. Solvent extraction, ion exchange and their application to industrial trioxonitrate (V) acid, sodium hydroxide, washing soda, baking soda, soaps, detergents, glass, alcohol, matches, iron and steel. Production and utilization of timber. Trips to related industries, a report should be written and this should form 20 % of the continuous assessment. Acid rain formation and its effects on the environment. Oil pollution and its hazards. Environmental studies and HIV education (i.e. HIV Transmission, other sexually transmitted infections, Body Abuse, prevention and control).

CHE 213 CHEMISTRY PRACTICALS III 1 Credit (3hours/week) Compulsory

REDOX TITRATIONS:

Objectives:

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

- manipulate equipments to carry out simple redox titration
- determine the partition coefficient of iodine between polar and non-polar solvents
- measure the pH of solutions

Topics:

Balancing of redox equations

Redox titrations using $KMnO_4$ with Iron (II) ammonium tetraoxosulphate (VI) and soidiumdioxonitrate (III).

Iodine with $Na_2S_2O_35H_2O$.

Silver trioxonitrate (V) with sodium chloride and mixture of $KClO_3$ and K_2 SO_4.

$K_2Cr_2O_7$ with iron (II) ammonium tetraoxosulphate (VI).

Determination of the partition coefficient of iodine between carbon tetrachloride and water.

Determination of molecular weight by freezing point depression.

Kinetic studies of hydrolysis of esters.

Measurement of pH using indicators.

Buffer solutions and pH meter.

CHE 214 NUCLEAR CHEMISTRY 1 Credit Elective

Objectives:

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

- define the concept of radioactivity
- classify nuclear reaction as artificial and natural
- state Eiestein equation and its application in solving simple problems
- mention the uses and application of radioactivity
- identify radioactive isotopes and calculate the half-life radioactive substances
- list the effects of nuclear reaction on the environment

Topics:

Nuclear stability. Natural artificial radioactivity: Alpha, beta and gamma rays. Einstein's mass-energy equation. Kinetic calculations of half-life.

Identification of Radio Isotopes. Application and uses of radioactivity: tracers, dating and nuclear reactors.

Effects of nuclear reactions on the environment.

CHE 215 CHEMISTRY OF NON-METALS 1 Credit Compulsory

Objectives:

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

- list the chemical and physical properties of non-metals

- state the differences and similarities among the groups V,VI & VII
- describe the peculiarity of the first row elements and mention the factors responsible for the peculiarity
- describe the extraction of sulphur
- mention the types of oxides, hydrides and oxy - acids formed by non – metals & their properties and uses

Topics:

Physical and chemical properties of non-metals. Group V, VI and VII. Extraction of sulphur. Peculiarity of the first row elements. Detailed treatment of group trends. Group similarities and differences. Simple inorganic compounds: hydrides, oxides and oxyacids including their properties and uses.

CHE 216 PROPERTIES OF IONIC COMPOUNDS 1 Credit Compulsory

Formation of ions. Ionization Potential and electron affinity. Formation of an ionic solid. Arrangement of ions in crystals. Diffraction of electro-magnetic radiation. Experimental methods of X-ray diffraction. Bragg's equation. The structure of Sodium Chloride from X-ray diffraction. Avogadro's number from lattice dimensions. Effects of ion size on crystal geometry. Electrolytic solutions. Dissociation of strong and weak bases. Electromotive force and Galvanic cells. Faraday's laws and electrode reactions.

i) Position in the Periodic Table
ii) General characteristics (1^{st}, 2^{nd} and 3^{rd} row) of transition elements.
iii) Electronic structure of the atoms and ions (1^{st} row only)
iv) Bonding in transition elements
    - Crystal Field Theory (CFT)
    - Adjusted Crystal Field Theory (ACFT)
    - Ligand Field Theory (LFT). Emphasis should be on CFT, while ACFT and LFT should be mentioned only.
v) Formation of complexes: Isomerism and stability of complexes
vi) Physical and chemical properties of 1^{st} row transition elements, their compounds and uses. Extraction of Fe
vii) Lanthanide contraction, chemical behavior and periodic comparison

CHE 217 LIQUID STATE AND COLLOIDS 1 Credit Compulsory

General comparison of solids, liquids and gases. The liquefaction of gases and the critical state. Vapour pressure. Boiling point. Freezing point. Sublimation. Viscosity of liquids. Surface tension. Vapour pressure of solutions. Ideal solutions and Raoult's law. Non-ideal solutions and Henry's law. Boiling points of solutions containing volatile compounds. Immiscible components. Dilute solutions containing non-volatile solutes. Colligative properties: Vapour pressure lowering, boiling point elevation, freezing point lowering and osmotic pressure. The Nernst Distribution law.

The colloidal state: preparation and properties of hydrophilic and hydrophobic colloids.
Stability of colloids. Separation of colloids. Surface phenomenon and adsorption.
Chromatography: gas, solid and liquid.
Catalysis.

NCE II - SECOND SEMESTER

CHE 221 ORGANIC CHEMISTRY I 2 Credits Compulsory

(MECHANISM IN EACH OF THE VARIOUS REACTIONS IN THE COURSE IS NECESSARY)

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

- describe the geometry of saturated hydrocarbons
- identify electrophiles and nucleophiles in a chemical reaction
- state Markonikuff's rules and its application unsymmetrical olefins
- describe the reactions of unsaturated hydrocarbons including dienes

Topics:
Chemistry and molecular geometry of alkanes. Electrophilic and nucleophilic addition. Oxidative cleavage and its application in structural determination (e.g. Ozonolysis).
Relative stabilities of carbonium ions. The Markownikoff's rule: radical addition.
Reduction. Polymerization: addition of polymers from akenes and vinyl compounds, natural and synthetic rubber. Conjugated dienes: electrophilic 1, 2 – and 1, 4 – additions to conjugated dienes. Resonance orbital interaction. Alkyne chemistry: acidity of C ≡ C and reactions of – C ≡ C —.

CHE 222 METAL, ALLOYS AND TRANSITION ELEMENTS 2 Credits C

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

- state the physical and chemical properties of metals and alloys
- state valence and molecular orbital theories as apply to solids
- classify compounds as conductors, semi-conductors and insulators
- mention the properties of group I,II, III and IV elements
- Identify the transition elements in the periodic table
- Write the electronic configuration of the 1^{st} row transition elements
- Describe the physical and chemical properties of the 1^{st} row transition elements, their compounds and uses.
- Explain the lanthanide contraction

Topics:
Physical and chemical properties of metals. Arrangement of atoms in metals.
Bonding in metals. Valence bond theory of metallic bond.

Molecular orbital approach to the theory of solids. Free electron theory of metals. Structure of pure metals. Insulators and semiconductors.
Alloys: Classification of alloys.
Structure of simple alloys, interstitial couples and bonding.
Group I/the Alkali metals. Group II/the Alkaline – earth metals. The elements of groups IIIA (Boron group). IVA (Carbon group).

CHE 223 CHEMISTRY PRACTICALS IV 1 Credit, (3 hours/week) Compulsory

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

- describe the various separating techniques
- state the criteria for determining purity of a substance
- verify Raoult's law for ideal solutions

Topics:
Separation techniques: solvent – solvent extraction, column chromatography, etc.
Criteria for purity: Determination of melting point; determination of boiling point.
Determination of solubility and solubility products.
Determination of equilibrium constant. Verification of Raoult's Law.

CHE 224 BASIC ANALYTICAL CHEMISTRY AND RESEARCH TECHNIQUES
1 Credit Compulsory

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

- list the preliminaries title in a research work
- state the types of research design
- differentiate between precision and accuracy
- state the type of statistical tools for analysis a research work
- Identify the units of measurements of some qualities such as time, concentration, mass etc.

Topics:

a) Project work in Chemistry
   i) Title
   ii) Abstract
   iii) Introduction
   iv) Experimental
   v) Results
   vi) Discussion
   vii) Summary & Conclusion
   viii) References

b) Significant figures:
   i) Addition and subtraction
   ii) Multiplication and division

c) Measurement:

i) Accuracy
ii) Precision
iii) Errors (concept, types, sources, control, estimation)

d) Measures of central tendency: mean, mode, median, range, co-efficient of variance, standard deviation.

e) Test of significance
Chi^2-Test and t-test.

f) Units of concentration: $mol.dm^{-3}$ (molarity), gdm^{-3} (mass concentration), molality, parts per million, percentage concentration.

g) Titrations:
i. Complexometric titrations
ii. Precipitation titrations

CHE 225 CHEMISTRY METHODOLOGY II 1 Credit Compulsory

Objectives:
At the end of the course the students should be able to:
- Mention and explain the various methods of teaching chemistry
- Differentiate between lesson note and lesson plan
- Identify the personnel involved in organizing chemistry laboratory
- State the criteria for selecting chemistry text books for use

Topics:
Trends in the teaching of chemistry. Lesson note preparation. Methods of teaching Chemistry. Demonstration, Guided discovery, Discussion, Activity, Tutorial, Project.
Organization of the chemistry laboratory
Duties of laboratory personnel (technologist, assistant, attendant)
Record keeping in the chemistry laboratory
Use of Audio-Visual in chemistry teaching (use of films, slides and overhead projector during a chemistry lesson).
Computer Assisted Instruction (CA)
Games and simulations, concept mapping
Evaluation of chemistry textbooks

Practicum in Chemistry teaching (Microteaching)

NCE YEAR III - FIRST SEMESTER

EDU 311
TEACHING PRACTICE

NCE III - SECOND SEMESTER

CHE 321 CHEMICAL KINETICS 2 Credits Compulsory

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

- Define reaction rate and identify factors affecting rates of reaction
- Define and explain concepts related to chemical kinetics
- Differentiate between concepts related to chemical kinetics
- Differentiate between moleculiaty and order of reactions
- Describe the methods for determining reaction order
- List the methods for determining 1st order reaction
- Explain the various theories of reaction rate
- Use steady state approximation to derive theoretical rate law from reaction mechanism

Topics:
The reaction rate: Reaction order. Molecularity. The rate law. Experimental techniques for determining first order reactions. Derivation of firs-order kinetic equation. Example of first order reactions, second order reactions, third order reactions. The half-life of a reaction. Methods for determining the reaction order. Factors affecting rates of reactions. Solvent effects. The Arrhenius theory of reaction rates. The collision theory of reaction rates. The transition state theory of reaction rates, the activated complex relationship between Arrhenius and Transition state theories. Unimolecular gaseous decomposition reactions. Steady state approximation. Reaction mechanisms.

CHE 322 CHEMISTRY OF ALCOHOLS, CARBONYL COMPOUNDS AND MONOCARBOXYLIC ACIDS 2 Credits Compulsory

ALCOHOLS:

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

- Mention the methods of preparation , properties and uses of alcohol
- Describe the reaction of carbonyl compound
- State the characteristic reactions of carbonyl compounds
- Mention some reaction of carboxylic acids
- Differentiate between mesomeric and inductive effect
- State the reaction and preparation of some aromatic acid derivatives

Topics:
Structure, nomenclature and properties
Methods of preparation
Uses

CARBONYL COMPOUNDS

Chemistry and reactivity of the carbonyl group. Structural survey of alkanals and alkanones. General characteristics and nomenclature of alkanals and alkanones. Similarities and contracts with other types of double bonded compounds. Nucleophilic addition to the carbonyl group. Some examples of aliphatic and aromatic. Alkanones and Alkanals. Special topics related to carbonyl groups. Acetals, ketals and use as protecting groups.
Introduction to reactions of anolate ions. Keto-enol tautomerism. Simple aldol condensation and its synthetic utility. Halogenation of ketones. The haloform reactions. The Cannizaro reaction.

CARBOXYLIC COMPOUNDS

Chemistry of the carboxylic acids and derivatives. Polarity, structure and nomenclature of monocarboxylic acids, hydrogen bonding in carboxylic acids and its medication by inductive effects and mesomeric effects.
Some reactions of carboxylic acids.
Some reactions of carboxylic acid derivatives e.g. anhydrides, acyl halides, esters and amides.
Synthesis and reactions of aromatic suphonic acids.

CHE 323 NATURAL PRODUCTS AND AMINES 1 Credit Elective

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

- State the composition, structure and functions of lipids in living organisms
- Mention the types of fatty acids
- Appreciate the economical application of lipids
- State and explain the classes of carbonhydrates
- State the characteristics of amino-acids and amines

Topics:
Lipids. Triglycerides: structure, composition and functions in living organisms. Types of fatty acids encountered in lipids. Commercial applications as soaps, edible oils and fats, etc.
Carbohydates: aldoses and ketoses.
General features, configuration in relation to glyceraldehydes. Aldohexoses – structure and chemical reaction. Disaccharides, sucrose, maltose, lactose, etc. Polysaccharides starch, cellulose, etc. Brewing.
Proteins: Properties, structure, nomenclature, synthesis and uses.
Amino-acids: Their dipolar nature and relationship to proteins.
Amines and derivations: General characteristics and nomenclature of amines; structure, physical and chemical properties. Amines as nucleophiles: General reaction of aliphatic and aromatic amines. Quatemacy ammonium compounds. Hoffman Benzene diazonium salts and their reactions.

CHE 324 CHEMICAL EQUILIBRIUM AND THERMODYNAMICS 2 Credits C

Objectives:

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

- Define thermodynamics terms and principles
- State and explain the laws of thermodynamics
- Derive the relationship between heat of reaction at constant pressure and volume
- Explain the dependence of heat capacity and enthalpy of reaction on temperature
- Explain the interdependence of Gibb's free energy with equilibrium constant, entropy change and temperature

- define chemical equilibrium and state factors affecting chemical equilibrium
- determine the pH of solutions
- state the effects of common ions on the solubility of salts
- calculate the equilibrium constants of ionic salts
- explain phase rule

Topics:

The nature of thermodynamics. Definition of some thermodynamic terms, including temperature. The first law of thermodynamics. Enthalpy. Heat capacity of gases. Reversible adiabatic processes. Thermochemistry. Standard states. Enthalpy of reactions. Hess's law. Relationship between heat of reaction at constant pressure and at constant volume.

Heat of solution. Enthalpy of formation of ions in solution. Bond energies. Dependence of heat capacity and enthalpy of reaction on temperature. The second law of thermodynamics. Bohr Energy Circle. Molecular interpretation of entropy. Examples of entropy calculations. Criteria for equilibrium. The work function and Gibb's Free Energy. Free energy and the equilibrium constant. Equilibrium between phases.

The Clapeyron equation.

The third law of thermodynamics.

Law of chemical equilibrium. Equilibrium constants expressed in different units. Variables affecting chemical equilibrium. Effects of pressure, temperature, concentration and catalyst. Aqueous solutions of weak acids and bases. The ionization of water and the pH scale. Buffer solutions.

Polyfunctional acids and bases. Hydrolysis: Salts of a weak acid and a weak base. Metallic ions, salts of dibasic acid.

Titration of acids and bases: strong acids and strong bases, weak acids and weak bases. Indicators. Complex ion equilibrium. Equilibrium between ions in the solid and liquid phases. Solubility and solubility products: effect of a common ion on the solubility of slightly soluble salts. Equilibrium in systems containing solid and gaseous phases. Phase rule. One component system and two component systems.

CHE 325 CHEMISTRY PRACTICALS V 1 Credit, (3 hours/week) **C**ompulsory

Objectives:

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

- Synthesize and characterize inorganic complex and benzene derivatives
- Determine enthalpies of neutralization and combustion
- Test for food content

Topics:

Synthesis and characterization of inorganic complexes.
Determination of enthalpies of neutralization and combustion.
Synthesis of some benzene derivatives.
Tests for proteins, carbohydrates, sucrose, glucose and lipids

Note: C = Compulsory
E = Elective

COMPUTER SCIENCE

1. PHILOSOPHY

Nigeria cannot afford to ignore the role which computer literacy plays in achieving the national goal of technological development. Hence she has resolved to introduce computer education in primary and secondary schools. For meaningful teaching of computer science in our primary and secondary schools, there is a need to produce professional teachers in the discipline. Hitherto there has been provision for the training of computer scientists in the universities and the polytechnics but little attention was paid to the training of teachers in computer education. There is now an urgent need for the Colleges of Education to offer computer studies as a subject in the programme of professional preparation of teachers.

2. OBJECTIVES

By the end of the programme, the student should be able to:

i) Teach Computer Studies at the Primary and Secondary School levels;

ii) Write Computer program and process data with maximum speed and accuracy;

iii) Demonstrate reasonably high level of competence in preparation for further studies in computer science education.

iv) Motivate pupils' interest in the study of computers by appropriately using ICT teaching/learning strategies.

v) Apply the use of computer as an aid in daily life activities

3. (i) GENERAL ADMISSION REQUIREMENTS

a) Senior Secondary School Certificate of WAEC or NECO or any other equivalent Certificate from recognized examination bodies with credit passes in four (4) subjects including English Language and Mathematics at not more than two sittings. Two of the credits must be in the subjects making up the combinations the candidates wish to offer

b) A Grade II Teacher's Certificate (TC II) with credit or merit in four (4) subjects, two of which must be relevant to the course the candidate wishes to offer. Credits/Merits in English Language and Mathematics are required for candidates wishing to study computer.

c) A pass in Pre-NCE final examination or a pass in IJMB final examination and a pass in JAMB is required for admission.

d) All candidates wishing to be considered for direct admission must enroll for and write the selected examination organized by an accredited body such as JAMB.

e) It should be noted that some colleges may in addition to all the above, administer their own elimination tests and/or interviews for some courses. This is legitimate.

4. a) **Facilities**

For Colleges to run a computer studies programme, it is essential that the following facilities should be provided as a minimum condition:

i) One computer for a group of not more than 2 students
ii) Laboratory for Computer Studies, which must be air-conditioned
iii) Cabinet for storage facilities
iv) Regular supply of software material
v) 1 Computer Centre for training/teaching of other students/commercial purposes
vi) Alternative power supply – Generator

All computer systems must be full multimedia system whose configuration is not less than the following:

- INTEL PIV 3GHZ (100 FSB) MMX
- 2 GB RAM
- 120 GBHD
- DVD ROM Drive
- Flat Screen Monitor
- USB Keyboard and Mouse
- SUBMIDI PIV casing
- 650 VA UPS for each computer system
- 1000-Watt stabilizers for each system
- all computers must be on Local Area Network
- Every system must be connected with Internet
- The following additional equipment must be available:-
- Scanners
- Printer (Laser printers and DeskJet Printers)
- Computer projectors
- One Laptop Computer to each lecturer of the department
- Journals:-Local and international journals on computer studies education must be made available

b) **Computer Lab.**

Equipment Required for Computer Laboratory

i) Microcomputers with the following configuration:
   INTEL PIV 3GHZ (100 FSB) MMX
   2GB RAM
   120 GBHD
   DVD ROM Drive
   Flat Screen Monitor
   USB Keyboard and Mouse
   SUBMIDI PIV casing
ii. UPS 1.22 KVA OR HIGHER CONFIGURATION

iii. PRINTERS
   a) LQ 2170 EPSON PRINTER/DFX 5000
   b) HP LASERJET 2015 or higher

iv. The Lab should be well cabled.

v. PEN BOARD

vi. COMPUTER PROJECTOR/SCREEN

vii. Due to the dynamic nature of the advancement of Information and Communication Technology (ICT), equipment and software should be updated regularly to meet with the current changes in Technology.

5.0 PERSONNEL

5.1 ACADEMIC STAFF

Minimum of eight (8) academic staff with Bachelors degree in Computer Science with at least a Second Class Lower (2/2) (Honours) degree in Computer Science and a professional teaching qualification or a minimum of Bachelor of Education Degree in computer Science with at least a Second Class Lower (2/2) status. The staff-students ratio should be 1:25. Also those without teaching qualifications should be advice to take Postgraduate Diploma in Education (PGDE)/ Professional Diploma in Education (PDE).

5.1.1 SUPPORT STAFF

a) 1 Computer Technologist/Engineer
b) Two (2) Computer Operators
c) At least one Cleaners per Laboratory
d) At least one Instructor per Laboratory.
e) 1 Standby Security Staff

6.0 Mode of Teaching

Computer Studies at the NCE level shall be taught by an appropriate selection or Combination of the followings teaching strategies:

Discussion
Lecture
Practical Demonstration
Tutorials
Supervised projects
Student's Guided Practice
Problem Solving/Inquiry Method
Excursion to computer firms
Seminar
Computer Assisted Instruction (CAI)

NOTE:
Every Computer Science student must be exposed to 5 hours of practical per week

7 GRADUATION REQUIREMENTS

Computer	-	Minimum	32	Maximum	34	Credits
Second Teaching subjects	-	Minimum	32	Maximum	34	Credits
Education including TP	-	Minimum	36	Maximum	36	Credits
General Study	-	Minimum	18	Maximum	18	Credits
Total	=	**Minimum**	**118**	**Maximum**	**122**	**Credits**

8.a) **TEACHING PRACTICE**

Every student is required to complete successfully Teaching Practice for a period of 12 weeks. The whole of 300 level first semester should be devoted to teaching practice i.e. starting from mid September to December. This covers one term of school year of 2 weeks. The credit earned is recorded in EDU 324.

b) **SIWES: -** A One-phase SIWES is recommended: - 8 weeks programme at the end of the second session coded CSC 224 (1 credit unit, Compulsory).

8 FINALYEAR PROJECT

Every student is required to write and submit a project in Computer Science and the credit is recorded under EDU 323. All topics should reflect computer in education (Teaching and Learning) Project carries 2 Credit Units.

9 MANDATORY REFRESHER COURSES

Due to very rapid changes in the field of Information Technology/Computer Science, it is mandatory for all Computer Science Staff to regularly undergo Workshops/refresher courses/programmes in the field and belong to relevant professional bodies.

SUMMARY OF COURSE TITLES AND STATUS

Code & Number	COURSE TITLE	UNIT	STATUS
	NCE 1 FIRST SEMESTER		
CSC 111	Introduction to Computer Science	1	C
CSC 112	BASIC Programming Language	2	C
CSC 113	Computer Operations & Application	1	C
CSC 114	Number System	1	C
CSC 115	Introduction to Micro Processor	1	C
	Total	**6 credits**	

	NCE 1 SECOND SEMESTER		
CSC 121	Electronic Data Processing (EDP)	1	C
CSC 122	Word Processing MS word	1	C
CSC 123	Electronic Spreadsheet with MS Excel	1	C
CSC124	The Teaching of Computer Science	1	C
	Total	**4 credits**	

	NCE II FIRST SEMESTER		
Either CSC 211	Introduction to Symbolic Logic	1	E
Or CSC 212	Introduction to Operations Research	1	E
CSC 213	Database Management	2	C
CSC 214	Data Structure	1	C
CSC 215	Computer Logic	2	C
CSC 216	C Programming Language	**2**	**C**
	Total	**7C+1E=8**	

	NCE II SECOND SEMESTER		
CSC 221	PASCAL Programming Language	2	C
CSC 222	Operating Systems (OS)/windows application	2	C
CSC 223	Introduction to Numerical Methods	1	C
CSC 224	SIWES	1	C
CSC 225	System Analysis and Design	2	C
	Total	**8 Credits**	

	NCE FIRST SEMESTER		
EDU 324 (Teaching Practice)	Teaching Practice		
	Total	**6 Credits**	

	NCE III SECOND SEMESTER		
CSC 321	Advance Level Programming Language(JAVA, C++,VBASIC, VCOBOL, etc)	2	C
CSC 322	Seminars	1	C
CSC 323	Desktop Publishing	1	E
CSC 324	Computer Graphics	1	E
CSC 325	Introduction to Computer Networking	1	**C**
CSC 326	Computer Maintenance/Troubleshooting	1	C
	Total	**5C+1E=6**	

SUMMARY

Study Status	First year credit units	Second year credit units	Third year credit units	TOTAL
Compulsory	10	15	5	30
Elective (Optional)	-	2	2	4
Total	10	17	7	34

*The project may be done in either Computer or the other teaching subject but it will be credited to EDU 323

Minimum Credits Required for Graduation

Compulsory = 30 Credits
Elective = 2 Credits
Total = 32 Credits

9. ASSESSMENTS AND CERTIFICATION

C.A. = 40%; Externally Moderated Examination = 60%

10. COURSE CODE COURSE TITLES CREDIT UNITS STATUS

NCE 1 - FIRST SEMESTER

CSC 111: **Introduction to Computer Science 1 Credit Compulsory**

Objectives:

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

i. Explain the historical development of computers from 1st generation to-date.
ii. Identify and explain the basic components of computers.
iii. Identify and explain ICT tools.
iv. Define computer and identify the basic classification of computers

Course Content:

Historical development of Computers starting from early counting devices to electronic counting devices
Basic Computer concepts (definition and components of computers)
Classification Computer by size, signal, purpose etc
Hardware components
Software components
Peripheral devices
Bits, Bytes, Word, Storage size
Computer Worms and viruses
ICT (definition and tools)

CSC 112 BASIC Programming Language 2 Credits Compulsory

Objectives:

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

i. Explain the following: Programming, Algorithm, Flowchart and Pseudocode
ii. Identify BASIC Programming data types.
iii. Explain the following concepts: Loop, Array, Table, Control structure and subprogram.
iv. Design and write BASIC code to create and access data file (Sequential and Random files.)
v. Write error free BASIC programs.

Course Content:

What is programming?
Need for Computer Language
BASIC as a Computer Programming Language

Algorithm & Flowcharting/Pseudocode
Data and Variable Types
BASIC Key words
Statements (Commands)
Loops
Arrays and Tables
Control Structures in BASIC
Subprograms (subroutines, procedures and functions)
Data/Computer files in BASIC
File creation and accessing
String manipulation
Using BASIC to real life problems/application
Intensive BASIC program designing, coding, running and debugging
At least two hours practical per week

CSC 113 Computer Operations and Applications 1 Credit Compulsory

OBJECTIVES

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

i. Operate the computer systems
ii. Identify and explain at least five areas of computer application.
iii. Use internet for e-mail and searching for information
iv. Install operating system and at least two application packages

Course Content:

Operating the Microcomputer (operating systems)
Use of the Keyboard and the mouse
Booting of computer, file handling, multimedia systems, installation of application software (two hours practical per week)
Internet Operations and Application
The use of Computers in Education, administration, Transportation, job creation, library, protection of Documents, domestic chores, municipal work and National development etc
Use of Computer Assisted Instructions (CAI)
Computer Games

CSC 114 Number System 1 Credit Compulsory

Objectives

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

i. Identify the basic number system
ii. Convert any of the basic number system to binary and vice versa
iii. Convert denary number system to any number system and vice versa
iv. Explain how data are represented in the computer.

Course Content:

Binary Number system

Binary Arithmetic
Octal and Hexadecimal Numbers
Floating and Fixed Point Numbers
Data and Character representations (codes)
Four-bit Binary coded decimal
Six-bit Binary coded decimal
The Binary Arithmetic's should treat 1's and 2's complement

CSC 115 **Introduction to Microprocessor** **1 Credit** **Compulsory**

Objectives:

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

i. Identify and explain the characteristics and features of the microprocessor.
ii. Explain the following: Bus systems, ROM and RAM.
iii. Identify and explain at least four models of microprocessor and their significance.

Course Content:

Characteristics, Features and Anatomy
Addressing Modes
The BUS System (Data bus, Address bus, Instruction bus)
ROM and RAM
Limitations and Virtues of Micros
The Microprocessor as one of the Selection Criteria for the purchase of a Computer
Generation of Microprocessor

NCE I SECOND SEMESTER

CSC 121 **Electronic Data Processing (EDP)** **1 Credit** **Compulsory**

Objectives:

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

i. Explain the followings: Data, information, and information system.
ii. Identify and explain at least three techniques of EDP.
iii. Identify and explain: Data processing stages/cycles, Data entry, Data collection and Data collation.
iv. Identify two types of files and storage devices.

Course Content:

Meaning of data, information and information system concept of EDP
Techniques of EDP (Batch Processing, Real-Time processing, Online Processing, etc)
Data processing stages/cycle
Data entry and problems of data entry
Data collection media and methods
Data collation and devices
Information storage and retrievals

Types of files, types of storage (main and backing storage)

CSC 122 **Word Processing MS Word** **1 Credit** **Compulsory**

Objectives:

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

i. Create, Edit, save and Print word documents.

Course Content:

Basic concept of word processing
Opening a Document File
Production of Memoranda, Letters and Reports
Techniques of Underlining, Bolding, Editing and Spell-checking
Saving a file
Printing a file
Exiting Computers following normal sequence
Two hours practical per week

CSC 123 **Electronic Spreadsheet with MS Excel** **1 Credit** **Compulsory**

Objectives:

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

i. Create, Edit, Save, Print spreadsheet documents.
ii. Represent data in graphical forms (Pie chart, bar chart, line graph, etc).

Course Content:

Definition of Spreadsheet, Structure of the Spreadsheet
Opening Files
Keying-in/manipulation of Data
Graphs (line, pie chart, bar chart, stack-bar chart)
Printing of graphs, saving files and graphs
Retrieving files and graphs
Common uses of spreadsheets
Use of formula and functions
Two hours practical per week

CSC 124 **The Teaching of Computer Science** **1 Credit** **Compulsory**

Objectives:

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

i. Explain at least four methods of teaching computer.
ii. Identify and explain at least three competencies of a computer science teacher
iii. Prepare a good lesson plan and lesson note in any computer topic.

Course Content:

Introduction to the Teaching Profession
Basic Competencies of the Computer Science Teacher (An Overview)

- The Lecture Method
- The Discussion Method
- The Demonstration Method

- The Practice and Drill Method
- The Problem-solving (Heuristic) Method
- Computer Aided Learning
- Computer Assisted Instruction
- Simulation Method

Analysis of Upper Basic Education Curriculum in computer Science
The Use of the Chalkboard/Magnetic Board
Preparation of Lesson Plan and Lesson Notes
Micro Teaching Practice
Assessment of Students' Achievement in Computer Science
Construction and use of Simple Computer-Assisted Instruction (CAI)
Assessment of Student's Achievement in Computer

NCE II – FIRST SEMESTER

CSC 211 **Introduction to symbolic Logic** **1 Credit Elective**

Objectives:

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

i. Explain the meaning of logic.
ii. Identify and explain the four types of logic statements.
iii. Differentiate between valid and invalid validity.
iv. Prove a valid argument.

Course Content:

An Overview of Computer Logic
Arguments: Deductive and Inductive
Proposition of forms, validity, truth, falsity
Type of Logic Statements: Negation, Conjunctions, Disconjunctions and Implications
Arguments form and validity
Formal proof of Validity
Truth functional equivalence

CSC 212 **Introduction to Operations Research** **1 Credit Elective**

Objectives:

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

i. Explain the meaning of Operations Research.
ii. Identify and explain at least two linear programming models.
iii. Solve simple Transportation problems
iv. Solve simple linear programming problems.

Course Content:

An Overview Operations Research
Linear programming models and selected areas of application
Decision Theory: Uncertainty
Maximum and Minimum Strategies
Network Analysis
Transportation Problems

CSC 213 **Database Management** **2 Credits Compulsory**

Objectives:

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

i. Identify and explain different types and modules of database.
ii. List the advantages and disadvantages of database models.
iii. Explain data storage, retrieval, security, and integrity.
iv. Use database management system to store, update, insert, retrieve and delete records.
v. Identify and explain at least three Dbase administrative functions.

Course Content:

An Overview Database Management
Nature of Database Management system (DBMS)
Different types of DBMS
Models of Database: Network, Hierarchical, Relational, Distributed
Advantages and Disadvantages
Concept of Fields, Records, Access Methods
Data Storage and Retrieval
Data Security and Integrity
Database Administration (DBA)
Methods of Data Organization
Data capturing
Query, sorting, Report generation
Wizard and Design view etc
Application in student record, payroll, inventory control etc Intensive Practice with Relational Data base
At least two hours of practical per week

CSC 214 **Data Structure** **1 Credit Compulsory**

Objectives:

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

i. Explain the meaning and usage of data structure.
ii. Identify and explain the two types of data structure.
iii. Write simple algorithm to implement data structure.

Course Content:

An overview of Data structure
Queues, Stacks, LIFO, FIFO, Deques
Linked-List, Doubly linked Lists
Arrays and Trees
Algorithms to implement the Data Structure

CSC 215 **Computer Logic** **2 Credits Compulsory**

Objectives:

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

i. Explain the meaning and nature of computer architecture and its levels

ii. Design logic gates and circuits.
iii. Explain in practical terms at least three applications of logic gates,

Course Content:

Meaning and nature of Computer Architecture levels within Computer Architecture
Logic Gates and Logic Circuits (OR, AND, NOR, NAND, etc)
Truth Tables
Circuit simplification (Minterm & Maxterm), Karnaugh – Map (K-Map)
Boolean postulates (Commutative; Associative, Distributive, Negation and, Redundancy Laws and De Morgan's Theorem)
Application of Logic gates (Diodes, Registers, Transistors, etc).

CSC 216 **C Programming Language** **2 Credits Compulsory**

Objectives:

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

i. Identify and explain fundamental types in C.
ii. Explain selection/control structure in C
iii. Use iteration, and functions in C
iv. Use operators and manipulate arrays and strings in C.
v. Create classes in C
vi. Write error-free programs in C

Course Content:

Overview of C Programming Language
Fundamental types
Input/Output Statements
Selection /Control Structure
Iteration
Functions
Operators
Arrays and Strings
Pointers and References
Classes
Design and write error free programs in C
At least two hours of practical per week

NCE II SECOND SEMESTER

CSC 221 **PASCAL Programming Language** **2 Credits Compulsory**

Objectives:

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

i. Explain the areas of application of PASCAL programming language.
ii. Design, write, debug and run PASCAL programs.
iii. Identify and explain at least four keywords and data types.
iv. Write subroutines.

Course Content:

An overview of PASCAL Programming Language
PASCAL data and Variables types
PASCAL identifiers and functions
Keywords in PASCAL
Statements (Read, Write, etc)
Looping in PASCAL
Arrays and Tables
Subroutines
Intensive practice in program designing, coding and running
At least two hours of practical per week

CSC 222 **Operating Systems (Windows Application) 2 Credits Compulsory**

Objectives:

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

i. Explain the meaning of operating system
ii. List at least four advantages and disadvantages of OS
iii. Outline the functions of operating system
iv. Explain Assemblers, Compilers and Interpreters
v. Explain Batch processing, Real time processing, Time sharing processing and Multi-processing

Course Content:

Definition and functions of Operating system (OS)
Advantages and disadvantages of using (OS)
Windows (types, uses, etc)
Assemblers, Compilers and Interpreters
Batch processing, Real time processing, Time sharing and Multiprocessing
Allocation and Scheduling Resource
Operating System Nucleus and memory management
Input/Output systems
Intensive Practice in Application of Windows

CSC 223 Introduction to Numerical Methods 1 **Credit Compulsory**

Objectives:

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

i. Understand and explain at least three numerical methods
ii. Use at least three methods to solve numerical problems.
iii. Design error free computer programs using at least three of the methods to solve numerical problems

Course Content:

Exposition and Program Design for:
Methods of Interpolation
Halving the Square Method
Newton-Raphson Method
Trapezoidal Rule, Simpson's Rule
Gaussian Method
Using Computer for treating the above

CSC 224 **SIWES** **1 Credit Compulsory**

CSC 225 **Systems Analysis and Design** **2 Credits Compulsory**

Objectives:

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

i. Identify and explain two types of system
ii. Explain system analysis and at least five of its objectives
iii. Identify and explain basic stage of system analysis and design.
iv. Explain at least three system analysis techniques
v. Explain three levels of management

Course Content:

Types of systems, System Analysis definition and objectives
Organizational Chart
Stages of Systems Analysis and Design
Information and Sources of Information
Feasibility Study
System Design
System Analysis Techniques
Management Information Systems (MIS)
Explain management and level of management

NCE III: FIRST SEMESTER

NCE YEAR 3 - FIRST SEMESTER

EDU 311
TEACHING PRACTICE

NCE III – SECOND SEMESTER

CSC 321 Advance level programming language (Java, C++, V Basic, VCOBOL etc)
2 Credits Compulsory

Objectives:

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

i. Identify and explain at least three principles of object oriented programming language
ii. At least explain three differences between procedural programming languages and object oriented programming language
iii. Design and write error free object oriented programs

Course Content:

An Overview of Object Oriented Programming

Comparison of various level of Advance Programming Language with other programming language (such as BASIC, Pascal etc)
Application of the selected Advanced Programming: Designing, Coding, Debugging and Running
Intensive practices on the selected programming language
At least two hours of practical per week

CSC 322 **Seminars** **1 Credit Compulsory**

Academic Seminars on selected topics in Computer Applications,
Students should present papers on allocated topics in Computer Applications
Intensive discussion and critical review of each paper should be carried out under the guidance of lecturers in the Department. Copies of presented (and updated) papers should be kept in the Departmental Library for consultation and reference.

CSC 323 **Desk Top Publishing** **1 Credit Elective**

Objectives:

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

i. Explain the basic concepts of Desktop Publishing (DTP)
ii. Explain the tools that are required for DTP
iii. Identify publishable materials
iv. Design, compose and publish materials using DTP methods
v. Identify and explain problems associated with DTP

Course Content:

Explanation of the Concept of Desk Top Publishing (DTP)
Advantages and problems of DTP
Equipment required for DTP
What can you publish?
Methods of Design, Composing and Production
Use of DTP Application Software (Coreldraw, PageMaker, Ms- Publisher etc)
At least two hours of practical per week

CSC 324 **Computer Graphics** **1 Credit Elective**

Objectives:

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

i. Explain the meaning of computer graphics
ii. Design Logos, Id cards, etc.
iii. Present information graphically using Pie Charts, Histograms, Line graphs, etc.
iv. Present Numerical Data/Formula in graphics.

Course Content:

What are Computer Graphics?
Production of Designs, Plans, Logos, etc

Presentation of Information as Pie Charts, Histograms and Line graphs
Presentation of Numerical Data in graphics
Use of Graphics application software (Draw, Instant Artist, etc)
Practical to emphasize: Drawing, Shape Variation, Labeling, Graphical Outputs from Numerical Data/Formula
At least two hours of practical per week

CSC 325 **Introductions to Computer Networking 1 Credit Compulsory**

Objectives:

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

i. Explain Information Technology (IT) and importance of Networking
ii. Explain at least two communication protocols.
iii. Identify and explain at least four networking tools
iv. Explain advantages and disadvantages of any three network topologies.
v. Differentiate between LAN and WAN networks
vi. Use Internet and Intranet

Course Content:

Meaning and nature of Information technology
Definition and Importance of Computer Networking
Networking Topology (Characteristics, advantages and disadvantages of each)
Types of Topology (Star, Ring, Bus, Tree and Mesh)
Networking types: Local Area Networking, (LAN), Wide Area Network (WAN)
Network Tools (Modems, Servers, ISP, etc)
The Use of Internet and Intranet
Multiplexing and communication protocols
Network Media

CSC 326 Computer Maintenances /Troubleshooting 1 Credit Compulsory

Objectives:

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

i. Identify and explain five (5) equipment required in a computer laboratory.
ii. Identify and explain five (5) dos and don'ts in a computer laboratory.
iii. Troubleshoot basic operating system problems.
iv. Prevent/clear viruses on computer system unit.
v. Identify and replace faulty computer components.

Course Content:

Overview of Computer Laboratory Environment
Identification of Basic components (Processor, Hard Disk, Motherboard, I/O ports, VDU, Keyboard, Flash Drives, CD ROM Drives, Printers, Mouse etc)

Management of Computer Science Laboratory
Care of Computer System
Prevention of computer viruses
Care of Computer Systems' components (Processor, Hard Disk, Motherboard,
I/O ports,, VDU, Keyboard, Flash Drives, CD ROM Drives, Printers, Mouse, etc)
Solving basic operating problems, removing viruses, trouble shooting etc.
At least Two hours of practical per week

NCE INTEGRATED SCIENCE (SINGLE MAJOR)

1.0 PHILOSOPHY

The philosophy of the Nigerian Certificate in Education NCE Integrated Science is anchored on the following areas:

a) Fundamental unity of science
b) The use of scientific method as a common approach in solving
c) The role and function of science in everyday life
d) To prepare students for further studies in Integrated Science

Integrated Science has been described as that science which has not been disintegrated. It supposes to be an approach to the study of the environment, free of the limitation imposed by the separate subject disciplines. This is not to' decry the value of a subject discipline approach; it clearly has its uses. However, at the-level of readiness for learning of secondary school students, the boundaries between the disciplines can only appear as artificial, man-made constructs which interfere with unified view of nature as a whole, which children bring to the classroom with them.

Integrated science emphasizes those concepts which are common to all of science, the process of science and the skills associated with them. The great themes of science such as energy, field and particle theories, conservation, balance and cycles in nature are also emphasized as it's the relevance of science to everyday life. Integrated Science also emphasizes inquiry into the nature of the environment. The scientific method of inquiry can be learned by everyone, and a prime aim of the programme is to provide students 'with an introduction to this method and allow them to follow their own inquiries. The method of inquiry has cognitive and practical aspects.

These cognitive aspects include the ability to formulate questions, to identify variables and design experiments, to interpret results, recognize patterns, generate hypotheses, draw conclusions and develop theoretical models. The practical skills required include general skills such as ability to observe and to measure, and more specialized skills in the handling and use of laboratory apparatus, living material, and chemical.

2. OBJECTIVES

In preparing teachers of Integrated Science, the principal objectives include:

i) Enabling students gain the concept of the fundamental unity of science;
ii) Installing in students a commonality of approach to problems of a scientific nature i.e. the scientific method;
iii) Increasing students' understanding of the role and functions of science in everyday life and in the world in which they live;
iv) Making students well informed and scientifically literate;
v) Enabling students acquire and demonstrate the intellectual-competence and professional skills necessary to the teaching of Integrated Science in Primary and Junior Secondary Schools, as an inquiry based subject, in conformity with National Curriculum;
vi) Developing in students the ability to impart and encourage in their pupils the spirit of inquiry into living and non-living things in the environment;

vii) Developing the ability and motivation in students to work and think in an independent manner;

viii) Enabling students carry out scientific investigations, emphasizing co-operation, development of appropriate scientific processes and skills and improving their written and oral communications skills.

ix) To develop in students the interest to pursue higher studies in integrated science.

3) (i) GENERAL ADMISSION REQUIREMENTS

a) Senior Secondary School Certificate of WAEC or NECO or any other equivalent Certificate from recognized examination bodies with credit passes in four (4) subjects including English Language and Mathematics at not more than two sittings. Two of the credits must be in the subjects making up the combinations the candidates wish to offer

b) A Grade II Teacher's Certificate (TC II) with credit or merit in four (4) subjects, two of which must be relevant to the course the candidate wishes to offer. Credits/Merits in English Language and Mathematics are required for candidates wishing to study Chemistry.

c) A pass in Pre-NCE Chemistry final examination or a pass in IJMB Chemistry final examination and a pass in JAMB is required for admission.

d) All candidates wishing to be considered for direct admission must enroll for and write the selected examination organized by an accredited body such as JAMB.

e) It should be noted that some colleges may in addition to all the above, administer their own elimination tests and/or interviews for some courses. This is legitimate.

Note;

A credit in Mathematics and credit in English Language at the Senior secondary School Certificate/equivalent are required of all science-based specializations.

(ii) ADDITIONAL ADMISSION REQUIREMENTS

Candidates wishing to study Integrated Science at the NCE level' must satisfy the general admission requirements. For candidates with Senior Secondary School Certificate or GCE 'O' Level, the credit passes must be from any two of the following groups:

a) Biology/Health Science/Agricultural Science
b) Physics
c) Chemistry
d) General Science/Integrated Science

For candidates with Grade II Certificates, the credit or merit passes must be from any two of the following groups:

a) Biology/Health Science
b) Chemistry
c) Physics
d) General Science/Integrated Science
e) Agricultural Science

There should be introduction of Pre-NCE Integrated Science for the Double major students in Colleges of Education(the head of the department could guide the lecturers in selection of the basic courses that would introduce the students to the course at Pre NCE level.)

4.0 FACILITIES

1. Classrooms/Laboratories

i) Classes of a maximum of 30 are seen as suitable teaching groups. Where the student intake exceeds this number they should be grouped into parallel groups.
ii) Classroom/Laboratory size should be between 10 x 8 and 12 x 9sq. meters to afford adequate space for practical activities and interaction.
iii) Special purpose laboratories and workshops should have a floor space of between 18 x 8 and 20 x 8sq. meters respectively.
iv) Biological Garden
v) (a) There should be a general purposes laboratory adequately stocked to cater for the interest of the students.
b) Since teaching in the very near future will be I.T. driven the Department should be provided with a Computer and Power point presentation projector. All staff are advised to be Computer literate.
c) There should be a digital laboratory for the Department
d) There should be enough classrooms and lecture venues for students: Computers should be provided to the Departments.
e) There should be an office for each staff (academic) furnished to enable the staff to work effectively.
f) There should be a weather station, fishpond, botanical garden/zoological and a nursery for the plants.

2. Staff Offices

The Head of Department and each senior staff should have a comfortably furnished office to himself/herself. There should also be an office for support staff (Typist, Clerks etc.) with relevant equipment e.g. Computer set, duplicating machines, etc. Every HOD should have a personal office separate from HOD's office.

3. The Library

There must be enough books to cover all the areas of the subject in the ratio of one student to ten books.

EQUIPMENT REQUIRED FOR THE TEACHING OF INTEGRATED SCIENCE

S/№.. DESCRIPTION	QUANTITY
1) Skeleton System	3
2) Muscular System	3
3) Brain and Nervous System	3
4) Circulatory System	3
5) Digestive System	3
6) Eye and Vision	3
7) Skin and Excretory organs	1

8) Microscope	40
9) Incubator/Sterilizer	1
10) Autoclave (portable)	3
11) Top Loading Balances	4
12) Hot Plates	1
13) Refrigerator	1
14) Water Filter	1
15) Hygrometer	1
16) Drying Oven	1
17) Microtome	1
18) Automatic Tissue Processor	3
19) Centrifuge	1
20) Herbarium Cabinet	9
21) Herbarium Index Boxes	3
22) Air Pump	1
23) Photometer	1
24) Kymograph	1
25) Dissecting Microscope	3
26) Insect Light Traps	3
27) Insect Box (large)	many
28) Slide Projector	1
29) Overhead Projector	2
30) Steel Frame Aquarium	1
31) Oxygen Meter	3
32) Herbarium	4
33) Binocular Microscope	30
34) Embedding Bath	
35) Manesty Still	
36) Water Bath	
37) PH meter	
38) Tissue Grinder lan	
39) Calorimeter	
40) Auxanometer (Electric)	
41) Soil Auger	4
42) Plant Press	2
43) Soil Testing Kit	2
44) Wooden Quadrant	1
45) Measuring Tape	10
46) Biological Tape	1
47) Bunsen Burner	18
48) Gas Cylinder	2
49) Meter Balance	
50) Cone Balance	
51) Thermostat	
52) Steam Bath	
53) Magnetic Stirrer	

54) Suction Pump
55) Circulating Water Pump
56) Soxlet Extractor
57) Rotary Evaporator
58) Water Tank
59) First Aid Box
60) Conductivity Meter
61) Water Distiller
62) Spectrophotometer
63) Oven and Victor Meyer's apparatus
64) for measuring
65) Vapour density (density bottle)
66) Ammeter
67) Volmeter
68) Rheostat
69) Triangular Prism
70) Rectangular Prism
71) Pendulum Equipment
72) Stop Clock
73) Meter Rule
74) Convex Mirror
75) Concave Mirror
76) Telescope
77) Vernier Calipers
78) Micrometer Screw Gauge
79) Thermometer
80) Bar Magnet
81) U-shaped Magnet
82) Soft-iron Bar
83) Solenoid
84) Steel Bar
85) Electromagnet
86) Colour Disc
87) Colour Filter
88) Iron Fillings
89) Compass
90) Ticker-Timer
91) Glass String (100ml)
92) Pine-hole Camera (can be made by students
93) Ray Box
94) Ripple Tank
95) Tuning Fork
96) meter Box
97) Resonance Table
98) Lead-acid-Accumulators
99) Dry Cell

100) Connecting (copper) wire
101) Roll-assorted
102) Plug key
103) Simple Electric Motor Generator
104) Zinc Rod
105) Copper Tubes
106) Capillary tubes
107) Glass Tubes
108) Stop Watch
109) Dissecting Kit
110) Hand Lens
111) Beam Balance
112) Spring Balance
113) Computer
114) Workbench with all accessories
115) Vice
116) Tool box with the following content:
  i) Hammer
  ii) Hack saw
  iii) Soldering iron and lead
  iv) Tri square
  v) Pliers
  vi) Files
  vii) Glass Cutter
  viii) Spoke Shave
  ix) Spanners
  x) Tape
  xi) Chisel
  xii) Tester
  xiii) Coping Saw
  xiv) Cross Cut
  xv) Tenon Saw
  xvi) Mallet
  xvii) Marking Gauge
  xviii) Collapsible Meter Rule
  xix) Hand drill with set of twist drills and drill bits
  xx) Punch/pincer
  xxi) Adjustable Screw Driver
  xxii) Knife
  xxiii) Rasp plane

Note: the quantity should be determined by the number of students in the programme

e) ESSENTIAL NEEDS

Constant supply of (i) water (ii) electricity and (iii) gas.

f) SUPPLY OF CHEMICALS

Integrated Science teaching involves the use of chemicals that would need to be replenished. There is therefore need to provide adequate potent chemicals/reagents for the experiments specified in the curriculum.

6. PERSONNEL

i) ACADEMIC STAFF

For the double major programme staff strength of:

(a) a minimum of 10 lecturers for double major programme

(b) a minimum of 8 lectures for single major programme will be required.

Qualification: At least B.Sc (Ed) Hons. Degree or its equivalent with NCE or PGDE or B.Ed with a minimum of Second Class Lower. The staff should preferably be qualified in Integrated Science. Master Degree in Science education is acceptable.

ii) SUPPORT STAFF

One Laboratory Technologist
One Laboratory Technician
One Laboratory Assistant
One Workshop Attendant
One Laboratory Attendant
One Cleaner
One Typist/Computer Operator

iii) MODE OF TEACHING

Any teaching and learning of Integrated Science should emphasis the principle of integrated based on the following.

a) Unity of all knowledge;
b) Conceptual unity of all Sciences
c) Unified process of science enquires
d) Inter-disciplinary studies
e) Social relevance of Science

Note:

Integrated Science lecturers are encouraged to published books at all levels.

The most basic and fundamental approach to the teaching of Integrated Science at the NCE level is that it must **be activity-based** at all points. This has been reflected in the time allocated to the various courses. Practical work is not listed separately since if forms an integral part of the teaching programme and can be assessed as part of the continuous assessment scores for the

programme. It has long been noted that students ***'teach as they have been taught'.*** The aim of this programme is to capitalize on this phenomenon so that graduates of the programme will continue with the **activity-based approach when they reach schools to teach pupils.**

The development of the science skills of observing, classifying, measuring, organizing, formulating hypothesis, experimenting and interpreting data and reporting results should be a major aim. A brief checklist for an activity-based approach to learning science is that students should be:

(a) Handling materials, living and non-living;
(b) Designing, making or manipulating apparatus using' a variety of materials including 'junk' items;
(c) Moving around freely and finding the materials they need;
(d) Discussing their work with each other and the teacher;
(e) Busy doing things they feel are important;
(f) Trying to work out for themselves what to do, from step to step, and not expecting to be told what to do;
(g) Puzzling over problems;
(h) Comparing their ideas or observations with those of others;
(i) Embarking on Field Trips;
(j) Excursion to places where students can observe science in operation/action to enhance better understanding of science.

The Integrated Science programme should be taught in such a way that those students:

(a) Take the initiative in suggesting what to do and how to set about it;
(b) Try out ideas to see what happens;
(c) Observe things closely – watching, listening, touching, smelling;
(d) Try different ways of approaching a problem;
(e) Classifying things according to their properties or characteristics;
(f) Make sure record of what they find out or observe
(g) Use instruments for aiding observation and measurement;
(h) Devise and apply tests to find out what things will do;
(i) Make predictions of what they expect to happen;
(j) Look for evidence to support the statements they make;
(k) Try to explain their observations;
(l) Confirm their findings carefully before accepting them as evidence;
(m) Have workshop's experience and practice.

Note
(a).The above checklists give a clear idea of the different approaches required for the effective training of teachers of Integrated Science. A re-orientation of course tutors from the traditional approach to science' teaching will certainly be required.

(b) In addition to that, fundamental unity of science, the social responsibility of science should be emphasized

(c) There is the need for materials to be produced for the course in form of modules so that there will be a standardization of teaching.
In addition, there should also be in-house Workshop in the various colleges to help in enhancing the capabilities of the new ISC teachers.
(d) The Students-teachers ratio should be 1:25

ADMINISTRATION OF THE DEPARTMENT: -
A lecturer of the rank of Senior Lecturer and above should administer the department.

8) GRADUATION REQUIREMENT

Integrated Science (Single Major)

Integrated Science	-	Minimum	32	Maximum	34	Credits
Second Teaching subjects	-	Minimum	32	Maximum	34	Credits
Education including TP	-	Minimum	36	Maximum	36	Credits
General Study	-	Minimum	18	Maximum	18	Credits
Total	=	**Minimum**	**118**	**Maximum**	**122**	**Credits**

9. TEACHING PRACTICE

All students must successfully complete Teaching Practice before graduating. Teaching practice ears 6 credits under Education 311.

10. PROJECT

A final year project is to be written in either Integrated Science or second teaching subject. The grade for the project is to be credited to EDU 324. It carries 2 credits.

11. ASSESSMENT AND CERTIFICATION

i) Semester examination must have 3 components essay questions, short structured questions and multiple choice questions.

For theory based courses CA = 40% and

Examination = 60% and for Practical courses, CA = 50% and Examination = 50%

12. Some of the available integrated science combinations are;

i. Integrated science/Mathematics
ii. Integrated Science/Biology
iii. Integrated Science/Chemistry
iv. Integrated Science/Physics
v. Integrated Science/Computer Science

COURSE TITLES AND STATUS FOR INTEGRATED SCIENCE (SINGLE MAJOR)

FIRST SEMESTER NCE I

COURSE CODE	TITLE	CREDITS	STATUS
ISC 111	Mathematics for Science I	1	Compulsory
ISC 112	Science Education I	1	Compulsory
ISC 113	Introduction to Scientific methods	1	Compulsory
ISC 114	Components of the environment I	2	Compulsory
ISC 115	Nature of matter I	1	Compulsory
	Total	6	

SECOND SEMESTER NCE I

COURSE CODE	TITLE	CREDITS	STATUS
ISC121	Mathematics for Science II	1	Compulsory
ISC122	Processes of Life	2	Compulsory
ISC123	Man and Energy I	2	Compulsory
	Total	**5**	

FIRST SEMESTER NCE II

COURSE CODE	TITLE	CREDITS	STATUS
ISC 211	Components of the environment II	2	Compulsory
ISC 212	Science Education II	1	Compulsory
ISC 213	Man and the Environment	1	Compulsory
ISC 214	Workshop practices and laboratory management	2	Compulsory
	Total	6	

SECOND SEMESTER NCE III

COURSE CODE	TITLE	CREDITS	STATUS
ISC 221	Nature of matter II	2	Compulsory
ISC 222	Science Education III	1	Compulsory

ISC 223	Dynamics	2	Compulsory
ISC 224	Research method	2	Compulsory
ISC 225	Carbon Compound I	1	Compulsory
	Total	8	

NCE III FIRST SEMESTER

	EDU 311	**Teaching Practice**	**6**

SECOND SEMESTER NCE III

COURSE CODE	TITLE	CREDITS	STATUS
ISC 321	Man and Energy II	2	Compulsory
ISC 322	Reproduction and Growth	2	Compulsory
ISC 323	Carbon compounds II	1	Compulsory
ISC 324	The earth and the moon	2	Elective
ISC 325	Global ecology	2	Elective
	Total	5C+2E=7	

SUMMARY

Study Status	First year credit units	Second year credit units	Third year credit units	TOTAL
Compulsory	11	14	5	30
Elective (Optional)	-	-	4	4
Total	11	14	9	34

*The project may be done in either Integrated Science or the other teaching subject but it will be credited to EDU 323

Minimum Credit Units Required for Graduation

Compulsory = 30 Credits
Elective = 2 Credits
Total = 32 Credits

Notes:
Courses are core courses satisfying a minimum credit requirement for the award of the NCE Single Major Integrated Science. There are 30 compulsory credit units and students are required to take additional 2 credit units from any of the 2 elective courses to meet up to a minimum of 32 credits

a) Integrated Science is designed to be taught as an activity-based 'subject' and practical should be included in every course.
b) Activity-based courses have been assessed as requiring more than 1 hour per Week per Semester for a single credit unit, the allocation being based upon the quantity of practical work implied by the stated course objectives.

NCE 1 – FIRST SEMESTER

ISC 111 MATHEMATICS FOR SCIENCE II (ARITHMETIC)

1 Credit (2 Hours/Week) Compulsory

Objective;

i. Use mathematical tables and electronic calculators for basic arithmetic functions.
ii. Solve simple algebraic equations

Use calculating aids such as tables and electronic calculators for me four arithmetic functions, plus, square roots, sine, cosines, tangents, exponentials and logarithms. .

1.1 Take account of accuracy in numerical work so that significant figures .are neither lost nor carried beyond what is justified.

1.2 Make appropriate evaluations of numerical expressions (e.g. $n^2 = 10$; $\sin 30° = 0.5$) and use such approximations to check the magnitudes of machine • calculations.

1.3 Use the following as examples:

- Exponential growth in Human population
- Population data: the accuracy of census, sample survey and vital registration system
- Population quantities e.g. birth rate, population density.

2) ALGEBRA

2.1 Positive and negative indices and square roots.

2.2 Simple algebraic equations, linear equations and quadratic equations, using correct formulae

ISC 112 SCIENCE EDUCATION I 1 Credit (2 Hours/Week) Compulsory

Objectives

By the end of the course students should be able to;

i. Describe how children learn science
ii. Explain some learning theories.

The science methodology component of the course acts as a bridge between the more formal education course taught by the Education Department and the science content which forms the bulk of the work done within the NCE Integrated Science. The focus is on the question: how can we help children to learn science? This subsumes two further questions: "how do children learn science? What is special about science? These questions loosely correspond to cognitive and developmental psychology and to the sociology and history of science. These themes are presented as questions in order to emphasize their application to classroom practice and curriculum implementation • The first year of Science Education (courses **ISC 112** and 1*22}* concentrates upon the psychological, philosophical and historical aspects of answering these questions.

"HOW DO CHILDREN LEARN SCIENCE?"

1.0 A Brief Introduction

1.1 History and philosophy of Integrated Science;

1.2 Traditional African ideas;

1.3 Behaviorism;

1.4 Constructivism;

2.0 CURRENT OR RECENT COMPETING THEORIES ON LEARNING

Their implications for the Science Curriculum;
2.1 Skinner's behavioral ideas;
2.2 The Bloom taxonomy of educational objectives;
2.3 Gagne's ideas;
2.4 Piagetian Stage theory;
2.5 Brunner's ideas;
2.6 Ausubel and the alternative conceptions movement;
2.7 Application of education theories to science teaching.

This will demonstrate to students that our best theories are only, provisional and arise out of several competing theories. The greatest emphasis should. be laid upon the Piagetian stage theory because it is important to give the students a- firm grip upon the most wide-ranging and easily applicable theory we have .to hand at present. (Time: 16 hours, with at least 6 hours on Piaget).

3.0 EVIDENCE FROM RESEARCH

3.1 Stages of cognitive development and the cognitive demands of science curricula;
3.2 Children's alternative conceptions;
3.3 Scientific concepts;
3.4 Science Education research from Nigeria.

NOTE:
This will give students a feel for the empirical evidence that must be gathered to test and develop theories of learning, and for the nature of data that is accepted as evidence in building psychological models (Time: 10 hours).

1SC 113 INTRODUCTIONS TO SCIENTIFIC METHODS

1 Credits, 2 Hours/Week) Compulsory

Objective;

i. Name the various senses and related organs.
ii. Measure quantities using standard ST units.
iii. Apply science process in every day life.

Definition of science, ethics and science process skills as ways of finding but about the environment and attempt to put structure on it. Assumptions of. Science concerning nature and the processes and products of scientific investigations.

1.0 OBSERVATION

1.1 Senses and related organs
1.2 Use of senses to make and record observations
1.3 Uses of Aids such as microscope, hand lens, telescope, glasses, hearing Aids

MEASUREMENT

Standard S.I. units and common related units for measurement of length, area, volume, mass, temperature and time.

Apparatus and instruments for measurement in the units specified in 2.1.

CLASSIFICATION
Grouping or classifying /objects in the environment by colour, shape, behaviour and other observed criteria.

Classification of living things: plants .and animals; vertebrates and invertebrates; groups of vertebrates, flowering and non-flowering plants.

4.0 **ETHICS OF SCIENCE AND SCIENTIFIC ATTITUDES**
Knowing the ethics of science and developing scientific attitudes know the assumptions of science concerning nature and the processes and products of scientific investigations/implication

SCIENCE PROCESS SKILLS
Application of science process skills to emphasis on communicating, interpreting data, designing experiments, reporting completely, and accurately, formulating hypotheses, genera1lizing, predicting, etc.

ISC114 COMPONENTS OF THE ENVIRONMENT I 2 Credits Compulsory

Objective:

i. State the qualitative and quantitative composition of air.
ii. Identify and describe the elements of weather
iii. Identify the various sources of water
iv. Identify organism that live in the soil in your environment.

Air, water, weather and soil as components of the environment.

1.0 AIR
1.1 Air pollution, sources and consequences of air pollution
1.2 One method for determining experimentally the-prop6rtion of oxygen in the atmosphere;
1.3 Qualitative and Quantitative composition of air in terms of nitrogen, oxygen, and water vapour, inert gases and carbon dioxide;
1.4 Physical properties and uses of oxygen and carbon dioxide and their importance to living things;

2.0 WATER
2.1 Sources of water;
2.2 Importance of water to Life;
2.3 Nature of water as a solvent;
2.4 Importance of oxygen dissolved in water;
2.5 Sources of water and contaminating agents, (e.g.: sewage, oil, Chemicals);
2.6 Methods of water purification (e.g. use of chemicals, filtration, boiling, sedimentation);
2.7 Compare rural and urban water supplies;
2.8 Effects of water cycle, including the formation of ice, thunder, lightning, non-uniform rainfall on the environment, with respect to plant growth and erosion.

3.0 WEATHER

3.1 Elements of weather (temperature, humidity, wind, rain, etc.);
3.2 uses of simple weather recording instruments in a weather station (thermometer, rain gauge, wind vane, barometer, hygrometer, etc.);
3.3 keep weather records in chart form.

4.0 SOIL

4.1 Organisms that live in soils in our environment;
4.2 Mineral component of the soil: soil texture, inorganic and organic components, air content and water;
4.3 Formation of soil in the light of climate and weathering, parent material, topography, organisms, influence of man and time;
4.4 Types of soil; sandy, clay, loamy, humus, etc;
4.5 Value of soil as a non-renewable resource and discuss the uses and importance of soil
4.6 Common causes and forms of soil erosion and the relevant preventive measures
4.7 Practices that influence of bush burning regulations agent
4.8 Drainage patterns, causes, prevention and effect

ISC115 NATURE OF MATTER I 1 Credit (2hours/week) Compulsory

Objective:

i. Explain the three states of matter in terms of its particulate nature
ii. Differentiate between physical and chemical changes
iii. Classify matter in terms of elements, mixture and compounds.

States of Matter explained in terms of particles; physical and chemical changes; separation; elements; compounds and mixtures.

1.0 STATES OF MATTER

1.1 Evidence for the existence of matter as particles;
1.2 General physical properties of solids, liquids and gases;
1.3 Boyle's law, Charles' law. Ideal gas law, PV=nRT and the effect of intermolecular forces on physical properties;
1.4 Vapour pressure of a pure liquid depends on temperature (qualitative treatment only);
1.5 Vapour pressure and relationship with external pressure;
Structure of NaCl as an ionic solid and carbon (diamond) and carbon (graphite) as macromolecular -structures; plastics as polymers (cross-linked or not) and glasses as super cooled liquids.

2.0 PHYSICAL AND CHEMICAL CHANGES; SEPARATION TECHNIQUES

2.1 Differences between physical and chemical changes;
2.2 Meanings of solution, solute, solvent, and apply them to Aqueous and some non-aqueous systems;
2.3 Techniques and applications of distillation, evaporation, sedimentation, crystallization, filtration, and chromatography e.g. paper and alum.

3.0 ELEMENTS, MIXTURES AND COMPOUNDS

3.1 classification of matter into elements, mixtures and compounds; and distinguish between them;
3.2 classification of common elements as metals and non-metals and as solids, liquids, or gases at room temperature.
3.3 Uses of common elements, compounds and mixture.

NCE I, SECOND SEMESTER

ISC 121 MATHEMATICS FOR SCIENCE II 1 Credit (2 hours/week) Compulsory
Objectives

i. Linear and linear graphs and determine their gradients.
ii. Relate variables using plotted graphs.
iii. Measure substended angles and apply trigonometry in solacing scientific problems.

1.0 GRAPHS

1.1 Graphical, numerical, algebraic and verbal forms;
1.2 Variables and Scales for graph plotting;
1.3 Slope and intercept on a linear graph;
1.4 Standard linear form y = m x + c and re-arrange relationships into linear form where appropriate;
1.5 Forms of common plots such as $\frac{1}{x}$, x^2, $\frac{1}{x^2}$, sinx, cosx, e''x, Sinx, Cosx;
1.6 The slope of a tangent to a curve as a means of obtaining gradient;
1.7 The use of population data.

2.0 GEOMETRY AND TRIGONOMETRY

2.1 Areas of right angle and isosceles triangles;
2.2 Circumferences and areas of circles and segments;
2.3 Areas and volumes of rectangular blocks, cylinders and spheres;
2.4 Pythagoras' theorem, similarity of triangles and angle sum of a triangle;
2.5 Sines, Cosines and Tangents in physical problems;
2.6 Relationship between degrees and radians

3.0 GRAPHS II

2.1 Revision from ISC 121 (1.0) the use of the slope of a tangent to a curve' as a means of obtaining gradient; e.g. distance/time graphs;

2.2 $\frac{d}{dx}$ For a rate of change with respect to variable x;
2.3 Area below a curve and relate this to integration, e.g. velocity/time graphs;
2.4 Histograph plots,
2.5 Apply the wave equation to simple harmonic motion, AC generation, Wave interference and diffraction;
2.6 Use of data from a variety of sources including population education to illustrate rate of change, histogram plots, and line graphs.

ISC 122 PROCESSES OF LIFE 2 Credits, (4 Hours/Week) Compulsory

Objectives:

i. Identify some vital life processes e.g. photosynthesis, reproduction, etc
ii. Explain some vital life processes
iii. Mention the importance of the life processes.

Photosynthesis, combustion and respiration, nutrition, and digestion, circulatory system Excretory system, Nervous system, Skeletal system.

1.0 PHOTOSYNTHESIS

1.1 Photosynthesis in terms of plants trapping energy and using it with carbon dioxide and water to make carbohydrate;
1.2 Test leaves and storage organs for starch;
1.3 Importance of light, carbon iv oxide and chlorophyll in photosynthesis;
1.4 Importance of photosynthesis to life processes

2.0 COMBUSTION AND RESPIRATION

2.1 Combustion and respiration;
2.2 Oxidation and reduction as the addition and removal of oxygen respectively;
2.3 Oxidation reactions and oxidizing agents in cases where oxygen has been added;
2.4 Reactions of-oxygen with some common elements (e.g. carbon, hydrogen, magnesium, sulphur, zinc);
2.5 Respiration in terms of the release of energy from the reaction of oxygen with food, forming waste products, carbon dioxide and water;
2.6 Experiment to measure the energy change during the burning of food;
2.7 Part of a mammalian respiratory system: nostrils, trachea, epiglottis, bronchi, bronchioles, alveoli, lungs, capillaries, ribs, intercostals muscles and diaphragm
2.8 Functions of respiratory system and the respiratory problems connected to breathing e.g. Asthma

3.0 NUTRITION

3.1 Types of food and test for the presence' of glucose, starch, protein and fats;
3.2 Sources of carbohydrates, fats and proteins and their importance to animals and plants;
3.3 Sources of calcium, iron and vitamins and their importance to animals;
3.4 Interrelationship between population, personal health and nutrition (Meaning, methods of personal health, advantages and disadvantages)

4.0 DIGESTIVE SYSTEM

4.1 Digestion as the process of making large particles small enough lo be soluble; reference to the physical and chemical action of teeth, gut muscles, digestive juices and enzymes.

4.2 Digestive system of mammals: mouth, esophagus, stomach, liver, small intestine, large intestine (colon and rectum), anus and the origin of the bile duct and pancreatic duct.

4.3 Absorption of food and simple food test.

4.4 Forms, places of storage and problems associated with food storage

5.0 CIRCULATORY SYSTEM

5.1 Composition of blood and lymph;

5.2 Role of blood in the transport of foodstuffs, respiratory gases, hormones, heat, excretory materials and as defence against diseases;

5.3 Role of lymph in the transport of foodstuffs;

5.4 Structure and function of the mammalian heart.

6.0 EXCRETORY SYSTEM

6.2 Process of excretion, the excretory organs and their functions in plants and mammals;

6.3 Excretion and elimination in mammals.

6.4 The excretory product

7.0 NERVOUS SYSTEM

7.1 Sense organs and their uses

7.2 Structure and function of the gross nervous system;

7.3 Simple reflex action and examples

7.4 Central nervous system in the detection and protection of the environment\

8.0 SKELETAL SYSTEM

8.2 Structure and function of the skeletal system support, movement arid' protection;

8.4 Muscles as energy converters;

8.5 Bones and joints as it relate to lever systems.

ISC 123 MAN AND ENERGY I 2 Credits, (4 Hours/Week) Compulsory

Objectives:

i. Explain the concepts of force, work, energy, and power.
ii. Identify forms of energy.
iii. Explain processes of leatflrasfer
iv. Describe the behaviours of light and sound.

Measuring and converting energy: force, work, energy, power. Forms of energy. Heat, temperature and heat transfer.

1.0 FORCE, WORK, ENERGY, POWER

1.1 Work done as force x distance, and is measured in joules;

1.2 Knows that the energy of a body is a measure of its capacity to do work and is measured in joules;

1.3 Concept of power as the rate at which work is .done (energy is transferred) and that the unit of power is the Watt (joule/second)

2.0 FORMS OF ENERGY.

2.3 Kinetic and potential energy, with kinetic energy associated with motion, and potential energy associated with position in a force field e.g. gravity;

2.4 Sources of forms of .energy: chemical, heat, magnetic, sound, and electro-magnetic radiation including light;

2.5 Transfer of energy from one form to another e.g. electrical to sound, heat to mechanical

2.6 Meaning, examples, uses and misuse of renewable and non renewable energy.

2.7 Energy conservation to machines, power stations and to animals (metabolism).

3.0 HEAT AND TEMPERATURE

3.1 Heat of a body as it relate to energy of movement of particles'.

3.3 Effects and uses of the expansion of solids, liquids and gases on heating;

3.4 Celsius and Kelvin temperature scales- and the concept of absolute zero of temperature;

3.5 Meaning of fixed points, temperature interval and the use of different thermometric substances (e.g. alcohol,, mercury) and. other properties (e.g. electrical resistance) for temperature measurement.

4.0 **HEAT TRANSFER**

4.1 Heat transfer by conduction, convection and radiation;

4.2 Simple demonstrations of the conduction of heat along good and poor conductors, and daily life examples of the use of good, and poor conductors;

4.3 Simple demonstrations of the transfer of heat by. Convection, and cite daily life examples of the use of convection;

4.4 Simple demonstrations of the absorption and emission characteristics, of matter and shiny surfaces with regards to -radiant heat and describe experiments to compare these surfaces.

5.0 LIGHT

1.0 Rectilinear propagation of light, shadows and eclipse;

1.1 Laws of reflection;

1.2 Position and nature of an image formed by a plane mirror;

1.3 Uses of convex and concave mirrors;

1.4 Behaviour of light as it passes from one medium to another; - (Refraction) to apparent dept vision, dispersion and rainbow.

6.0 SOUND

2.1 Sound waves as produced, propagated and reflected in- terms of longitudinal waves in a medium;

2.2 Velocity of sound in air by a simple method of measurement;

2.3 Factors which cause changes in the frequency of sounds given out by vibrating strings, air columns and other objects; the application of these .to musical instruments;

2.4 Pitch of a sound as it is related to frequency and loudness to amplitude;

NCE II FIRST SEMESTER

ISC211 COMPONENTS OF THE ENVIRONMENT II

2 Credits (4 Hours/Week) Compulsory

Objectives;

i. Classify living things and non living things.
ii. Describe the structure and function of plant cells and animal cells.
iii. Identify the relationship between chromosomes and genes.
iv. Explain the economic importance of bacteria, viruses and fungi.

1.0 CHARACTERISTICS OF LIVING AND NON LIVING THINGS

Characteristics and classification of living things, cells, chromosomes and genes, bacteria and viruses, fungi

1.1 Classification of growth in terms of temporary and permanent changes

1. 2 Physical and chemical changes in non living things and their characteristics.

2.0 PLANT AND ANIMAL CELL

2.1 Cheek cells and onion cells for viewing under a microscope, and to observe permanent slides of different types of cells under microscope.

2.2 Distinguish between animal and plant cells e.g. cytoplasm, cell wall, cell membrane, nucleus, vacuoles and chloroplast in a plant cell, cytoplasm, cell membrane and nucleus in animal cell.

CHROMOSOMES AND GENES

Nuclei as it contain chromosomes and that chromosomes carry, genes;.

Genes as a carrier of chemical information which determines an individual Characteristics / traits.

Sex preferences among Nigerian communities and consequences on population; Importance of family trait.

BACTERIA AND VIRUS

Bacteria and viruses are micro-organisms

Bacteria and viruses are important members of ecological cycles

Importance of bacteria in natural water

Diseases caused by Viruses and some bacteria

Importance of some bacteria in making yoghurt and cheese

Bacteria and viruses and their effects on food, nutrition and health

5.0 FUNGI

5.1 Fungi and state their characteristics;

5.2 types of fungi;

5.3 Occurrence of fungi, their use as food and in industry;

5.4 Fungi and its effects on food, nutrition and health.

ISC 212 SCIENCE EDUCATION II 1 Credits (2 hours/week) Compulsory

Objective;

i. Design lesson plan and activities.
ii. Explain the traditional role of the teacher.
iii. Describe how a teacher organize learning activities.

In the second year, student-teachers will be turning their, attention towards the business of teaching science in schools to pupils. This is the time to draw together the work of the first year and to think about how the fundamental question of: "How can we help children learn science?" Can be translated, into classroom practice and management of the learning environment

The following topics form the basis of discussion (about 10 hours for each):-

1.0 **THE TEACHER AS A MANAGER OF THE LEARNING ENVIRONMENT**
1.1 Time and lesson planning;
1.2 Resources and pupil activities;
1.3 Pupils and grouping of pupils for different activities;
1.4 Space and efficiency of operation.

2.0 THE TEACHER AS AUTHORITY VERSUS THE TEACHER AS FACILITATOR
2.1 Traditional role of the teacher;
2.2 Problems associated with developing or changing subject content;
2.3 School as an encouraging or a restricting environment.

3.0 THE TEACHER AS AN ORGANISER OF LEARNING OPPORTUNITIES
3.1 Finding out what children already think and know;
3.2 Presenting counter demonstrations and arguments, generating cognitive conflict;
3.3 Drawing arguments and evidence together;
3.4 Maximizing children's involvement in their own learning.
3.5 Using context to explain concepts.
3.6 Use of analogies (similes and metaphors)

ISC213 MAN AND THE ENVIRONMENT 1 Credits, (2 hours/week) Compulsory

Objectives

i. Differentiate human beings from other Primates.
ii. Identify the major ecosystem in the environment.
iii. Explain the role of human beings in resource development.
iv. Enumerate the effects of urbanization on the environment.

The special role of the human animal, ecological concepts, the influence of man on the environment, pollution and conservation

1.0 HUMAN BEINGS AS HIGHER ANIMALS
1.1 Characteristics of primates; the similarities and differences with other animals;

1.2 Human beings and other primates, (differences in terms of skeletal structure, size of brain, manipulation and use of tools, language and intelligence).
1.3 Application of basic intelligence skills e.g. observations, measurement and inquisitiveness.

2.0 INTRODUCTORY ECOLOGY

2.1 Concept of an ecosystem;
2.2 Major ecosystems in Nigeria: deciduous, savannah, and tropical forests;
2.3 Physical and biotic factors and uses of smaller ecosystems e.g. ponds, streams, farmland, etc;
2.4 Relationships between plants and animals, food chains, food webs;
2.5 People's use of land with reference to food production and food chains;
2.6 Carbon and nitrogen cycles;
2.7 Importance of fertilizers, herbicides and pesticides in food production;
2.8 Traditional and modem methods of food preservation
2.9 Associations: parasitism, symbiosis and commensalisms.

3.0 THE ROLE OF MAN IN RESOURCE DEVELOPMENT

3.1 Exploitation of resources by man, such as deforestation, desertification (Definition, causes, effects and control) and mining etc.
3.2 Causes of environmental .pollution: biological (sewage), chemical (especially fertilizers and power station emissions), thermal, and others e.g. oil spillages, slit and other waste from mining.
3.3 Environment as its being affected by pollution; land, air and water (rivers, lakes, the seas and pipe water).
3.4 Define environmental pollution- water, air and soil (types)
3.5 Causes of the environmental pollutants, their consequences and control.
3.6 Transfer of pollutants to the food chain, resulting in concentration in carnivores; the particular danger to large predators.
3.7 Ozone layer: definition, importance, effects depletion and control measures,
3.8 Human activities and its effects on the environment.

4.0 CONSERVATION

4.1 Natural resources from living things and non living things and their uses in Nigeria such as plant sources, animal sources and their economic importance.
4.2 Conservation and recycling of natural resources
4.3 Role of conservation organizations at local national and international levels
4.4 Improvement and the management of environment.

5.0 POPULATION STUDIES, QUALITY AND VALUE OF LIFE

5.1 Population and environmental quality;
5.2 Population and quality of life,
5.3 Effects of urbanization on the environment.

6.0 FIELD TRIP

ISC 214 WORKSHOP PRACTICES, LABORATORY MANAGEMNET AND SAFETY 2 Credits Compulsory

Objectives;

i. Prepare laboratory reagents and solutions.
ii. Develop skills for maintaining laboratory equipment.
iii. Administer first aid treatment.
iv. Improvise simple laboratory instruments.
v. Explain the importance of skill acquisition.

1.0 Laboratory Management
1.1 Laboratory rules
1.2 Laboratory equipment/apparatus
1.3 Storage and management procedures
1.4 Parts and use of microscope. Section Cutting: temporary and permanent preparation of slides.
1.5 Balances: Parts and manipulation of different types of balances
1.6 Preparation of solution - Molar and percentages.
1.7 Indicators - pH ranges.
1.8 Uses of burettes and pipettes and their maintenance
1.9 Bunsen burners, flame parts and adjustments.
1.10 Glass-blowing.
1.11 The accumulator, circuit connection - series and parallel.

2.0 **Safety in the Environment**
2.1 First aids for victims of acid/alkali burns, electric shock and other common accidents, ways/methods of extinguishing fires including oil and electric fires.

3.0 **Workshop Practice and skill acquisition**
3.1 Improvisation — definition and its advantages.
3.2 Production of improvised materials for teaching Integrated Science at Primary and Junior Secondary School Levels.
3.3 Recognition and use of basic carpentry tools in improvisation of science equipments e.g. test-tube racks. Acquisition of elementary skills in carpentry
3.4 Using paper work in modeling e.g. use of paper-Mache. .
3.5 Glass work: Glass-cutting, construction of aquarium etc.
3.6 Preparation of skeletons and herbariums.
3.7 Elements of painting - types of paints, colour mixing and sign writing.

4.0 **Metal Work**
4.1 Identification and uses of simple instruments used in metal workshop.
4.2 Soldering techniques
4.3 Welding techniques
4.5 Engraving

5.0 Electrical/Electronic Work

5.1 Meaning of ICT, component of ICT and importance of ICT
5.2 Identification and uses of simple instruments used in electrical workshop.
5.3 Simple circuit connection and types
5.4 Fuses and uses
5.5 Elementary Electronics
5.6 Mechanism of radio and tape recorder and T.V functions
5.7 Wavelengths and channels
5.8 Batteries – types, functions and maintenance

N.B Students should do a simple project on either of the following.

1) Improvisation of apparatus/equipment for science.
2) Simple experiments to demonstrate scientific processes and principles.

6.0 Skills acquisition

6.1 Meaning and reasons for skill acquisition, the risk, decision making, managing emergency situation, survival strategies and learning together.
6.2 Type of skills such as farming, computer literacy, photography, internet browsing, e-mail operation, fax, desktop publishing and networking etc.
6.3 Importance of skill acquisition, improvement of quality of life and appreciation of human capability.

NCE II SECOND SEMESTER

ISC 221 NATURE OF MATTER II 2 Credits (4 hours/week) Compulsory

Objectives;

i. Describe the atomic structure.
ii. Describe the arrangement of elements in the periodic table.
iii. Define and explain transition elements and their characteristics.
iv. Describe the concept of ionic and covalent bonding.
v. Identify communications and avionics using simple chemical test.

Atomic structure and the periodic Table, electronic structure and its relationship to the properties of the elements and to bonding. Reactions of some ions. Basic volumetric analysis.

ATOMIC STRUCTURE AND THE PERIODIC TABLE

1.1 Structure of the atom in terms of protons, neurons, and electrons – each, particle and described in terms of its relative charge and mass.
1.2 Define element by the number of protons in its nucleus
1.3 Concepts of atomic number and mass number, in relation to the number of protons and neurons in a nucleus
1.4 Isotopes in terms of variations of numbers of neutron
1.5 Arrangement of electrons in "shells" (considered as-energy levels, not as Bohr orbits) for the elements Hydrogen to Krypton

1.6 Grouping of elements according to their properties and reactions and similarities of arrangement of electrons
1.7 Gradation of properties within groups (alkali metals and Halogens), change in electro negativity and oxidizing / reducing properties down the group
1.8 Gradation of properties along period, such as metallic / non-volatility for the period Sodium to Chlorine
1.9 Ionic and covalent compounds with properties characteristics of their bond type

2.0 REACTIONS OF SOME IONS

2.1 Identification of anions such as Cl^-, Br^-, F^- etc using sodium hydroxide NaOH\ and NH"$_4$ OH
2.2 Identification cations such as Zn^{2+}, Cu^{2+}, $A1^{3+}$, Fe^{2+}, Fe^Pb* Using NaOH\ and NH"$_4$ OH (aq), as illustrations of precipitation reactions of metallic ions; their use in identification. Do confirmatory test for all the ions listed above
2.3 General characteristics of transition elements; coloured ions, variable oxidation states, para-magnetism, and their use as catalyst.
2.4 Transition elements and their' properties

3.0 VOLUMETRIC ANALYSIS

3.1 Simple acid-base volumetric analysis to show the concept of molarity (concentration).Mole Ratio ,Calculations ,end point, role of indicators etc.

ISC 222 SCIENCE EDUCATION III 1 Credits (2 hours/week) Compulsory

Objectives:

i. Describe the structure and function of a lesson plan.
ii. Differentiate between a syllabus and a scheme of work.
iii. Design a scheme of work and lesson plan for a given topic.
iv. Explain the important of asseement.

A continuation of ISC 212 Science Education III, translating the fundamental question:
"How can we help children learn science?" in classroom practice: by addressing the problem of effective management of the learning environment.
The following topics form the basis of discussion:

1.0 STRUCTURING LEARNING EXPERIENCES
1.1 Developing a course
1.2 Developing a lesson
1.3 Increasing the practical component
1.4 Devising work for mixed ability groups
1.5 Caring for pupils with special educational needs.

2.0 THE TEACHER AS A PRESENTER

2.1 Board work
2.2 Demonstrations
2.3 Practical activities
2.4 Discussions

2.5 Teaching/learning aids.

3.0 THE TEACHER AS AN ASSESSOR

3.1 Purposes of assessment
3.2 Different modes of writing questions
3.4 Preparing marking schemes
3.6 Assessments of practical activities with cognizance to Cognitive, Psychomotor and Affective domains
3.7 Evaluation of classroom activities and end of course performance.

4.0 MICRO-TEACHING

Students should prepare lessons and present topics in Integrated Science as a group or individually.

ISC223 DYNAMICS 2 Credits (4 Hours/Week) Compulsory

Objectives:

i. Explain the terms speed, velocity, acceleration, momentum and force
ii. State the 3 Newton's laws of motion and their applications
iii. Define work, energy and power
iv. With practical examples describe a simple harmonic motion

1.0 SPEED AND ACCELERATION

1.1 Derive and use the equation: average speed – distance over time taken
1.2 Derive and use the relationship: acceleration - change of velocity over time taken
1.3 Compute and use the relationship that acceleration is proportional to the force acting on a body
1.4 Interpret a speed/time graph for linear motion
1.5 Newton's law of motion
1.6 Gravitational force
1.7 Concept and purpose of space travels.
1.8 Satellite and its uses in the society

2.0 MOMENTUM

2.1 Application of momentum to the study of moving objects e.g. table tennis ball compared to a stone; a bullet thrown or fired by a gun
2.2 Application of Newton's Laws of Motion and derivation of the concept of force as rate of change of momentum
2.3 Derivations; $F = \frac{mv}{mu}$ and impulse as Ft = mv - mu

2.3 Principles of conservation of linear momentum.

3.0 WORK, ENERGY AND POWER

3.1 Concepts and units of work, energy and power from *iSC* 115

3.2 Derivation of the expressions KE = $\frac{1}{2}mv^2$ and PE = mgh, and apply them to example

4.0 MOTION IN A CIRCLE

4.1 Uniform motion in a circular path.
4.3 Application of the concept of angular velocity to circular motion.
4.5 Centrifugal and Centripetal force, production of artificial gravity.

5.0 SIMPLE HARMONIC MOTION

5.1 Simple Harmonic• Motion (SHM) as motion of a particle whose acceleration is proportional to- its displacement from its mean position and is always directed towards it;
5.2 Amplitude, frequency and period with respect to SHM, and the energy associated with SHM;
5.3 SHM with practical examples e.g. the simple pendulum and oscillating mass on spring in a qualitative manner.

ISC 224: RESEARCH METHOD 2 Credit Compulsory

Objectives:

i. Identify types of research
ii. State the importance of a research.
iii. List some simple methods of data analysis and their application.
iv. Identify the variables in any given research topic.

1.0 Meaning, types and importance of research
1.1 Identifying the topics
1.2 Topic selection
1.3 Literature Review
1.4 Construction of instruments
1.5 Data Analysis
1.6 Project reports

ISC225 CARBON COMPOUNDS I 1 Credits (2 hours/week) Compulsory

Objectives:

i. Explain the concept catenation of carbon.
ii. Describe the structure of the aliphatic hydrocarbons and their reactions.
iii. Describe petroleum, its origin, occurrence, composition and its economic importance.
iv. Describe the origin, occurrence, composition and uses of coal as fuel and petrochemical.

General concepts, aliphatic hydrocarbons, industrial sources.

1.0 INTRODUCTION TO CARBON CHEMISTRY

1.1 Principles of functional groups and structural formulae of organic-compounds.
1.2 Principles of determination of empirical and molecular formula.
1.5 Application of the IUPAC rules to hydrocarbons and their simple substitution products.
2.0 ALIPHATIC HYDROCARBONS
2.1 Organic compounds and their homologous series
2.2 Alkanes: general formula, type of bonding, methods of preparation, natural occurrence, combustion and their uses as fuels

2.3 Alkenes: general formula, methods of preparation, type of bonding, addition reactions of ethane and propene with bromine, hydrogen bromide and sulphuric acid

2.4 Alkynes: general formula, a method of preparation of ethyne, type of bonding, addition reaction, energy of triple bond with reference to ethyne.

3.0 CRUDE OIL

3.1 Petroleum; origin, occurrence, composition as a mixture of predominantly aliphatic hydrocarbons, fractional distillation of petroleum (crude oil) and uses of the different fractions

3.2 Cracking as a way of breaking longer chains to shorter more commercially ; useful ones

3.3 Meaning of the octane number of a fuel

3.4 Ethane as product of cracking, and as important source of chemicals for agriculture medicine and industry.

3.5 Processes of refining crude oil, its uses and its economic importance.

4.0 COAL

4.1 Origin, occurrence, composition (as predominantly a 'composing of carbon and many useful organic compounds) and uses of coal as fuel.

4.2 Distillation of coal to release coal gas and coal tar from which important organic compounds are separated, including aromatics such as benzenes, phenol, and toluene

4.3 Resource management and national wealth

4.4 Mineral exploration and pollution management.

NCE III FIRST SEMESTER

EDU 311 TEACHING PRACTICE

SECOND SEMESTER NCE III

ISC 321 MAN AND ENERGY II 2 Credits (4 hours/week) Compulsory

Magnetism, electrostatics, current electricity, main electric circuits, costing electrical energy

1.0 MAGNETISM

1.1 Magnetism, North and South poles, attraction and repulsion, lines of forces. Magnets

1.2 Making a permanent magnets

1.3 Laws of magnetism

1.5 Magnetic induction as the mechanism for magnetic North and South Poles

2.0 ELECTROATATICS

2.1 Phenomena of static electricity by rubbing different materials e.g. polythene and acetate rods,

2.2 Static electricity and magnetism

2.3 Electrostatics in terms of electrons.

3.0 CURRENT ELECTRICITY

3.2 Parts of simple circuit and their functions . .
3.3 Conductor, electrical insulator and describe common application of both
3.4 Series and parallel circuits.
3.5 Transfer of chemical energy to electrical energy in an electrical cell
3.6 Electromagnetism
3.7 Source of energy for large-scale electrical production are the combustion of fossil fuels (e.g. Egbin thermal power station) water-flow (e.g. Kanji dam) and nuclear reactions (not available in Nigeria)
3.8 Ohm's law
3.9 Direct and alternating currents.

4.0 MAINS ELECTRICAL CIRCUITS

4.1 House Wiring, 3 pin plugs, fuses, ear thing, safety devices or practices for Electrical Circuit
4.2 Electrical fuses and reasons for the choice of a particular rating of fuse for a particular use
4.3 Principle of a ring-main circuit
4.4 Principle of earthling appliances and other safety aspects of electrical circuits.

5.0 COSTING OF ELECTRIC ENERGY

5.1 Calculating cost of power consumption, the KWH, the importance of power for national development.
5.2 Energy consumption, conservation and management for development.

6.0 RADIOACTIVITY

6.1 Radioactive elements
6.2 Types, radiation and properties
6.2 Uses of radioactivity
6.3 Danger of radiation.

ISC 322 REPRODUCTION AND GROWTH 2 Credit (2hours/week) Compulsory

Sexual reproduction, growth and development in plants and animals

1.0 SEXUAL REPRODUCTION

1.1 Parts of reproductive system
1.1 Recognizing gametes as specialized cells;
1.2 Sexual reproduction as fusion of male and female gametes to form a zygote which develop into an embryo;
1.3 Functions of ovaries (animal and plant), testes and pollen grains as gamete-producing organs;
1.4 Physical problems of bringing together male and female gametes in plants, fish and mammal

2.0 HUMAN DEVELOPMENT

2.1 The monthly cycle, pregnancy and the shedding of the spongy lining of the uterus if pregnancy does not occur;
2.2 Mode of action and relative effectiveness of "natural" physical and Chemical (hormonal) methods of contraception in relation to population control, family and national economy;
2.3 Safe ages for reproduction in humans.

3.0 GROWTH AND DEVELOPMENT

3.1 Parturition and lactation; hormonal and neural control of labour, milk secretion and benefits of breast feeding
3.2 Behaviour that characterize Age of puberty
3.3 The couple's right in reproduction decisions.
3.4 Human potentials for population growth
3.5 An experiment to investigate conditions required for seed germination
3.6 An experiment to investigate the growth of a plant from a seed
3.7 An experiment to determine where growth occurs in a plant

4.0 INTRODUCTORY EMBRYOLOGY

A brief discussion on the fundamental processes which include determination, Fertilization, cleavage, blastula formation, gastrulation, organogenesis, differentiation, morphogenesis, with brief reference to some animals.

ISC 323 CARBON COMPOUNDS II 1 Credits (2hours/Week) Compulsory

Haloalkanes, alkanols, alkanoic acids, amines and amino acids macromolecule's

1.0 HALOALKANES

1.1 Nomenclature of the haloalkanes
1.2 Synthetic utility of substitution reactions on haloalkanes e.g. with. -OH, -CN, etc {restricted to the formation of primary amines)
1.3 Importance and dangers of some organo-chlorine compounds e'.g. DDT, PCBs, PVC, CFCs.

2.0 ALKANOLS

2.1 General molecular formula and nomenclature
2.2 Industrial preparation of ethanol by fermentation and from ethene.
2.3 Industrial and domestic uses of alkanols.

3.0 ALKANOIC ACIDS

3.1 General molecular formula and nomenclature
3.2 Properties of naturally occurring acids such as etbanoic and citric acids
3.4 Test for the carboxylic functional group

4.0 AMINES AND AMINO ACIDS

4.1 Classes of amines and their nomenclature . .
4.4 Acidic and Basic properties of amino acids that amino acids have acidic and basic properties
4.5 Relationship of amino acids to proteins.

5.0 SYNTHETIC MACRO-MOLECULES

5.1 Definition of polymerization
5.2 Nature and uses of an addition and condensation polymers e.g. polythene, polyamides and polyesters.

ISC 324 THE EARTH AND THE MOON 2 Credit Elective

Natural cycles, the Earth, the Moon

1.0 NATURAL cycles – days, lunar months, and year
1.1 Phenomena of seasons; harmattan; summer/winter, rainy/dry
2.0 THE EARTH
2.1 The structure of the Earth in terms of core, mantle and crust
2.2 Geological time scale and how it has been determined
2.3 Atmosphere as means of protection from radiation
2.4 Types of rocks; Igneous, Sedimentary and Metamorphic
2.5 Formation of the different types of rocks
2.8 Management, preservation and conservation of non-renewable natural resources

3.0 THE MOON
3.1 Relationship between moon and the earth
3.2 Phases of the moon
3.3 Conditions on the lunar surface
3.4 Solar and lunar eclipse

ISC 325 GLOBAL ECOLOGY I 2 Credit Elective
Socio-political aspects of science and technological, health and disease.

1.0 SOCIO-POLITICAL ASPECTS OF SCIENCE AND TECHNOLOGY
1.1 Appreciate-social and political implications of science and technology in the environment, including the problem of conflict between the need for electrical power and minerals, and the damage that may be caused to the environment.
1.2 Effects of science and technology on society in terms of science related occupations and changes in cultural and leisure activities.
1.3 Influence of science and technological development on population
1.4 Effects of Human Relationship in a larger society (e.g. Team work)
1.5 Gender roles in society and culture

2.0 HEALTH AND DISEASE (EMPHASIS ON TROPICAL DISEASES)
2.1 Possible causes, environmental effects, possible treatments and avoidance of non-communicable disease e.g. cardiovascular, cancers, respiratory.
2.2 drug abuse, and side effects, sources and drug/substance abuse
2.3 problem of drug abuse, alcohol, tobacco and hard drugs etc.
2.4 Methods of drug use, common ways of misusing drugs and social risk factors
2.5 Prevention of drug abuse and drug control agencies
2.6 Difference between methods of diseases transmission, with examples e.g. air-borne, flu, T.B. etc.
2.7 Causes of cholera, typhoid, intestinal infections etc.
2.8 Consequences of contacted diseases
2.9 Spread, prevention and control of STDS/AIDS
2.10 Blood transfusion and spread of diseases
2.11 Preventive medicines, including control or vectors
2.12 Importance of immunization

NCE INTEGRATED SCIENCE (DOUBLE MAJOR)

1) PHILOSOPHY

The philosophy of the Nigerian Certificate in Education NCE Integrated Science is anchored on the following areas:

a)Fundamental unity of science
b) The use of scientific method as a common approach in solving
c) The role and function of science in everyday life
d) To prepare students for further studies in Integrated Science

Integrated Science has been described as that science which has not been disintegrated. It supposes to be an approach to the study of the environment, free of the limitation imposed by the separate subject disciplines. This is not to' decry the value of a subject discipline approach; it clearly has its uses. However, at the-level of readiness for learning of secondary school students, the boundaries between the disciplines can only appear as artificial, man-made constructs which interfere with unified view of nature as a whole, which children bring to the classroom with them.

Integrated science emphasizes those concepts which are common to all of science, the process of science and the skills associated with them. The great themes of science such as energy, field and particle theories, conservation, balance and cycles in nature are also emphasized as it's the relevance of science to everyday life. Integrated Science also emphasizes inquiry into the nature of the environment. The scientific method of inquiry can be learned by everyone, and a prime aim of the programme is to provide students 'with an introduction to this method and allow them to follow their own inquiries. The method of inquiry has cognitive and practical aspects.

These cognitive aspects include the ability to formulate questions, to identify variables and design experiments, to interpret results, recognize patterns, generate hypotheses, draw conclusions and develop theoretical models. The practical skills required include general skills such as ability to observe and to measure, and more specialized skills in the handling and use of laboratory apparatus, living material, and chemical.

2. OBJECTIVES

In preparing teachers of Integrated Science, the principal objectives include:

i) Enabling students gain the concept of the fundamental unity of science;
ii) Installing in students a commonality of approach to problems of a scientific nature i.e. the scientific method;
iii) Increasing students' understanding of the role and functions of science in everyday life and in the world in which they live;
iv) Making students well informed and scientifically literate;
v) Enabling students acquire and demonstrate the intellectual-competence and professional skills necessary to the teaching of Integrated Science in Primary and Junior Secondary Schools, as an inquiry based subject, in conformity with National Curriculum;

vi) Developing in students the ability to impart and encourage in their pupils the spirit of inquiry into living and non-living things in the environment;
vii) Developing the ability and motivation in students to work and think in an independent manner;
viii) Enabling students carry out scientific investigations, emphasizing co-operation, development of appropriate scientific processes and skills and improving their written and oral communications skills.
ix) To develop in students the interest to pursue higher studies in integrated science.

3. GENERAL ADMISSION REQUIREMENTS

GENERAL ADMISSION REQUIREMENTS

a) Senior Secondary School Certificate of WAEC or NECO or any other equivalent Certificate from recognized examination bodies with credit passes in four (4) subjects including English Language and Mathematics at not more than two sittings. Two of the credits must be in the subjects making up the combinations the candidates wish to offer.
b) A Grade II Teacher's Certificate (TC II) with credit or merit in four (4) subjects, two of which must be relevant to the course the candidate wishes to offer. Credits/Merits in English Language and Mathematics are required for candidates wishing to study Biology.
c) A pass in Pre-NCE Biology final examination or a pass in IJMB Biology final examination and a pass in JAMB is required for admission.
d) All candidates wishing to be considered for direct admission must enroll for and write the selected examination organized by an accredited body such as JAMB.
e) It should be noted that some colleges may in addition to all the above, administer their own elimination tests and/or interviews for some courses. This is legitimate.

ADDITIONAL ADMISSION REQUIREMENTS

Candidates wishing to study Integrated Science at the NCE level' must satisfy the general admission requirements. For candidates with Senior Secondary School Certificate or GCE 'O' Level, the credit passes must be from any two of the following groups:

e) Biology/Health Science/Agricultural Science
a) Physics
b) Chemistry
c) General Science/Integrated Science

Pre-NCE Integrated Science courses can be mounted in the department for the double major students.

For candidates with Grade II Certificates, the credit or merit passes must be from any two of the following groups:

f) Biology/Health Science
g) Chemistry
h) Physics
i) General Science/Integrated Science
j) Agricultural Science

FACILITIES

1. Classrooms/Laboratories

i. Classes of a maximum of 30 are seen as suitable teaching groups. Where the student intake exceeds this number they should be grouped into parallel groups.
ii. Classroom/Laboratory size should be between 10 x 8 and 12 x 9sq. meters to afford adequate space for practical activities and interaction.
iii. Special purpose laboratories and workshops should have a floor space of between 18 x 8 and 20 x 8sq. meters respectively.
iv. Biological Garden
v. (a) There should be a general purposes laboratory adequately stocked to cater for the interest of the students.
vi. Since teaching in the very near future will be I.T. driven the Department should be provided with a Computer and Power point presentation projector. All staff are advised to be Computer literate.
vii. There should be a digital laboratory for the Department
viii. There should be enough classrooms and lecture venues for students: Computers should be provided to the Departments.
ix. There should be an office for each staff (academic) furnished to enable the staff to work effectively.
x. There should be a weather station, fishpond, botanical garden/zoological and a nursery for the plants.

Staff Offices

The Head of Department and each senior staff should have a comfortably furnished office to himself/herself. There should also be an office for support staff (Typist, Clerks etc.) with relevant equipment e.g. Typewriters, duplicating machines, etc. Every HOD should have a personal office separate from HOD's office.

The Library

There must be enough books to cover all the areas of the subject in the ratio of one student to ten books.

EQUIPMENT REQUIRED FOR THE TEACHING OF INTEGRATED SCIENCE

S/№.	DESCRIPTION	QUANTITY
1.	Skeleton System	3
2.	Muscular System	3
3.	Brain and Nervous System	3
4.	Circulatory System	3
5.	Digestive System	3
6.	Eye and Vision	3
7.	Skin and Excretory organs	1
8.	Microscope	40
9.	Incubator/Sterilizer	1

10. Autoclave (portable)	3
11. Top Loading Balances	4
12. Hot Plates	1
13. Refrigerator	1
14. Water Filter	1
15. Hygrometer	1
16. Drying Oven	1
17. Microtome	1
18. Automatic Tissue Processor	3
19. Centrifuge	1
20. Herbarium Cabinet	9
21. Herbarium Index Boxes	
22. Air Pump	
23. Photometer	
24. Kymograph	
25. Dissecting Microscope	
26. Insect Light Traps	
27. Insect Box (large)	
28. Slide Projector	
29. Overhead Projector	
30. Steel Frame Aquarium	
31. Oxygen Meter	
32. Herbarium	
33. Binocular Microscope	
34. Embedding Bath	
35. Manesty Still	
36. Water Bath	
37. PH meter	
38. Tissue Grinder lan	
39. Calorimeter	
40. Auxanometer (Electric)	
41. Soil Auger	4
42. Plant Press	2
43. Soil Testing Kit	2
44. Wooden Quadrant	1
45. Measuring Tape	10
46. Biological Tape	1
47. Bunsen Burner	18
48. Gas Cylinder	2
49. Meter Balance	
50. Cone Balance	
51. Thermostat	
52. Steam Bath	
53. Magnetic Stirrer	
54. Suction Pump	
55. Circulating Water Pump	

56. Soxlet Extractor
57. Rotary Evaporator
58. Water Tank
59. First Aid Box
60. Conductivity Meter
61. Water Distiller
62. Spectrophotometer
63. Oven and Victor Meyer's apparatus
64. for measuring
65. Vapour density (density bottle)
66. Ammeter
67. Volmeter
68. Rheostat
69. Triangular Prism
70. Rectangular Prism
71. Pendulum Equipment
72. Stop Clock
73. Meter Rule
74. Convex Mirror
75. Concave Mirror
76. Telescope
77. Vernier Calipers
78. Micrometer Screw Gauge
79. Thermometer
80. Bar Magnet
81. U-shaped Magnet
82. Soft-iron Bar
83. Solenoid
84. Steel Bar
85. Electromagnet
86. Colour Disc
87. Colour Filter
88. Iron Fillings
89. Compass
90. Ticker-Timer
91. Glass String (100ml)
92. Pine-hole Camera (can be made by students
93. Ray Box
94. Ripple Tank
95. Tuning Fork
96. Sono meter Box
97. Resonance Table
98. Lead-acid-Accumulators
99. Dry Cell
100. Connecting (copper) wire
101. Roll-assorted

102. Plug key
103. Simple Electric Motor Generator
104. Zinc Rod
105. Copper Tubes
106. Capillary tubes
107. Glass Tubes
108. Stop Watch
109. Dissecting Kit
110. Hand Lens
111. Beam Balance
112. Spring Balance
113. Computer
114. Workbench with all accessories
115. Vice
116. Tool box with the following content:

    a. Hammer
    b. Hack saw
    c. Soldering iron and lead
    d. Tri square
    e. Pliers
    f. Files
    g. Glass Cutter
    h. Spoke Shave
    i. Spanners
    j. Tape
    k. Chisel
    l. Tester
    m. Coping Saw
    n. Cross Cut
    o. Tenon Saw
    p. Mallet
    q. Marking Gauge
    r. Collapsible Meter Rule
    s. Hand drill with set of twist drills and drill bits
    t. Punch/pincer
    u. Adjustable Screw Driver
    v. Knife
    w. Rasp plane

Note: the quantity should be determined by the number of students in the programme

PERSONNEL

ACADEMIC STAFF

For the double major programmes, staff strength should be a minimum of 10 lecturers.

Qualification: At least B.Sc (Ed) Hons. Degree or its equivalent with NCE or PGDE or B.Ed with a minimum of Second Class Lower. The staff should preferably be qualified in Integrated Science.

SUPPORT STAFF
One Laboratory Technologist
One Laboratory Technician
One Laboratory Assistant
One Workshop Attendant
One Laboratory Attendant
One Cleaner
One Typist/Computer Operator

MODE OF TEACHING
It has be more activities base in Integrated Science.

Integrated is the key and central of teaching and learning at science consequently, any teaching and learning of Integrated Science should emphasis the principle of integrated based on the following.

a) Unity of all knowledge;
b) Conceptual unify of all Sciences
c) Unified process of science enquires
d) Inter-disciplinary studies
e) Social relevance of Science

Note:

Integrated Science lecturers are encouraged to published books at all levels. All zonal centres set up by NISTEP should be resource stated by NCCE.

The most basic and fundamental approach to the teaching of Integrated Science at the NCE level is that it must be activity-based at all points. This has been reflected in the time allocated to the various courses. Practical work is not listed separately since if forms an integral part of the teaching programme and can be assessed as part of the continuous assessment scores for the programme. It has long been noted that students *'teach as they have been taught'*. The aim of this programme is to capitalize on this phenomenon so that graduates of the programme will continue with the activity-based approach when they reach schools to teach pupils.

The development of the science skills of observing, classifying, measuring, organizing, formulating hypothesis, experimenting and interpreting data and reporting results should be a major aim. A brief checklist for an activity-based approach to learning science is that students should be:

a) Handling materials, living and non-living;
b) Designing, making or manipulating apparatus using' a variety of materials include 'junk' items;
c) Moving around freely and finding the materials they need;
d) Discussing their work with each other and the teacher;
e) Busy doing things they feel are important;
f) Trying to work out for themselves what to do, from step to step, and not expecting to be told what to do;
g) Puzzling over problems;
h) Comparing their ideas or observations with those of others;
i) Embarking on Field Trips;
j) Excursion to places where students can observe science in operation/action to enhance better understanding of science.

The Integrated Science programme should be taught in such a way those students:

a) Take the initiative in suggestive what to do and how to set about it;
b) Try out ideas to see what happens;
c) Observe things closely – watching, listening, touching, smelling;
d) Try different ways of approaching a problem;
e) Classifying things according to their properties or characteristics;
f) Make sure record of what they find out or observe
g) Use instruments for aiding observation and measurement;
h) Devise and apply tests to find out what things will do;
i) Make predictions of what they expect to happen;
j) Look for evidence to support the statements they make;
k) Try to explain their observations;
l) Confirm their findings carefully before accepting them as evidence;
m) Have workshop's experience and practice.

Note

a) The above checklists give a clear idea of the different approaches required for the effective training of teachers of Integrated Science. A reorientation of course tutors from the traditional approach to science' teaching will certainly be required.

b) In addition to that, fundamental unity of science, the social responsibility of science should be emphasized

c) There is the need for materials to be produced for the course in form of modules so that there will be a standardization of teaching. Also zonal centres set up by NISTEP should be resuscitated so that avenue will be created for teachers to meet and exchange ideas from time to time to uplift the teaching of ISC. In addition, there should also be in-house

Workshop in the various colleges to help in enhancing the capabilities of the new ISC teachers.

d) The Students-teachers ratio should be 1:25

ADMINISTRATION OF THE DEPARTMENT: -

A lecturer of the rank of Senior Lecturer and above should administer the department.

7. **GRADUATION REQUIREMENTS**

i) Successful completion of Teaching Practice and outdoor Education programmes.

ii) Successful completion of project for the award of NCE Certificate.

Integrated Science (DM)	-	Minimum	64	Maximum	66	Credits
Education including TP	-	Minimum	36	Maximum	36	Credits
General Study	-	Minimum	18	Maximum	18	Credits
Total	=	**Minimum**	**118**	**Maximum**	**120**	**Credits**

For computation of Grade Point Average (G.P.A.), all compulsory courses should count. For transition from Pre-NCE 1 Integrated Science the candidate must make a grade not less than D or CGPA of 2.0

TEACHING PRACTICE

All students must successfully complete Teaching Practice before graduating. Teaching practice ears 6 credits under Education 311

PROJECT

A final year project is to be written in Integrated Science. The grade for the project is to be credited to EDU 324. It carries 2 credits.

ASSESSMENT AND CERTIFICATION

i) Semester examination most have 3 components essay questions short structured questions and multiple choice questions.

For theory based courses CA = 40% and

Examination = 60% and for Practical courses, CA = 50% and Examination = 50%

COURSE TITLE AND STATUS FOR INTEGRATED SCIENCE

FIRST SEMESTER NCE 1

COURSE CODE	TITLE	CREDITS	STATUS
ISC 111	Mathematics for Science I	2	Compulsory
ISC 112	Science Education I	2	Compulsory
ISC 113	Introduction to Scientific methods	1	Compulsory
ISC 114	Components of the environment I	2	Compulsory

ISC 115	Nature of matter I	2	Compulsory
ISC 116	Earth in the universe	2	Compulsory
ISC 117	Processes of Life	2	Compulsory
	Total	13	

NCE 1 SECOND SEMESTER

COURSE CODE	TITLE	CREDITS	STATUS
ISC121	Mathematics for Science II	2	Compulsory
ISC122	Man and Energy I	2	Compulsory
ISC 123	Transport control and development in living thing	2	Compulsory
ISC 124	Fields and waves	3	Compulsory
ISC 125	Genetics growth and development	3	Compulsory
	Total	12	

NCE II FIRST SEMESTER

ISC 211	Components of the environment II	2	Compulsory
ISC 212	Science Education II	2	Compulsory
ISC 213	Man and the Environment	2	Compulsory
ISC 214	Workshop practices and laboratory management	2	Compulsory
ISC 215	Mathematics for Science III	2	Compulsory
ISC 216	Metals	3	Compulsory
	Total	13	

NCE II SECOND SEMESTER

COURSE CODE	TITLE	CREDITS	STATUS
ISC 221	Nature of matter II	2	Compulsory
ISC 222	Science Education III	2	Compulsory
ISC 223	Dynamics	2	Compulsory
ISC 224	Research method	2	Compulsory
ISC 225	Carbon Compound I	2	Compulsory
ISC 226	Fundamentals of Living things	2	Compulsory
ISC 227	Chemical Energetic	1	Compulsory
	Total	13	

NCE III FIRST SEMESTER

COURSE CODE	TITLE	CREDITS	STATUS
EDU 311	Teaching Practice	6	Compulsory

NCE III SECOND SEMESTER

COURSE CODE	TITLE	CREDITS	STATUS
ISC 321	Man and Energy II	2	Compulsory
ISC 322	Reproduction and Growth	3	Compulsory
ISC 323	Carbon compounds II	3	Compulsory
ISC 324	The earth and the moon	2	Elective
ISC 325	Global ecology	2	Elective
ISC 326	Science and society	3	Compulsory
	Total	11C+2E=13	

SUMMARY

Study Status	First year credit units	Second year credit units	Third year credit units	TOTAL
Compulsory	25	26	11	62
Elective (Optional)	-	-	4	4
Total	25	26	15	66

*The project must be done in Integrated Science but it will be credited to EDU 323

Minimum Credit Units Required for Graduation

Compulsory = 62 Credits
Elective = 2 Credits
Total = 64 Credits

Notes:
Courses are core courses satisfying a minimum credit requirement for the award of the NCE Double Major Integrated Science.

a. Elective course credit units. Students do 62 compulsory credit' units, and- one elective.
b. Integrated Science is designed to be taught as an activity-based 'subject' and practical should be included in every course.
c. Activity-based courses have been assessed as requiring more than 1 hour per Week per Semester for a single credit unit, the allocation being based upon the quantity of practical work implied by the stated course objectives.

NCE 1 – FIRST SEMESTER

ISC 111 MATHEMATICS FOR SCIENCE II (ARITHMETIC)

2 Credits Compulsory

Objective;

i. Use mathematical tables and electronic calculators for basic arithmetic functions.
ii. Solve simple algebraic equations

Use calculating aids such as tables and electronic calculators for me four arithmetic functions, plus, square roots, sine, cosines, tangents, exponentials and logarithms. .

2.1 Take account of accuracy in numerical work so that significant figures .are neither lost nor carried beyond what is justified.

2.2 Make appropriate evaluations of numerical expressions (e.g. $n^2 = 10$; $\sin 30° = 0.5$) and use such approximations to check the magnitudes of machine • calculations.

2.3 Use the following as examples:

- Exponential growth in Human population
- Population data: the accuracy of census, sample survey and vital registration system
- Population quantities e.g. birth rate, population density.

3) ALGEBRA

2.1 Positive and negative indices and square roots.

2.2 Simple algebraic equations, linear equations and quadratic equations, using correct formulae

ISC 112 SCIENCE EDUCATION I 2 Credits Compulsory

Objectives;

By the end of the course students should be able to;

i. Describe how children learn science
ii. Explain some learning theories.

The science methodology component of the course acts as a bridge between the more formal education course taught by the Education Department and the science content which forms the bulk of the work done within the NCE Integrated Science. The focus is on the question: how can we help children to learn science? This subsumes two further questions: "how do children learn science? What is special about science? These questions loosely correspond to cognitive and developmental psychology and to the sociology and history of science. These themes are presented as questions in order to emphasize their application to classroom practice and curriculum implementation • The first year of Science Education concentrates upon the psychological, philosophical and historical aspects of answering these questions.

"HOW DO CHILDREN LEARN SCIENCE?"

1.0 A Brief Introduction
1.1 History and philosophy of Integrated Science;
1.2 Traditional African ideas;
1.3 Behaviorism;
1.4 Constructivism;

3.0 CURRENT OR RECENT COMPETING THEORIES ON LEARNING

Their implications for the Science Curriculum;

2.1 Skinner's behavioral ideas;
2.2 The Bloom taxonomy of educational objectives;
2.3 Gagne's ideas;
2.4 Piagetian Stage theory;
2.5 Brunner's ideas;
2.6 Ausubel and the alternative conceptions movement;
2.7 Application of education theories to science teaching.

This will demonstrate to students that our best theories are only, provisional and arise out of several competing theories. The greatest emphasis should. be laid upon the Piagetian stage theory because it is important to give the students a- firm grip upon the most wide-ranging and easily applicable theory we have .to hand at present. (Time: 16 hours, with at least 6 hours on Piaget).

3**.0 EVIDENCE FROM RESEARCH**

3.1 Stages of cognitive development and the cognitive demands of science curricula;
3.2 Children's alternative conceptions;
3.3 Scientific concepts;
3.4 Science Education research from Nigeria.

NOTE:
This will give students a feel for the empirical evidence that must be gathered to test and develop theories of learning, and for the nature of data that is accepted as evidence in building psychological models (Time: 10 hours).

1SC 113 INTRODUCTIONS TO SCIENTIFIC METHODS

1 Credit (2 Hours/Week) Compulsory

Objective;

i. Name the various senses and related organs.
ii. Measure quantities using standard ST units.
iii. Apply science process in every day life.

Definition of science, ethics and science process skills as ways of finding but about the environment and attempt to put structure on it. Assumptions of. Science concerning nature and the processes and products of scientific investigations.

1.0 **OBSERVATION**
1.1 Senses and related organs
1.2 Use of senses to make and record observations
1.3 Uses of Aids such as microscope, hand lens, telescope, glasses, hearing Aids

MEASUREMENT
Standard S.I. units and common related units for measurement of length, area, volume, mass, temperature and time.

Apparatus and instruments for measurement in the units specified in 2.1.

CLASSIFICATION
Grouping or classifying ⁄objects in the environment by colour, shape, behaviour and other observed criteria.

Classification of living things: plants .and animals; vertebrates and invertebrates; groups of vertebrates, flowering and non-flowering plants.

ETHICS OF SCIENCE AND SCIENTIFIC ATTITUDES
Knowing the ethics of science and developing scientific attitudes know the assumptions of science concerning nature and the processes and products of scientific investigations/implication

SCIENCE PROCESS SKILLS
Application of science process skills to emphasis on communicating, interpreting data, designing experiments, reporting completely, and accurately, formulating hypotheses, genera1lizing, predicting, etc.

ISC114 COMPONENTS OF THE ENVIRONMENT I 2 Credits Compulsory

Objective:
i. State the qualitative and quantitative composition of air.
ii. Identify and describe the elements of weather
iii. Identify the various sources of water
iv. Identify organism that live in the soil in your environment.

Air, water, weather and soil as components of the environment.
1.0 AIR
1.1 Air pollution, sources and consequences of air pollution
1.2 One method for determining experimentally the-prop6rtion of oxygen in the atmosphere;
1.3 Qualitative and Quantitative composition of air in terms of nitrogen, oxygen, and water vapour, inert gases and carbon dioxide;
1.4 Physical properties and uses of oxygen and carbon dioxide and their importance to living things;

2.0 WATER

2.1 Sources of water;
2.2 Importance of water to Life;
2.3 Nature of water as a solvent;
2.4 Importance of oxygen dissolved in water;
2.5 Sources of water and contaminating agents, (e.g.: sewage, oil, Chemicals);
2.6 Methods of water purification (e.g. use of chemicals, filtration, boiling, sedimentation);
2.7 Compare rural and urban water supplies;
2.8 Effects of water cycle, including the formation of ice, thunder, lightning, non-uniform rainfall on the environment, with respect to plant growth and erosion.

3.0 WEATHER

3.1 Elements of weather (temperature, humidity, wind, rain, etc.);
3.2 uses of simple weather recording instruments in a weather station (thermometer, rain gauge, wind vane, barometer, hygrometer, etc.);
3.3 keep weather records in chart form.

4.0 SOIL

4.1 Organisms that live in soils in our environment;
4.2 Mineral component of the soil: soil texture, inorganic and organic components, air content and water;
4.3 Formation of soil in the light of climate and weathering, parent material, topography, organisms, influence of man and time;
4.4 Types of soil; sandy, clay, loamy, humus, etc;
4.5 Value of soil as a non-renewable resource and discuss the uses and importance of soil
4.6 Common causes and forms of soil erosion and the relevant preventive measures
4.7 Practices that influence of bush burning regulations agent
4.8 Drainage patterns, causes, prevention and effect

ISC115 NATURE OF MATTER I 2 Credits Compulsory

Objective:

i. Explain the three states of matter in terms of its particulate nature
ii. Differentiate between physical and chemical changes
iii. Classify matter in terms of elements, mixture and compounds.

States of Matter explained in terms of particles; physical and chemical changes; separation; elements; compounds and mixtures.

1.0 STATES OF MATTER

1.1 Evidence for the existence of matter as particles;
1.2 General physical properties of solids, liquids and gases;
1.3 Boyle's law, Charles' law. Ideal gas law, PV=nRT and the effect of intermolecular forces on physical properties;
1.4 Vapour pressure of a pure liquid depends on temperature (qualitative treatment only);
1.5 Vapour pressure and relationship with external pressure;

Structure of NaCl as an ionic solid and carbon (diamond) and carbon (graphite) as macromolecular -structures; plastics as polymers (cross-linked or not) and glasses as super cooled liquids.

2.0 PHYSICAL AND CHEMICAL CHANGES; SEPARATION TECHNIQUES

2.1 Differences between physical and chemical changes;

2.2 Meanings of solution, solute, solvent, and apply them to Aqueous and some non-aqueous systems;

2.3 Techniques and applications of distillation, evaporation, sedimentation, crystallization, filtration, and chromatography e.g. paper and alum.

3.0 ELEMENTS, MIXTURES AND COMPOUNDS

3.1 classification of matter into elements, mixtures and compounds; and distinguish between them;

3.2 classification of common elements as metals and non-metals and as solids, liquids, or gases at room temperature.

3.3 Uses of common elements, compounds and mixture.

ISC 116 The Earth in the Universe (2 Credits) C

Objective:

i. Identify the scale and details of the solar system and how it was discovered.
ii. Explain the relationships between the stars, planets and satellites.
iii. Describe the use of astronomical telescopes and radio telescopes.
iv. Explain the economic importance of air flight.
v. State the principles of rocketing and other aspects of space technology.

1.0 **The Solar System**

1.1 review the content of ISC 127 the `Earth and the Moon'

1.2 outline the scale and details of the solar system and how this was discovered

1.3 identify the presence and properties of space vacuum.

2.0 **The Universe**

2.1 Explain the differences between stars, planets and satellites.

2.2 Be aware of the existence of galaxies and other stellar phenomena

2.3 Give brief outline of the `big bang' theory of the formation of the universe, as an example of a theory which has gradually gained credence by the accumulation of many individual pieces of evidence.

2.4 Describe the use of astronomical telescopes and radio telescopes for the detection and tracking of radiation from wave emitting bodies.

3.0 **Flight**

3.1 outline simple details of the different methods of heavier than air flight; kites, gliders, aerofoil and helicopters.

3.2 Appreciate the economic importance of air flight.

4.0 **Activities in Space**

4.1 explain the principles of rocketry and other aspects of space technology.

4.2 Outline the history, successes and some dangers of space travel

4.3 Describe the present activities occurring in space: communication satellites, space shuttle, space station, interplanetary probes.

4.4 Describe the causes and possibilities of low weight and weightlessness

ISC 117 PROCESSES OF LIFE 2 Credits Compulsory

Photosynthesis, combustion and respiration, nutrition, and digestion, circulatory system Excretory system, Nervous system, Skeletal system.

1.0 PHOTOSYNTHESIS

1.1 Photosynthesis in terms of plants trapping energy and using it with carbon dioxide and water to make carbohydrate;

1.2 Test leaves and storage organs for starch;

1.3 Importance of light, carbon iv oxide and chlorophyll in photosynthesis;

1.4 Importance of photosynthesis to life processes

2.0 COMBUSTION AND RESPIRATION

2.1 Combustion and respiration;

2.2 Oxidation and reduction as the addition and removal of oxygen respectively;

2.3 Oxidation reactions and oxidizing agents in cases where oxygen has been added;

2.4 Reactions of-oxygen with some common elements (e.g. carbon, hydrogen, magnesium, sulphur, zinc);

2.5 Respiration in terms of the release of energy from the reaction of oxygen with food, forming waste products, carbon dioxide and water;

2.6 Experiment to measure the energy change during the burning of food;

2.7 Part of a mammalian respiratory system: nostrils, trachea, epiglottis, bronchi, bronchioles, alveoli, lungs, capillaries, ribs, intercostals muscles and diaphragm

2.8 Functions of respiratory system and the respiratory problems connected to breathing e.g. Asthma

3.0 NUTRITION

3.1 Types of food and test for the presence' of glucose, starch, protein and fats;

3.2 Sources of carbohydrates, fats and proteins and their importance to animals and plants;

3.3 Sources of calcium, iron and vitamins and their importance to animals;

3.4 Interrelationship between population, personal health and nutrition (Meaning, methods of personal health, advantages and disadvantages)

4.0 DIGESTIVE SYSTEM

4.1 Digestion as the process of making large particles small enough lo be soluble; reference to the physical and chemical action of teeth, gut muscles, digestive juices and enzymes.

4.2 Digestive system of mammals: mouth, esophagus, stomach, liver, small intestine, large intestine (colon and rectum), anus and the origin of the bile duct and pancreatic duct.

4.3 Absorption of food and simple food test.

4.4 Forms, places of storage and problems associated with food storage

5.0 CIRCULATORY SYSTEM

5.1 Composition of blood and lymph;

5.2 Role of blood in the transport of foodstuffs, respiratory gases, hormones, heat, excretory materials and as defence against diseases;

5.3 Role of lymph in the transport of foodstuffs;

5.4 Structure and function of the mammalian heart.

6.0 EXCRETORY SYSTEM

6.2 Process of excretion, the excretory organs and their functions in plants and mammals;

6.3 Excretion and elimination in mammals.

6.4 The excretory product

7.0 NERVOUS SYSTEM

7.1 Sense organs and their uses

7.2 Structure and function of the gross nervous system;

7.3 Simple reflex action and examples

7.4 Central nervous system in the detection and protection of the environment\

8.0 SKELETAL SYSTEM

8.2 Structure and function of the skeletal system support, movement arid' protection;

8.4 Muscles as energy converters;

8.5 Bones and joints as it relate to lever systems.

NCE I, SECOND SEMESTER

ISC 121: MATHEMATICS FOR SCIENCE II 2 Credits Compulsory

1.0 GRAPHS 1

1.1 Graphical, numerical, algebraic and verbal forms;

1.2 Variables and Scales for graph plotting;

1.3 Slope and intercept on a linear graph;

1.4 Standard linear form y = m x + c and re-arrange relationships into linear form where appropriate;

1.5 Forms of common plots such as $\frac{1}{x}$, x^2, $\frac{1}{x^2}$, sinx, cosx, e'"x, Sinx, Cosx;

1.6 The slope of a tangent to a curve as a means of obtaining gradient;

1.7 The use of population data.

2.0 GEOMETRY AND TRIGONOMETRY

2.1 Areas of right angle and isosceles triangles;
2.2 Circumferences and areas of circles and segments;
2.3 Areas and volumes of rectangular blocks, cylinders and spheres;
2.4 Pythagoras' theorem, similarity of triangles and angle sum of a triangle;
2.5 Sines, Cosines and Tangents in physical problems;
2.6 Relationship between degrees and radians

3.0 GRAPHS II

2.1 Revision from ISC 121 (1.0) the use of the slope of a tangent to a curve' as a means of obtaining gradient; e.g. distance/time graphs;
2.2 $\frac{d}{dx}$ For a rate of change with respect to variable x;
2.3 Area below a curve and relate this to integration, e.g. velocity/time graphs;
2.4 Histograph plots,
2.5 Apply the wave equation to simple harmonic motion, AC generation, Wave interference and diffraction;
2.6 Use of data from a variety of sources including population education to illustrate rate of change, histogram plots, and line graphs.

ISC 122 MAN AND ENERGY I 2 Credits, (4 Hours/Week) Compulsory

Measuring and converting energy: force, work, energy, power. Forms of energy. Heat, temperature and heat transfer.

1.0 FORCE, WORK, ENERGY, POWER

1.1 Work done as force x distance, and is measured in joules;
1.2 Knows that the energy of a body is a measure of its capacity to do work and is measured in joules;
1.3 Concept of power as the rate at which work is .done (energy is transferred) and that the unit of power is the Watt (joule/second)

2.0 FORMS OF ENERGY.

2.3 Kinetic and potential energy, with kinetic energy associated with motion, and potential energy associated with position in a force field e.g. gravity;
2.4 Sources of forms of .energy: chemical, heat, magnetic, sound, and electro-magnetic radiation including light;
2.5 Transfer of energy from one form to another e.g. electrical to sound, heat to mechanical
2.6 Meaning, examples, uses and misuse of renewable and non renewable energy.
2.7 Energy conservation to machines, power stations and to animals (metabolism).

3.0 HEAT AND TEMPERATURE

3.1 Heat of a body as it relate to energy of movement of particles'.

3.3 Effects and uses of the expansion of solids, liquids and gases on heating;

3.4 Celsius and Kelvin temperature scales- and the concept of absolute zero of temperature;

3.5 Meaning of fixed points, temperature interval and the use of different thermometric substances (e.g. alcohol,, mercury) and. other properties (e.g. electrical resistance) for temperature measurement.

4.0 HEAT TRANSFER

4.1 Heat transfer by conduction, convection and radiation;

4.2 Simple demonstrations of the conduction of heat along good and poor conductors, and daily life examples of the use of good, and poor conductors;

4.3 Simple demonstrations of the transfer of heat by. Convection, and cite daily life examples of the use of convection;

4.4 Simple demonstrations of the absorption and emission characteristics, of matter and shiny surfaces with regards to -radiant heat and describe experiments to compare these surfaces.

5.0 LIGHT

1.0 Rectilinear propagation of light, shadows and eclipse;

1.1 Laws of reflection;

1.2 Position and nature of an image formed by a plane mirror;

1.3 Uses of convex and concave mirrors;

1.4 Behaviour of light as it passes from one medium to another; - (Refraction) to apparent dept vision, dispersion and rainbow.

6.0 SOUND

2.1 Sound waves as produced, propagated and reflected in- terms of longitudinal waves in a medium;

2.2 Velocity of sound in air by a simple method of measurement;

2.3 Factors which cause changes in the frequency of sounds given out by vibrating strings, air columns and other objects; the application of these .to musical instruments;

2.4 Pitch of a sound as it is related to frequency and loudness to amplitude;

ISC 123 TRANSPORT CONTROL AND DEVELOPMENT IN LIVING THING

2 Credits Compulsory

Objective:

i. Describe the structure and functions of the vascular bandles.

ii. Differentiate between male and female gametes,

iii. State the importance of blood tests and its application to blood typing.

1.0 GAIN AND LOSS OF FOOD AND OTHER MATERIALS

1.1 review from ISC 123, food requirements, including classes of food and balanced diet and digestion.

1.2 explain root systems in relation to exchange of materials; root structure and growth in a herbaceous dicotyledonous plant in relation to water and soil, nutrients and salts.

1.3 distinguish between leaf and stem structure (cuticle, stomata, lenticels internal and space system) in relation to the exchange of exygen and carbon dioxide and loss of water vapour.

1.0 TRANSPORT IN FLOWERING PLANTS

2.1 review from ISC 124 and ISC 225, the physical processes in cells, including permeability and osmosis.

2.2 discuss the structure and arrangement of xylem and phloem tissues in relation to infrastructure in transport; evidence for transport in exlem and phloem.

2.3 explain how water, minerals (potassium, phosphorus, calcium) and organic compounds (carbohydrates and organic nitrogen compounds) are carried by transport systems and distributed in the plant.

2.4 discuss hypothesis involving active diffusion.

2.0 REPRODUCTION

3.1 review from ISC 227 cyclic changes in the ovary and uterus and their relation to hormone release
3.2 distinguish the structural and functional differences between male and female gametes; the role of testosterone in sexual differentiation.
3.3 identify the roles of the male and female reproductive tracts in coitus and capacitation
3.4 enumerate some causes of infertility in males and females.
3.5 explain the possibilities of determining the sex of the zygote
3.6 distinguish between monozygotic and dizygotic twins
3.7 consider and explain the role and importance of foetal membranes; amnion, chorion and allantois.
3.8 outline the structure and function of the placenta and its limitation as a barrier, the vulnerability of the foetus.
3.9 demonstrate awareness of the importance of blood tests and practical application of blood groups.
3.10 discuss and emphasize responsible sexual behavior
3.11 outline consequences of excessive reproduction
3.12 child spacing and health.

ISC 124 FIELD AND WAVES 3 Credits Compulsory

Objectives:

i. Describe force fields
ii. Differentiate with examples longitudinal and transverse waves.
iii. Discuss dapple effect and its application to sound and waves.
iv. Explain Faraday's and Lenz's laws of electromagnetic induction

1.0 FIELDS

1.1 define generally: force fields and inverse square law
1.2 apply to magnetic, electric and gravitational fields
1.3 explain the application of force fields to the television tube, man-made satellites, natural satellites (e.g the Moon) and the solar systems
1.4 discuss the current trends in communication – Internet, E-mail, voice-mail and global communication systems.

2.0 WAVE MOTION

2.1 identify types of waves, longitudinal and transverse, with examples.
2.2 explain polarization of transverse wave e.g radio waves, light waves etc.
2.3 outline the relationship between velocity, frequency and wave length; the equation v=fn applies to vibrating air columns, radio serials, resonance and beats.
2.4 explain in qualitative terms the Doppler effect and its application to sound and the spectrum of light from reseeding starts.
2.5 recognise the electromagnetic spectrum in terms of frequency and the applications of the major ranges e.g. radio waves, IR, visible light, UV, X-rays, y-rays
2.6 demonstrate knowledge of interference with applications in light, sound and radio waves, illustrate by the use of the ripple tank.

3.0 ELECTROMAGNETISM

3.1 review current electricity from ISC 226, cells, electrolysis, Ohm's law
3.2 explain and show how that a force acts on a current carrying conductor in a magnetic field
3.3 apply this to the design of the moving coil meter and the DC motor
3.4 know Faraday's and Lenz's laws of electromagnetic induction and their application to the generation of electricity.
3.5 review the generation of electrical power from ISC 226
3.6 outline the advantages of AC for the transmission of electrical energy.

ISC 125 GENETICS, GROWTH AND DEVELOPMENT

3 Credits Compulsory

Objectives;

- **i.** Explain the concept of heredity and principles of gene segregation and independent assortment.
- **ii.** Mention the importance of genetic engineering and its applications.
- **iii.** Indentify and explain the characteristic associated with puberty.

1.0 POPULATION AND GENETICS

1.1 review the work on genetics in ISC 225
1.2 explain the concept of hereditability and the relevance of twin studies
1.3 explain the principles of gene segregation and independent assortment
1.4 list and discuss some general applications of genetics e.g. blood groups, Down's syndrome, sickle cell anaemia
1.5 outline the possibilities of genetic engineering in the production of medical products
1.6 discuss the implication of blood type and genetics engineering for human population.

2.0 DEVELOPMENT AND GROWTH

2.1 list and discuss the main factors associated with growth

2.2 review growth patterns of the body system in terms of height and weight, growth curves; differences in growth patterns of males and females.

2.3 identify the characteristics associated with puberty

2.4 describe the changes and signs that occur associated with menopause

2.5 understand senescence as a progressive inability to respond to changes in the environment, degeneration of the lymphatic system and decreased functioning of the organs, skeletal changes, osteoporosis and osteoarthritis; calcification of tissue relating to malfunctioning of arteries, lungs and eye lens.

2.6 appreciate that many of the changes that occur with age are natural and may require support and sympathy.

NCE II FIRST SEMESTER

ISC211 COMPONENTS OF THE ENVIRONMENT II

2 Credits Compulsory

Objectives;

i. Classify living things and non living things.
ii. Describe the structure and function of plant cells and animal cells.
iii. Identify the relationship between chromosomes and genes.
iv. Explain the economic importance of bacteria, viruses and fungi.

1.0 CHARACTERISTICS OF LIVING AND NON LIVING THINGS

Characteristics and classification of living things, cells, chromosomes and genes, bacteria and viruses, fungi

1.1 Classification of growth in terms of temporary and permanent changes

1. 2 Physical and chemical changes in non living things and their characteristics.

2.0 PLANT AND ANIMAL CELL

2.1 Cheek cells and onion cells for viewing under a microscope, and to observe permanent slides of different types of cells under microscope.

2.2 Distinguish between animal and plant cells e.g. cytoplasm, cell wall, cell membrane, nucleus, vacuoles and chloroplast in a plant cell, cytoplasm, cell membrane and nucleus in animal cell.

CHROMOSOMES AND GENES

Nuclei as it contain chromosomes and that chromosomes carry, genes;.

Genes as a carrier of chemical information which determines an individual

Characteristics / traits.

Sex preferences among Nigerian communities and consequences on population; Importance of family trait.

BACTERIA AND VIRUS

Bacteria and viruses are micro-organisms
Bacteria and viruses are important members of ecological cycles
Importance of bacteria in natural water
Diseases caused by Viruses and some bacteria
Importance of some bacteria in making yoghurt and cheese
Bacteria and viruses and their effects on food, nutrition and health

5.0 FUNGI

5.1 Fungi and state their characteristics;
5.2 types of fungi;
5.3 Occurrence of fungi, their use as food and in industry;
5.4 Fungi and its effects on food, nutrition and health.

ISC 212 SCIENCE EDUCATION II 2 Credits Compulsory

Objective;

i. Design lesson plan and activities.
ii. Explain the traditional role of the teacher.
iii. Describe how a teacher organize learning activities.

In the second year, student-teachers will be turning their, attention towards the business of teaching science in schools to pupils. This is the time to draw together the work of the first year and to think about how the fundamental question of: "How can we help children learn science?" Can be translated, into classroom practice and management of the learning environment

The following topics form the basis of discussion (about 10 hours for each):-

1.0 **THE TEACHER AS A MANAGER OF THE LEARNING ENVIRONMENT**
1.1 Time and lesson planning;
1.2 Resources and pupil activities;
1.3 Pupils and grouping of pupils for different activities;
1.4 Space and efficiency of operation.

2.0 THE TEACHER AS AUTHORITY VERSUS THE TEACHER AS FACILITATOR

2.1 Traditional role of the teacher;
2.2 Problems associated with developing or changing subject content;
2.3 School as an encouraging or a restricting environment.

3.0 THE TEACHER AS AN ORGANISER OF LEARNING OPPORTUNITIES

3.1 Finding out what children already think and know;
3.2 Presenting counter demonstrations and arguments, generating cognitive conflict;
3.3 Drawing arguments and evidence together;
3.4 Maximizing children's involvement in their own learning.
3.5 Using context to explain concepts.
3.6 Use of analogies (similes and metaphors)

ISC213 MAN AND THE ENVIRONMENT 2 Credits Compulsory

Objectives

i. Differentiate human beings from other Primates.
ii. Identify the major ecosystem in the environment.
iii. Explain the role of human beings in resource development.
iv. Enumerate the effects of urbanization on the environment.

The special role of the human animal, ecological concepts, the influence of man on the environment, pollution and conservation

1.0 HUMAN BEINGS AS HIGHER ANIMALS

1.1 Characteristics of primates; the similarities and differences with other animals;
1.2 Human beings and other primates, (differences in terms of skeletal structure, size of brain, manipulation and use of tools, language and intelligence).
1.3 Application of basic intelligence skills e.g. observations, measurement and inquisitiveness.

2.0 INTRODUCTORY ECOLOGY

2.1 Concept of an ecosystem;
2.2 Major ecosystems in Nigeria: deciduous, savannah, and tropical forests;
2.3 Physical and biotic factors and uses of smaller ecosystems e.g. ponds, streams, farmland, etc;
2.4 Relationships between plants and animals, food chains, food webs;
2.5 People's use of land with reference to food production and food chains;
2.6 Carbon and nitrogen cycles;
2.7 Importance of fertilizers, herbicides and pesticides in food production;
2.8 Traditional and modem methods of food preservation
2.9 Associations: parasitism, symbiosis and commensalisms.

3.0 THE ROLE OF MAN IN RESOURCE DEVELOPMENT

3.1 Exploitation of resources by man, such as deforestation, desertification (Definition, causes, effects and control) and mining etc.
3.2 Causes of environmental .pollution: biological (sewage), chemical (especially fertilizers and power station emissions), thermal, and others e.g. oil spillages, slit and other waste from mining.
3.3 Environment as its being affected by pollution; land, air and water (rivers, lakes, the seas and pipe water).
3.4 Define environmental pollution- water, air and soil (types)
3.5 Causes of the environmental pollutants, their consequences and control.
3.6 Transfer of pollutants to the food chain, resulting in concentration in carnivores; the particular danger to large predators.
3.7 Ozone layer: definition, importance, effects depletion and control measures,
3.8 Human activities and its effects on the environment.

4.0 CONSERVATION

4.1 Natural resources from living things and non living things and their uses in Nigeria such as plant sources, animal sources and their economic importance.
4.2 Conservation and recycling of natural resources
4.3 Role of conservation organizations at local national and international levels
4.4 Improvement and the management of environment.

5.0 POPULATION STUDIES, QUALITY AND VALUE OF LIFE

5.1 Population and environmental quality;
5.2 Population and quality of life,
5.3 Effects of urbanization on the environment.

5.0 FIELD TRIP

ISC 214 WORKSHOP PRACTICES, LABORATORY MANAGEMNET AND SAFETY

2 Credits Compulsory

Objectives;

i. Prepare laboratory reagents and solutions.
ii. Develop skills for maintaining laboratory equipment.
iii. Administer first aid treatment.
iv. Improvise simple laboratory instruments.
v. Explain the importance of skill acquisition.

1.0 Laboratory Management
1.1 Laboratory rules
1.2 Laboratory equipment/apparatus
1.3 Storage and management procedures
1.4 Parts and use of microscope. Section Cutting: temporary and permanent preparation of slides.
1.5 Balances: Parts and manipulation of different types of balances
1.6 Preparation of solution - Molar and percentages.
1.7 Indicators - pH ranges.
1.8 Uses of burettes and pipettes and their maintenance
1.9 Bunsen burners, flame parts and adjustments.
1.10 Glass-blowing.
1.11 The accumulator, circuit connection - series and parallel.

2.0 **Safety in the Environment**

2.1 First aids for victims of acid/alkali burns, electric shock and other common accidents, ways/methods of extinguishing fires including oil and electric fires.

3.0 **Workshop Practice and skill acquisition**

3.1 Improvisation — definition and its advantages.

3.2 Production of improvised materials for teaching Integrated Science at Primary and Junior Secondary School Levels.

3.3 Recognition and use of basic carpentry tools in improvisation of science equipments e.g. test-tube racks. Acquisition of elementary skills in carpentry

3.4 Using paper work in modeling e.g. use of paper-Mache. .

3.5 Glass work: Glass-cutting, construction of aquarium etc.

3.6 Preparation of skeletons and herbariums.

3.7 Elements of painting - types of paints, colour mixing and sign writing.

4.0 **Metal Work**

4.1 Identification and uses of simple instruments used in metal workshop.

4.2 Soldering techniques

4.3 Welding techniques

4.5 Engraving

5.0 Electrical/Electronic Work

5.1 Meaning of ICT, component of ICT and importance of ICT

5.2 Identification and uses of simple instruments used in electrical workshop.

5.3 Simple circuit connection and types

5.4 Fuses and uses

5.5 Elementary Electronics

5.6 Mechanism of radio and tape recorder and T.V functions

5.7 Wavelengths and channels

5.8 Batteries – types, functions and maintenance

N.B Students should do a simple project on either of the following.

3) Improvisation of apparatus/equipment for science.
4) Simple experiments to demonstrate scientific processes and principles.

6.0 Skills acquisition

6.1 Meaning and reasons for skill acquisition, the risk, decision making, managing emergency situation, survival strategies and learning together.

6.2 Type of skills such as farming, computer literacy, photography, internet browsing, e-mail operation, fax, desktop publishing and networking etc.

6.3 Importance of skill acquisition, improvement of quality of life and appreciation of human capability.

ISC 215 MATHS FOR SCIENCE III 2 Credit Compulsory

Objectives;

i. Solve simple problem in differentiation and integration.
ii. Determine maxima and minima.
iii. Apply statistical principles to practical situations.

1.0 CALCULUS

1.1 differentiate kx", sin kx, cos kx
1.2 integrate kx^n, sin kx, cos kx
1.3 understand the graphical methods of differentiation and integration.
1.4 determine maxima and minima.

2.0 STATISTICS

2.1 determine the range, mean, median and mode of set values
2.2 explain the concept of dispersion and standard deviation
2.3 explain the concept of correlation
2.4 explain the normal distribution curve, probability, test of significance
2.5 apply the above to practical situations.

ISC 216 METALS **3 Credits Compulsory**

Objectives;

i. Explain the general properties of metals.
ii. Conduct experiment to establish the order of reaction of metals.
iii. Identify the importance of metals in industry and everyday uses.
iv. Explain the application of electrolysis to the extraction of metals.
v. Design experiments to determine factors which affect the corrosion of iron and steel.
vi. Explain the processes involved in mining and purification of ores.

General properties and reactivity of metals, common ores; extraction of economically important metals, electrolysis, corrosion, elastic properties of solids.

1.0 **General Properties and Reactivity**

1.1 outline the general properties of metals and appreciate their economic value related to properties such as conductivity, strength, malleability and ductility
1.2 describe experiments to establish the order of reactivity with water/steam, sodium, calcium, magnesium, zinc, iron and copper; interpret the results in terms of an order of reactivity.

2.0 **Commo ores and extraction of Metals**

2.1 differentiate the three most common types of metal ore in the earth's crust; exides, suphides and carbonates; and be able to identify these compounds.
2.2 Identify the importance of copper iron and aluminum metals in industry and everyday uses and give examples of their use.
2.3 Give examples of some early smelting processes in Africa;
2.4 Extraction of copper; iron, aluminium and tin can be extracted from their ores by chemical processes.
2.5 Describe and explain the process of heating metallic oxides with carbon
2.6 Outline the process by which iron is extracted from its ore in a blast furnace
2.7 Describe the management and development of mineral resources.

3.0 **Electrolysi**s

3.1 explain electrolysis: define the terms electrolyte, electrode, cathode and anode
3.2 explain the results of qualitative and quantitative investigations of the electrolysis of aqueous solutions of copper (II) sulphate and of acidified water.
3.3 Explain Faraday's laws of electrolysis
3.4 Explain the application of electrolysis to the extraction of metals
3.5 Outline other uses of electrolysis in industry; electroplating, purification of metals, manufacture of sodium hydroxide, reclamation of silver from silver salts.

4.0 Corrosion

4.1 discuss how corrosion is generally caused by atmospheric oxidation
4.2 describe experiments to determine factors which affect the corrosion of iron and steel
4.3 describe suitable methods for protecting metals against corrosion.

5.0 Elastic Properties of Solids

5.1 list the effects of external forces on elastic solids; Hooke's law and its limitations, the elastic limit.
5.2 Explain the meaning of tensile stress and strain, Young's modulus as an indicator of material elasticity and strength.
5.3 Perform simple experiments to determine Young's modulus
5.4 List the applications to mechanical and civil engineering e.g. bridge and building construction.
5.5 Explain the concept of elastic energy e.g. of a stretched spring, energy changes in bouncing balls.

NCE II SECOND SEMESTER

ISC 221 NATURE OF MATTER II 2 Credits Compulsory

Objectives:

i. Describe the atomic structure.
ii. Describe the arrangement of elements in the periodic table.
iii. Define and explain transition elements and their characteristics.
iv. Describe the concept of ionic and covalent bonding.
v. Identify communicators and anionic using simple chemical test

Atomic structure and the periodic Table, electronic structure and its relationship to the properties of the elements and to bonding. Reactions of some ions. Basic volumetric analysis.

ATOMIC STRUCTURE AND THE PERIODIC TABLE

1.1 Structure of the atom in terms of protons, neurons, and electrons – each, particle and described in terms of its relative charge and mass.
1.2 Define element by the number of protons in its nucleus

1.3 Concepts of atomic number and mass number, in relation to the number of protons and neurons in a nucleus
1.4 Isotopes in terms of variations of numbers of neutron
1.5 Arrangement of electrons in "shells" (considered as-energy levels, not as Bohr orbits) for the elements Hydrogen to Krypton
1.6 Grouping of elements according to their properties and reactions and similarities of arrangement of electrons
1.7 Gradation of properties within groups (alkali metals and Halogens), change in electro negativity and oxidizing / reducing properties down the group
1.8 Gradation of properties along period, such as metallic / non-volatility for the period Sodium to Chlorine
1.9 Ionic and covalent compounds with properties characteristics of their bond type

2.0 REACTIONS OF SOME IONS

2.1 Identification of anions such as Cl^-, Br^-, F^- etc using sodium hydroxide NaOH\ and NH"$_4$ OH
2.2 Identification cations such as Zn^{2+}, Cu^{2+}, $A1^{3+}$, Fe^{2+}, Fe^Pb* Using NaOH\ and NH"$_4$ OH (aq), as illustrations of precipitation reactions of metallic ions; their use in identification. Do confirmatory test for all the ions listed above
2.3 General characteristics of transition elements; coloured ions, variable oxidation states, para-magnetism, and their use as catalyst.
2.4 Transition elements and their' properties

3.0 VOLUMETRIC ANALYSIS

3.1 Simple acid-base volumetric analysis to show the concept of molarity (concentration).Mole Ratio ,Calculations ,end point, role of indicators etc.

ISC 222 SCIENCE EDUCATION III 2 Credits Compulsory

Objectives:

i. State how the problem of effective learning could be address.
ii. State the roles of teacher in the classroom

A , translating the fundamental question:
"How can we help children learn science?" in classroom practice: by addressing the problem of effective management of the learning environment.
The following topics form the basis of discussion:

1.0 STRUCTURING LEARNING EXPERIENCES
1.1 Developing a course
1.2 Developing a lesson
1.3 Increasing the practical component
1.4 Devising work for mixed ability groups
1.5 Caring for pupils with special educational needs.

2.0 THE TEACHER AS A PRESENTER

2.1 Board work
2.2 Demonstrations

2.3 Practical activities
2.4 Discussions
2.5 Teaching/learning aids.

3.0 THE TEACHER AS AN ASSESSOR
3.1 Purposes of assessment
3.2 Different modes of writing questions
3.4 Preparing marking schemes
3.6 Assessments of practical activities with cognizance to Cognitive, Psychomotor and Affective domains
3.7 Evaluation of classroom activities and end of course performance.

4.0 MICRO-TEACHING
Students should prepare lessons and present topics in Integrated Science as a group or individually.

ISC223 DYNAMICS 2 Credits Compulsory

Objectives
- **i. Define the term dynamics**
- **ii. Derive equations related to speed and acceleration**

1.0 SPEED AND ACCELERATION
1.1 Derive and use the equation: average speed – distance over time taken
1.2 Derive and use the relationship: acceleration - change of velocity over time taken
1.3 Compute and use the relationship that acceleration is proportional to the force acting on a body
1.4 Interpret a speed/time graph for linear motion
1.5 Newton's law of motion
1.6 Gravitational force
1.7 Concept and purpose of space travels.
1.8 Satellite and its uses in the society

2.0 **MOMENTUM**
2.1 Application of momentum to the study of moving objects e.g. table tennis ball compared to a stone; a bullet thrown or fired by a gun
2.2 Application of Newton's Laws of Motion and derivation of the concept of force as rate of change of momentum
2.3 Derivations; $F = \frac{mv}{mu}$ and impulse as Ft = mv - mu
2.3 Principles of conservation of linear momentum.

3.0 WORK, ENERGY AND POWER
3.1 Concepts and units of work, energy and power from *iSC* 115
3.2 Derivation of the expressions KE = $\frac{1}{2}$ mv^2 and PE = mgh, and apply them to example

4.0 MOTION IN A CIRCLE

4.1 Uniform motion in a circular path.
4.3 Application of the concept of angular velocity to circular motion.
4.5 Centrifugal and Centripetal force, production of artificial gravity.

5.0 SIMPLE HARMONIC MOTION

5.1 Simple Harmonic• Motion (SHM) as motion of a particle whose acceleration is proportional to- its displacement from its mean position and is always directed towards it;
5.2 Amplitude, frequency and period with respect to SHM, and the energy associated with SHM;
5.3 SHM with practical examples e.g. the simple pendulum and oscillating mass on spring in a qualitative manner.

ISC 224: RESEARCH METHOD 2 Credit Compulsory

Objectives

i. **State the components of a research project**
ii. **Right a prototype research project.**

1.0 Meaning, types and importance of research
1.1 Identifying the topics
1.2 Topic selection
1.3 Literature Review
1.4 Construction of instruments
1.5 Data Analysis
1.6 Project reports

ISC 225 CARBON COMPOUNDS I 2 Credits Compulsory

General concepts, aliphatic hydrocarbons, industrial sources.

Objectives

i. **state the principles of functional group**
ii. **enumerate the economic importance of crude oil**

1.0 INTRODUCTION TO CARBON CHEMISTRY

1.1 Principles of functional groups and structural formulae of organic-compounds.
1.2 Principles of determination of empirical and molecular formula.
1.5 Application of the IUPAC rules to hydrocarbons and their simple substitution products.
2.0 ALIPHATIC HYDROCARBONS
2.1 Organic compounds and their homologous series
2.2 Alkanes: general formula, type of bonding, methods of preparation, natural occurrence, combustion and their uses as fuels
2.3 Alkenes: general formula, methods of preparation, type of bonding, addition reactions of ethane and propene with bromine, hydrogen bromide and sulphuric acid
2.4 Alkynes: general formula, a method of preparation of ethyne, type of bonding, addition reaction, energy of triple bond with reference to ethyne.

3.0 CRUDE OIL

3.1 Petroleum; origin, occurrence, composition as a mixture of predominantly aliphatic hydrocarbons, fractional distillation of petroleum (crude oil) and uses of the different fractions

3.2 Cracking as a way of breaking longer chains to shorter more commercially ; useful ones

3.3 Meaning of the octane number of a fuel

3.4 Ethane as product of cracking, and as important source of chemicals for agriculture medicine and industry.

3.5 Processes of refining crude oil, its uses and its economic importance.

4.0 COAL

4.1 Origin, occurrence, composition (as predominantly a 'composing of carbon and many useful organic compounds) and uses of coal as fuel.

4.2 Distillation of coal to release coal gas and coal tar from which important organic compounds are separated, including aromatics such as benzenes, phenol, and toluene

4.3 Resource management and national wealth

4.4 Mineral exploration and pollution management.

ISC 226 FUNDAMENTALS OF LIVING THINGS 2 Credits Compulsory

Objectives:

i. Identify the nature and function of cellular constituents.
ii. Describe the process of cell division
iii. Describe the occurrence and functions of the main chemical constituents of the cell
iv. Explain the various genetic terms.

The structure of the cell and nucleus, important cell processes and elementary genetics.

1.0 **The Biology of Cells**

1.1 review the content of ISC 124 (plant and animal cells)

1.2 explain the nature and functions of nucleus, cell membrane, cell wall, vacuole, plastids and mitochondria.

1.3 compare prokaryotic and eukaryotic cells

1.4 explain cell division and the cell cycle, including mitosis and bacterial cell division

1.5 discuss the occurrence and functions in the body of the main chemical constituents:

1.5.1 carbohydrates (monosaccharide's, disaccharides and polysaccharides);

5.5.2 lipids (triglycerides and phospholipids):

5.5.3 protein (amino acids)

1.6 outline and discuss in general terms the replication of DNA

1.7 be aware of the main factors affecting the permeability of cell membranes and the concepts of osmosis, pinocytosis and phagocytosis, plasmolysis and tugor, hypothesis of active transport.

1.8 explain the mode of action of enzymes and factors affecting enzyme activity: temperature, pH, substracte/enzyme concentration, inhibitors and coenzymes.

2.0 Chromosomes, Genes and Variations

2.1 understand the general structure and importance in inheritance of the nucleus
2.2 recognise the significance of mitosis for genetic stability, growth and cell replacement, and meiosis in sexual reproduction and genetic variation.
2.3 exemplify single gene dominance as shown by Huntington's chorea
2.4 derive the expression of the genotype in the phenotype
2.5 explain the meaning and significance of gene pools

ISC 227 CHEMICAL ENERGETICS 1 Credit Compulsory

Objectives:

i. Describe energy of reactions
ii. Explain kinetics of reactions
iii. Explain chemical equilibrium and its application.
iv. Explain catalysis and enzymatic reactions.

1.0 Energy of Reactions

1.1 explain the meaning of enthalpy changes during a relation
1.2 explain exothermic and endothermic reactions and their reaction to the sign of AH
1.3 illustrate Hess's law using simple examples e.g formation of **NaCL or HCI**
1.4 explain enthalpies of formations, combustions and neutralizations
1.5 explain enthalpy chances in terms of internal energy.

2.0 Kinetics

2.1 define the rate of a reaction, explain factors which influence the rate include concentration, temperature, light and catalyst

2.2 demonstrate the meaning of order of `reaction' (distinguished from molecularity)
2.3 explain energy of activation in qualitative terms
2.4 give examples of photochemical reactions such as chlorine with hydrogen; photosynthesis; appreciate that the mechanism of photosynthesis is still not fully understood.

3.0 Catalysis/Enzymes Catalysts

3.1 identify catalysts as substances which change the rate of reaction
3.2 distinguish the action of homogenous and heterogeneous catalysts
3.3 explain in general terms the importance of enzymes as catalysts in biological processes
3.4 describe the effect of the activity of enzymes of yeast in brewing, wine making and the rising of bread
3.5 investigate the effect of heat on the activity of enzymes.

4.0 Equilibrium

4.1 demonstrate that chemical equilibrium is dynamic
4.2 identify and discuss the factors which affect the position of equilibrium (temperature, pressure and concentration)

4.3 demonstrate how to find the equilibrium constant of a reaction given the concentration of the reactants and products; distinguish between Kr and Kp

4.4 apply Le Chaterlier's principle to industrial processes e.g. Haber synthesis of ammonia and the Contact Process for sulphuric acid.

EDU 323

NCE III FIRST SEMESTER

EDU 311
TEACHING PRACTICE

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ISC 321 MAN AND ENERGY II 2 Credits Compulsory

Objectives:

i. Explain the concept of magnetism, electrostatics and current electricity
ii. Mention and explain the types of radiation.
iii. Explain the economic importance of radiation to the society.

Magnetism, electrostatics, current electricity, main electric circuits, costing electrical energy

1.0 MAGNETISM

1.1 Magnetism, North and South poles, attraction and repulsion, lines of forces. Magnets
1.2 Making a permanent magnets
1.3 Laws of magnetism
1.5 Magnetic induction as the mechanism for magnetic North and South Poles

2.0 ELCTROATATICS

2.1 Phenomena of static electricity by rubbing different materials e.g. polythene and acetate rods,
2.2 Static electricity and magnetism
2.3 Electrostatics in terms of electrons.

3.0 CURRENT ELECTRICITY

3.2 Parts of simple circuit and their functions . .
3.3 Conductor, electrical insulator and describe common application of both
3.4 Series and parallel circuits.
3.5 Transfer of chemical energy to electrical energy in an electrical cell
3.6 Electromagnetism
3.7 Source of energy for large-scale electrical production are the combustion of fossil fuels (e.g. Egbin thermal power station) water-flow (e.g. Kanji dam) and nuclear reactions (not available in Nigeria)
3.8 Ohm's law
3.9 Direct and alternating currents.

4.0 MAINS ELECTRICAL CIRCUITS
4.1 House Wiring, 3 pin plugs, fuses, ear thing, safety devices or practices for Electrical Circuit
4.2 Electrical fuses and reasons for the choice of a particular rating of fuse for a particular use
4.3 Principle of a ring-main circuit
4.4 Principle of earthling appliances and other safety aspects of electrical circuits.

5.0 COSTING OF ELECTRIC ENERGY
5.1 Calculating cost of power consumption, the KWH, the importance of power for national development.
5.2 Energy consumption, conservation and management for development.

6.0 RADIOACTIVITY
6.1 Radioactive elements
6.2 Types, radiation and properties
6.2 Uses of radioactivity
6.3 Danger of radiation.

ISC 322 REPRODUCTION AND GROWTH 3 Credits Compulsory

Objectives:
i.
ii. Explain the concept of reproduction in plants and animals.
iii. Explain the process of growth and development in human beings

Sexual reproduction, growth and development in plants and animals
1.0 SEXUAL REPRODUCTION
1.1 Parts of reproductive system
1.1 Recognizing gametes as specialized cells;
1.2 Sexual reproduction as fusion of male and female gametes to form a zygote which develop into an embryo;
1.3 Functions of ovaries (animal and plant), testes and pollen grains as gamete-producing organs;
1.4 Physical problems of bringing together male and female gametes in plants, fish and mammal

2.0 HUMAN DEVELOPMENT
2.1 The monthly cycle, pregnancy and the shedding of the spongy lining of the uterus if pregnancy does not occur;
2.2 Mode of action and relative effectiveness of "natural" physical and Chemical (hormonal) methods of contraception in relation to population control, family and national economy;
2.3 Safe ages for reproduction in humans.

3.0 GROWTH AND DEVELOPMENT
3.1 Parturition and lactation; hormonal and neural control of labour, milk secretion and benefits of breast feeding
3.2 Behaviour that characterize Age of puberty
3.3 The couple's right in reproduction decisions.

3.4 Human potentials for population growth
3.5 An experiment to investigate conditions required for seed germination
3.6 An experiment to investigate the growth of a plant from a seed
3.7 An experiment to determine where growth occurs in a plant

4.0 INTRODUCTORY EMBRYOLOGY

A brief discussion on the fundamental processes which include determination, Fertilization, cleavage, blastula formation, gastrulation, organogenesis, differentiation, morphogenesis, with brief reference to some animals.

ISC 323 CARBON COMPOUNDS II 3 Credits Compulsory

Objectives:

i. Describe the nomenclature of the substituted alkenes
ii. Give the general reaction
iii. Explain the economic importance and application of the substituted alkenes.

Haloalkanes, alkanols, alkanoic acids, amines and amino acids macromolecule's

1.0 HALOALKANES

1.1 Nomenclature of the haloalkanes
1.2 Synthetic utility of substitution reactions on haloalkanes e.g. with. -OH, -CN, etc {restricted to the formation of primary amines)
1.3 Importance and dangers of some organo-chlorine compounds e'.g. DDT, PCBs, PVC, CFCs.

2.0 ALKANOLS

2.1 General molecular formula and nomenclature
2.2 Industrial preparation of ethanol by fermentation and from ethene.
2.3 Industrial and domestic uses of alkanols.

3.0 ALKANOIC ACIDS

3.1 General molecular formula and nomenclature
3.2 Properties of naturally occurring acids such as etbanoic and citric acids
3.4 Test for the carboxylic functional group

4.0 AMINES AND AMINO ACIDS

4.1 Classes of amines and their nomenclature . .
4.4 Acidic and Basic properties of amino acids that amino acids have acidic and basic properties
4.5 Relationship of amino acids to proteins.

5.0 SYNTHETIC MACRO-MOLECULES

5.1 Definition of polymerization
5.2 Nature and uses of an addition and condensation polymers e.g. polythene, polyamides and polyesters.

ISC 324 THE EARTH AND THE MOON 2 Credit Elective

Objectives:

i. Explain the structure and the earth geological line scales and types of rock.
ii. Describe the phenomenal involved in the earth and the moon rotation.

Natural cycles, the Earth, the Moon

1.0 NATURAL cycles – days, lunar months, and year
1.1 Phenomena of seasons; harmattan; summer/winter, rainy/dry
2.0 THE EARTH
2.1 The structure of the Earth in terms of core, mantle and crust
2.2 Geological time scale and how it has been determined
2.3 Atmosphere as means of protection from radiation
2.4 Types of rocks; Igneous, Sedimentary and Metamorphic
2.5 Formation of the different types of rocks
2.8 Management, preservation and conservation of non-renewable natural resources

3.0 THE MOON

3.1 Relationship between moon and the earth
3.2 Phases of the moon
3.3 Conditions on the lunar surface
3.4 Solar and lunar eclipse

ISC 325 GLOBAL ECOLOGY I 2 Credit Elective

Objectives:

i. Identify and explain economic, social and political implication of science and technology.
ii. Explain the concept of health and disease.
iii. Explain the factors that cause diseases.
iv. Suggest preventive measures against tropical diseases.

Socio-political aspects of science and technological, health and disease.

1.0 SOCIO-POLITICAL ASPECTS OF SCIENCE AND TECHNOLOGY

1.1 Appreciate-social and political implications of science and technology in the environment, including the problem of conflict between the need for electrical power and minerals, and the damage that may be caused to the environment.
1.2 Effects of science and technology on society in terms of science related occupations and changes in cultural and leisure activities.
1.3 Influence of science and technological development on population
1.4 Effects of Human Relationship in a larger society (e.g. Team work)
1.5 Gender roles in society and culture

2.0 HEALTH AND DISEASE (EMPHASIS ON TROPICAL DISEASES)

2.1 Possible causes, environmental effects, possible treatments and avoidance of non-communicable disease e.g. cardiovascular, cancers, respiratory.
2.2 drug abuse, and side effects, sources and drug/substance abuse
2.3 problem of drug abuse, alcohol, tobacco and hard drugs etc.
2.4 Methods of drug use, common ways of misusing drugs and social risk factors
2.5 Prevention of drug abuse and drug control agencies
2.6 Difference between methods of diseases transmission, with examples e.g. air-borne, flu, T.B. etc.
2.7 Causes of cholera, typhoid, intestinal infections etc.
2.8 Consequences of contacted diseases
2.9 Spread, prevention and control of STDS/AIDS
2.10 Blood transfusion and spread of diseases
2.11 Preventive medicines, including control or vectors
2.12 Importance of immunization

ISC 326 SCIENCE AND SOCIETY 3 Credits Compulsory

Application of Science and Technology to everyday life.

Objectives:

i. Explain the concept of science and Technology.
ii. Describe the role and application of science and Technology in everyday.

1.0 Application of Science and Technology

Know and understand the basic scientific principles involved in the design and functioning of the following devices systems and phenomena:

1.1 atmospheric phenomena (whirlwinds, tornadoes, mist, rain, hail, thunder, lightning)
1.2 bridges
1.3 building blocks (cement, mud and bricks)
1.4 cassette recorders (audio and video)
1.5 cinema projectors
1.6 clinical thermometer (mercury, electronic and liquid crystal)
1.7 clothing
1.8 computers
1.9 cooking pots
1.0 electric circuit breaker
1.11 electric bulbs and fluorescent tubes
1.12 electric cookers
1.13 electric kettles
1.14 electric calculators
1.15 engines: petrol, diesel and jet
1.16 explosive and propellants
1.17 flight of birds and insects
1.18 fuses and earthling systems
1.19 generators

1.20 immersion heaters and thermostats
1.21 insulation and ventilation in houses, including roof design
1.22 laboratory scales
1.23 microwave ovens
1.24 musical instruments
1.25 pressing irons
1.26 pumps and siphons
1.27 refrigerators, freezer and air conditioners
1.28 photocopier
1.29 radar
1.30 radio
1.31 simple torches
1.32 solar energy, including collection and use by man
1.33 steel railway lines
1.34 submarines
1.35 telephone system
1.36 television
1.37 volcanoes and hot springs
1.38 wind and tidal energy
1.39 identify safety measures in using appliances in the home, school, work place etc
1.40 identify safety measures in using road, rail and other transportation systems/means
1.41 amplifiers.

PHYSICS

1.0 PHILOSOPHY

The philosophy of the Nigeria Certificate in Education, (N.C.E.), physics is inspired by the desire to help students become intellectually informed in physics, and by the need to produce competent and effective teachers with good mastery of content and method, and a knowledge of the development of the learner.

2.0 OBJECTIVES

At the end of the programme the students should be able to:

i) Have basic knowledge of the organizational concepts and techniques in practical physics and laboratory management,
ii) Be aware of the fact that the fundamental ideas of physics evolved from a process of inquiry, which will enable them to develop scientific attitudes which are transferable to other life situations,
iii) Plan and effectively execute physics-based lessons in B1-B9 classes in accordance with the UBE policy,
iv) Have sound basic knowledge of the physics concepts and principles to equip them for further studies in physics and physics- related courses,
v) Explain the nature of science,
vi) Use science resources effectively,
vii) Use Information Technology (IT) effectively to support pupils/students learning physics,
viii) Demonstrate the understanding of concepts of physics, reflect upon them and revise them when necessary;
ix) Organize physics lessons for the whole class, groups, and individuals effectively,
x) Recognize the difficulties students face with their physics learning,
xi) Remedy students misconception in physics,
xii) Develop pupils' use of physics language and
xiii. Carry out formative, diagnostic and summative assessment of students' work (theory and practice) in physics very successfully.

3.1. 1 GENERAL ADMISSION REQUIREMENTS

a) Senior Secondary School Certificate of WAEC or NECO or any other equivalent Certificate from recognized examination bodies with credit passes in four (4) subjects including English Language and Mathematics at not more than two sittings. Two of the credits must be in the subjects making up the combinations the candidates wish to offer

b) A Grade II Teacher's Certificate (TC II) with credit or merit in four (4) subjects, two of which must be relevant to the course the candidate wishes to offer. Credits/Merits in English Language and Mathematics are required for candidates wishing to study

c) A pass in Pre-NCE Physics final examination or a pass in IJMB Physics final examination and a pass in JAMB is required for admission.

d) All candidates wishing to be considered for direct admission must enroll for and write the selected examination organized by an accredited body such as JAMB.

e) It should be noted that some colleges may in addition to all the above, administer their own elimination tests and/or interviews for some courses. This is legitimate.

Note;
A credit in Mathematics and credit in English Language at the Senior secondary School Certificate/equivalent are required of all science-based specializations.

ii) ADDITIONAL ADMISSION REQUIREMENTS

A candidate must posses at least a credit in Mathematics at the Senior Secondary School Certificate level, and a credit in physics at the same or equivalent level. (e.g. NTC from National Business and Technical Examinations Board, NABTEB).

4. FACILITIES

i) Classrooms/Laboratories

a) One standard and well equipped laboratory for at least 30 students.
b) One preparatory room
c) Three Specialized laboratories one each for electronics, optics and workshop.
d) At least one adjoining classroom to the laboratory.
e) One computer room with at least 5 computer systems, overhead projector, slide projector and screen stencil scanners.

(ii) Staff Offices

Each senior member of staff should have a comfortably furnished office to himself/herself. There should also be an office for support staff (typist, clerks etc.) with relevant equipment e.g. typewriters, duplicating machines.

(iii) Books in the Library

There must be enough relevant and current books and journals to cover all the areas of Physics in the ratio of one student to ten books.

(iv) Students/Staff should have access to the INTERNET.

5. PERSONNEL

(a) Academic Staff

There should be at least eight (8) lecturers each with a minimum of B.Sc. (Ed.) Or B.Ed. Honours degree or B.Sc. (Honours) degree in Physics plus professional qualifications such as NCE or PGDE.

b) Support Staff

i) A minimum of three qualified laboratory technicians, one of which must be a workshop technologist to assist the lecturers during practical and to organize the laboratory activities in each of the specialized laboratories. There should also be a workshop technician
ii) A laboratory assistant who has background in the sciences
iii) A cleaner/messenger.

6. ADMINISTRATION OF THE DEPARTMENT

Only a lecturer of Senior Lecturer status and above should head the department.

7. MODE OF TEACHING

Physics is the most basic of the sciences and as such the students should be led to develop critical attitudes which can make them function effectively as teachers.

The integration of practical work with theory and the use of teaching aids and modern physics teaching techniques are essential. The practical work and the workshop practice are introduced as compulsory courses in order to achieve the desired effect. The following methods are desirable when reasonably used singly or combined:

i) Lecture
ii) Demonstration
iii) Practical
iv) Project/Assignment
v) Problem-solving in the classroom
vi) Field trip/excursion
vii) Team teaching
viii) Tutorial
ix) Discussion/Seminar/Workshop
x) Computer-Assisted Learning
xi) Internet/E-mail
xii) Game/Simulation
xiii) Any other relevant method.

8. GRADUATION REQUIREMENTS

i) An average of D in each of the 2 major subjects and education i.e. cumulative Grade point average of 2 points each plus a pass in English and Mathematics including other GSE courses.

ii) Successful completion of Teaching Practice and outdoor Education programmes.

iii) Successful completion of project for the award of NCE Certificate.

Physics	-	Minimum	32	Maximum	34	Credits
Second Teaching subjects	-	Minimum	32	Maximum	34	Credits
Education including TP	-	Minimum	36	Maximum	36	Credits
General Study	-	Minimum	18	Maximum	18	Credits
Total	=	**Minimum**	**118**	**Maximum**	**122**	**Credits**

For computation of Grade Point Average (G.P.A.), all compulsory courses should count. For transition from Pre-NCE 1 Physics the candidate must make a grade not less than D or CGPA of 2.0

9. TEACHING PRACTICE

Teaching Practice is compulsory for every student to graduate. Teaching practice earns 6 credits under Education 311

10. ASSESSMENT AND CERTIFICATION: For theory based courses CA = 40% and

Examination = 60% and for Practical courses, CA = 50% and Examination = 50%

11. PROJECT

Final Year Project is compulsory for all graduating students. The project may be written and supervised in any of the student's chosen subject areas. The grade for the project is credited to EDU 323. Project carries 2 credits

12. COURSE CONTENT AND STATUS

NCE I FIRST SEMESTER

Course Code	Course Title	Credit	Status
PHY 111	Mathematics for Physics I	1	C
PHY 112	Electromagnetism I	2	C
PHY 113	Mech & Properties of Matter I	2	C
PHY 114	Introduction to Physics Practical	1	C
	TOTAL	6	

NCE I SECOND SEMESTER

Course Code	Course Title	Credit	Status
PHY 121	Thermal Physics I	2	C
PHY 122	Intro. To Astronomy & Environmental Physics	2	C
PHY 123	Basic and Digital Electronics	2	C
PHY 124	Acoustics	1	C
PHY 125	Physics Practical	1	C
	TOTAL	8	

NCE II FIRST SEMESTER

Course Code	Credit Unit	Status
PHY 211 – Atomic and Quantum Physics I	1	C
PHY 212 – Electromagnetism II	2	C
PHY 213 – Mech & Properties of Matter II	3	C
PHY 214 – Mathematics for Physics II	1	C
PHY 215 – Physics Practicals II	1	C
TOTAL	8	

NCE II SECOND SEMESTER

Course Code	Credit Unit	Status
PHY 221 – Workshop Practice	1	C
PHY 222 – Optics	2	C
PHY 223 – Thermal Physics II	2	C
PHY 224 – Physics Methodology	1	C
TOTAL	6	

NCE III FIRST SEMESTER

EDU 311: TEACHING PRACTICE

NCE III SECOND SEMESTER

Course Code	Credit Unit	Status
PHY 321 – Electromagnetism III	2	C
PHY 322 – Atomic & Quantum Physics II	1	C
PHY 323 – Physics Practical III	1	C
TOTAL	4	

SUMMARY

Study Status	First year credit units	Second year credit units	Third year credit units	TOTAL
Compulsory	14	14	4	32
Elective (Optional)	-	-	-	-
Total	14	14	4	32

*The project may be done in either Physics or the other teaching subject but it will be credited to EDU 323

Minimum Credit Units Required for Graduation

Compulsory = 32 Credits
Elective = - Credits
Total = 32 Credits

EQUIPMENT REQUIRED FOR THE TEACHING OF PHYSICS

Ammeters (0-3A, 0-5A, -3A-+3A)	For every student
Voltmeters (0-3V, 0-5V, 0-10V)	For every student
Milliammeter (0-5m A, 0-10mA)	For every student
Millivoltmeters (0-5mV, 0-10mV)	For every student
Rheostat (Various sizes)	10
Triangular prisms	20
Pendulum equipment	10
Stop clocks	10
Meter rulers	30
Convex mirrors	30
Concave mirrors	30
Telescope	2
Vernier callipers	10
Micrometer screw gauge	10
Thermometers	40
Bar Magnets	20
Electromagnets	5
U-shaped Magnet	10
Soft-iron wires	For every student
Solenoid	10
Steel Bars	10
Colour Disc	5
Colour Filters	5
Iron Filings	1kg
Compasses	20
Ticker-Timer	10
Glass beaker	20
Pin-hole camera (can be made by students)	15
Ray boxes	15
Ripple tank and Accessories	3
Tuning Forks	20 boxes
Sonometer Box	10
Resonance tubes	10
Lead acid accumulators	5
Battery charger	2
Hydrometers	2
Dry cells	20
Connecting (Copper) wires (rolls)-assorted	For every student
Plug keys	5
Simple electric motor	2
Generators	2
Capillary tubes	For every student
U-tubes	5

Glass tubes		10
Stop watch		15
Meter Bridge		10
Daniell cells		5
Standard Cells (1.018V)		10
Standard Resistors (1R.2R,3R)	assorted	For every student
Retort clamps & Stand		10
Calorimeters		10
Electric Water Heaters		5
Weighing Balances		5
Elastic springs		10
Standard weights		For every student
Optical Pins		10 packets
Spherometer		3
Spectrometer		3
Inclined Plane		5
Pulleys (Various types)		10 each
Wheel & Axle		5
Roll of String		1 big roll
Elastic Bands (variety)		5 packets
Lens Holders		40
Force Board		10
Optical Benches		10
Searle's Apparatus (Elasticity)		5
Travelling Microscope		2
G-Clamps (Variety)		40
Mercury Vapour Lamps, Sodium Lamps, hydrogen lamp		2 each
Lamp holders and Resistors		20 each
Steam Generators		10
Rubber tubing (Variety of sizes)		For every student
Rubber Bungs (Variety of sizes)		For every student
Ordinary Corks (Variety of sizes)		For every student
Tripod Stands Bunsen Burners		30
Bimetallic strip		5
Searles Conductivity Apparatus		2
Lee's Disc Apparatus		2
Radiation Detectors & Apparatus		
Metal Strips and Metal Bars		5 each
Measuring Cylinders (Variety of sizes)		5 each
Glass Bath		2
Variety of liquids such as glycerol, alcohol, kerosene, naphthalene, mercury (250g)		2.5 each
Dip circles		3
Hare's Apparatus		3
Hoffmann's Voltameter		3
Electrodes (Copper, Zinc, Carbon etc)		1 dozen each

Crocodile clips	5 dozen
Electrical Calorimeter	2
Eureka can	3
Platinum Resistance Thermometer	2
Cathode Ray Oscilloscope	2
Perin's tube	2
Power Supply Unit	5
Shunts (Various Values)	10 each
Sonometer	10
Frequency Generator	2
Kundt's tube	2
Boyle's Law Apparatus	2
Aneroid Barometer	2
Transistors (different Values)	30
Viscometer (Oswalds)	2
Gold leaf Electroscope	5
Induction Coil	5
Van de Graaff Generator	2
Worchester Circuit Kits	2
Electrostatic Kits	2
Diodes (solid state)	Many (30) each
Vacuum Diodes (Valves)	2
Capacitors, Inductors, Resistors (Various Values)	30
Variac transformer	2
Frequency counter	2
Plane Mirrors & Holders	20 each
Spherical bobs (Various sizes) of Steel, Copper etc	3 bottles of various diameters
Long Cylindrical tube	5
Ball & Ring	2
Bar Breaking Instrument	2
Leslie Cube	2
Radiometer	2
GM tube	2
(Copper Sulphate) Copper (II) Tetraoxosulphate (VI)	1000g
(Silver Nitrate) Silver Trioxonitrate (V)	1000g
Zinc Rod	5
Porous Pot	5
Lycopodium Powder	500g (2bottles)

15. MATERIALS, TOOLS AND MACHINES REQUIRED FOR THE COLLEGE WORKSHOP

A. Machine tools for a Standard Physics Mechanical Workshop

1. Universal Lathe Machine
2. Universal Milling Machine
3. Pillar Drilling Machine

4. Radial Drilling Machine
5. Bench Drilling Machine
6. Universal Grinding Machine
7. Tool Grinding Machine
8. Bench Grinding Machine
9. Sharpening Machine
10. Hand Grinder
11. Gillotine
12. Bending Machine
13. Jig Saw Machine
14. Band Saw Machine
15. Power Saw Machine
16. Hand (Sanding) Grinding Machine
17. Machine Vice
18. Welding Machine (Arc)

B. Hand-tools for a Standard Mechanical Workshop

1. Bench Vice	4
2. Sets of files (rough and smooth)	5 sets
3. Hacksaw with Blades	10
4. Chisels	10
5, Shear snips	4
7. Hammer	5
8. Punchers	10
9. Sets of Spanners	5 sets
10. Sets of screwdrivers	10 sets
11. Plier	10
12. Gripping plier	10
13. Long nose plier	10
14. T-square	10
15. Dividers	10
16. Calipers and odd leg calipers	10 each
17. Tape and Dies (metric and imperial((B.A. thread)	10 each

C. Measuring tools

1. Micrometer screw gauge 0-25, 25-50mm	10
2. Vernier calipers 0-18cm	10
3. Steel Rule	5
4. Inside and outside calipers	20

D. Cutting tools

1. Hacksaw blades	20
2. Power blade	10
3. Lathe cutting tools (turning and Boring tools)	10
4. Thread cutting tools (internal and external)	10

E. Protective wears

1) Plain Goggles 5
2) Dark goggles for gas welding 5
3) Welding shield (opaque glass Dark) 5

F. Others

1) Gas welding set (Oxygen and Acetylene 2 sets
2) Engraver 2

16. COURSE CODE COURSE TITLE CREDIT UNIT AND STATUS

NCE I FIRST SEMESTER

PHY 111 MATHEMATICS FOR PHYSICS 1 1 Credit Compulsory

Numerical Techniques
Significant figure and decimal places
Indices and Logarithms
Standard Form
Simple algebraic equations, inequalities and solutions
Binomial theorem
Matrices and determinants
Numerical Techniques.

ANALYTICAL GEOMETRY AND TRIGONOMETRY

Compound angle geometry
Sine and cosine rules
Small angle approximations
Triangular relations
Vector algebra

CALCULUS

Partial fractions
General rules of differentiation and integration
Differentials and integrals of common functions
Differential Equations and Partial Derivative.

Objectives:

By the end of this course, student should be able to identify and explain the basic mathematical skills which will help them in solving problems in physics.

The students will be able to:

a) State the laws of indices & logarithm, and apply them in solving physics problems.

b) Solve simple problems in matrices.
c) Solve problems in geometry and trigonometry and applying them in solving problems in physics.
d) State the basic rules in calculus and apply them in solving physics problems.

PHY 112 ELECTROMAGNETISM 1 2 Credits Compulsory

ELECTROSTATICS

Concept of charge, Coulomb's law
Electric fields and electric potential
Compare: gravitational fields and potentials
Charge distribution over conductors
Storage of charges - capacitance, dielectrics and problems relating to them
Van de Graaf Generator.

MAGNETOSTATICS

Concepts of magnetic fields including the earth's magnetic induction.

CURRENT ELECTRICITY

Ohm's law

Simple circuit analysis

Thermal electricity and applications

ELECTROLYSIS

Concept of electrolysis

Cells - primary and secondary cells e.g. simple Voltaic,

Daniell, Leclanche, Weston, Lead-Acid, Nickel-Iron (NIFE) cells, etc.

CAPACITANCE

Parallel plate capacitor, energy stored in capacitor, Charging and discharging a capacitor.

Objectives:

By the end of this course, student should be able to identify and explain the basic concept in electromagnetism.

The students should be able to:

a) State the laws in electrostatic and compare the electrostatic field with gravitational field.
b) Identify and explain basics concept in magnetostatics.
c) Identify and explain basics concept in current electricity.
d) Identify and explain basics concept in electrolysis.

e) Identify and explain basics concept in capacitance.

PHY 113 MECHANICS AND PROPERTIES OF MATTER I 2 Credits Compulsory

QUANTITIES, UNITS AND DIMENSIONS

Fundamental quantities (mass, length, time, current, temperature, luminous intensity, amount of substance, Plane angle and Slid angle)
Derived quantities (e.g. volume, speed, momentum etc).
Fundamental and derived units
Dimensions - dimensional equations and their uses

SCALARS AND VECTORS

Scalar and vector quantities
Vector components
Addition and subtraction of vectors
Composition and resolution of vectors
Vector and scalar products

MOTIONS

Displacement, velocity and acceleration
One, two-dimensional motions
Relative velocity
Projectiles

OSCILLATORY AND CIRCULAR MOTIONS

Simple Harmonic Motion (Oscillation)
Period, amplitude and phase
Expression for period, frequency, velocity and acceleration
Damped S.H.M.

Newton's LAWS OF MOTION

Force, inertia and friction
MOMENTUM
Definition

Newton's second law; F□ time rate of change of momentum $\left(\frac{mdv}{dt}\right)$

Law of conservation of linear momentum
Collisions (elastic and inelastic; straight line & oblique).

Objectives:

By the end of this course, student should be able to identify and explain the basic concepts in mechanics and properties of matter.

The students will be able to:

a) Differentiate between basic (fundamental) and derived quantities and their units.
b) Solve problems involving dimensional analysis.
c) Differential between scalar and vector quantities with examples.
d) Solve problems involving vectors.
e) Identify types of motion and solve simple problems involving 1 – and 2 – dimensional motion.
f) State the Newton's law of motion and apply them in solving simple physics problems.
g) State and define the concept of energy, work and power.
h) Identify and explain concepts of equilibrium of forces.
i) Define Young shear and bulk modulus as well as Poisson's ratio of materials.

PHY 114 - INTRODUCTIONS TO PHYSICS PRACTICALS

1 Credit Compulsory

THEORY

The theory of practical: students are to be referred to relevant texts e.g. by Nelkon, Okeke, Armitage, Tyler etc.
Reporting practical
Graphical skills - plotting experimental data, suitable choice of axes and scales; line of best fit Interpretation and expression of equations in the form of $y = mx + c$ Evaluation of slope and intercept - extrapolation and interpolation; plotting with logarithmic scales.
Experimental errors and their treatment. Use and maintenance of simple measuring instruments e.g. vernier callipers, ammeter, galvanometer, micrometer screw gauge, etc.

Objectives:

By the end of this course, student should be able to acquire basic knowledge of the organizational concepts and techniques in practical physics and laboratory managements.

NCE I SECOND SEMESTER

PHY 121 THERMAL PHYSICS 1 2 Credits Compulsory

CONCEPTS OF HEAT AND TEMPERATURE

Nature (properties) of Heat and Temperature
Various measurements involving them with emphasis on constant pressure and Resistant thermometers. Other thermometric properties.

THERMAL ENERGY DEVELOPMENT

Quantity of heat and calorimetry including cooling corrections
Change of state, molecular interpretations
Gaseous process and laws;
Definitions and measurements of latent heats
Calculations involving quantity of heat and latent heat.

HEAT TRANSFER

Conduction, convection, radiation
Black-body radiation
Stefan's, Planck's and Wien's laws
Prevost's theory of heat exchange
Problems involving these.

KINETIC THEORY

Assumptions of the kinetic theory model of gases e.g. Brownian motion
Ideal gas laws and equations
Quantitative treatment of molecular speed and root mean square speed
Differences between real and ideal gas
Van der Waal's equation for real gases
Zeroth and First laws of thermodynamics

Objectives:
By the end of this course, student should be able to identify and explain the basic concepts of heat and temperature, and describe their measurements.

The students should be able to:

a) Differentiate between heat and temperature.
b) Identify types of thermometers and their thermometric properties.
c) Solve simple problems on quantity of heat.
d) Explain the concepts of heat transfer.
e) Explain the concepts of the kinetic theory.

PHY 122 INTRODUCTION TO ASTRONOMY AND ENVIRONMENTAL PHYSICS

2 Credits Compulsory

ASTRONOMY

Origin of the solar system
Components of cosmos
Night Sky
Cosmology
Atmosphere
Figure of the Earth

ENVIRONMENTAL PHYSICS

This part is based on the premise that physics is a concept-laden discipline and that almost all human activities involve these concepts, theories, laws and principles of Physics. Students are therefore expected to use their knowledge of physics to explain natural phenomena and other incidental occurrences as well as developments in science and technology. Such phenomena or occurrences include:-

*To provide detailed course content would defeat the objectives of this course. While a lecturer assigned the course serves as a co-ordinator, all staff should be encouraged to contribute. Students on their part should bring their own environmental observation, experiences and views on superstitions, development on science and technology for class discussions.

*The younger colleges could benefit from the bank of such issues available at such Colleges like FCE, Zaria, FCE Kano, COE Ilorin and COE, Ankpa that started this programme with physics department, ABU, Zaria, many years ago.

Objectives:

At the end of this course, student should be able to use their knowledge of physics to explain natural phenomena and their incidental occurrences.
The students will be able to:

a) Explain scientifically the following natural phenomena among others, earthquake, eclipse, climate change, ozone layer depletion, environmental pollution, etc.
b) Explain the concepts of solar system, cosmology, Night sky, Shape of the earth, etc.

PHY 123 BASIC AND DIGITAL ELECTRONICS 2 Credits Compulsory

Passage of electricity in gases and in evacuated tubes and applications
Induced electricity and heir uses in some electronic devices
Cathode rays, positive rays and their properties
Simple electronic devices, diodes properties
Oscilloscope T.V. tubes
Band theory of solids LC (simple account)
Energy level diagrams for conductors, semi-conductors and insulators
Doping
Types of semiconductors:- P-types and N-types, P-N JUNCTIONS
Rectifying property of a P-N Junction
Forward and Reverse Biasings, simple transistors and oscillator circuits.

TRANSISTOR CONFIGURATION

n-p- and p-n-, basic structures and terminologies and their applications
Colour coding
Integrated circuits (ICS)

DIGITAL ELECTRONICS

Binary, Octal and BCD Hexadecimal numbering system, conversion from one form to another, addition and subtraction of Binary number, switch current, NOR gate, or gate, exclusion or gate, exclusive and gate.

Objectives:

By the end of this course, student should be able to identify and explain the basic concepts in electronics.

The students will be able to:

a) Explain the passage of electricity and their uses in some vacuum tubes electronic devices.
b) Explain the band theory of solids to explain conductors, semiconductors and insulators.
c) Explain doping of semi-conductors.
d) Explain the rectifying properties of a P.N junction transistors and oscillator circuit.
e) Identify and explain basic concepts in integrated circuits.
f) Explain basic concepts in digital electronics.

PHY 124 ACOUSTICS 1 Credit Compulsory

CONCEPT OF SOUND

Definition of Sound
Classification into infrasonic, sonic (audible) and ultrasonic and their applications.

WAVE NATURE OF SOUND

Characteristics of sound Intensity, quality or timbre, etc
Speed of sound in various media (solid, liquid, gas)
Echo, its effects and applications
Vibrations of sound in strings, air columns and pipes
Concept of resonance
Doppler effects
Musical instruments
Acoustics of buildings
Ultrasonic - General and practical application
(Qualitative treatment only).

Objectives:

By the end of this course, student should be able to identify and explain the basic concepts in sound.

The students should be able to:

a) Define and classify sound and state their applications.
b) Explain the wave nature of sound.
c) Identify and classify musical instruments according to types materials.

PHY 125 PHYSICS PRACTICALS I 1 Credit Compulsory

Consider at least two (2) practicals from each of the following courses:
Thermal Physics I
Mechanics and Properties of Matter I
Electromagnetism I
Optics I, and
Basic Electronics (A minimum of 10 experiments is expected from all the topes)

Objectives:

By the end of this course, student should be able to

carry the prescribed experiments, analyse the resulting data and state the appropriate scientific inference(s).

NCE II Second Semester

PHY 211 ATOMIC AND QUANTUM PHYSICS I 1 Credit Compulsory

STRUCTURE OF ATOM

Atomic models - Thompson's, Rutherford's experiments etc
Determination of e/m for the electron (Milikan's oil drop experiment, Thompson's experiment, etc).

CONCEPT OF QUANTUM THEORY

Photo-electricity and its applications (including Einstein's photoelectric equations) Compton effect
Application of the Bohr's model to the one-electron atom
Pauli exclusion principle and its application to the atom
Energy and Spectra.

Objective

By the end of the course, the student should be able to:

i. List and explain atomic methods.
ii. Describe methods for determination of e/m, the concept of photo electricity, applications of Bohr's model to one – electron atom, Pauli's exclusion principle and its application to the atom energy and spectra.

PHY 212 ELECTROMAGNETISM II 2 Credits Compulsory

MAGNETIC EFFECTS OF CURRENT

D. C. (direct current)
Circuit analysis (Kirchhoff's laws. Thevenin's and Norton's equivalent circuits)
Principle and applications of electromagnetic inductions
D.C. instruments and measurements - Voltmeter, ammeter, galvanometer,
Wheatstone bridge, potentiometer, etc.

Ampere's law, Biot-Savart's Law and their applications to the induction coil, electric generator, the dynamo and transformer.

GROWTH AND DECAY OF CURRENT
Inductive - time constant
Capacitive - time constant
Applications of capacitors and inductors in circuits (R-L, R-C, circuits)

Objective

At the end of this course, the student should be able to:
i. Analyse d.c. circuits.
ii. Describe the process of growth and decay of current.

PHY 213 MECHANICS AND PROPERTIES OF MATTER II
3 Credits Compulsory

INERTIA OF RIGID BODY
Rotation of a rigid body about an axis, kinetic energy of rotation
Moment of inertia
Radius of gyration
Principle of parallel and perpendicular axes
Angular momentum and its conservation
Torque

GRAVITATION
Kepler's laws of planetary motion
Newton's universal law of gravitation
Measurement of G (universal constant of gravitation)
Mass and density of the earth
Earth's satellite
Escape velocity

SURFACE TENSION

Explanation of surface tension

Angle of contact

Surface energy

Capillary rise

Drops and bubbles

Calculations and applications of surface tension

FLUID MOTION
Stream-line flow
Bernoulli's theorem and its applications

Circular motion - angular velocity, angular acceleration, centripetal force, centrifugal force, application to road and rail construction.

Objective

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

i. The concept of physics of inertia of rigid body.
ii. Gravitation.
iii. Surface tension.
iv. Fluid motion.

PHY 214 MATHEMATICS FOR PHYSICS II 1Credits Compulsory

Vector differentiation
D-Grad and D - Vector
Divergence and curl
Analytical Geometry and Trigonometry
Multiple angle formula
Application of vector algebra
Divergence (Gauss and Stokes Theorems, dipole, energy relation)
Introduction to complex numbers.

Objective

By the end of this course, student should be able to discuss the basic mathematical concepts which will enable them to solve problems in relevant areas in physics.

PHY 215 PHYSIC PRACTICALS II (3 HOURS A WEEK)

1Credit compulsory

Experiments should be selected from topics covered in the courses listed below with at least three (3) experiments drawn from each. A minimum of 10 experiments and maximum of 12 experiments should be covered.

Courses:-

PHY 211 - Thermal Physics II
PHY 212 - Electromagnetism II
PHY 213 - Mechanics and Properties of Matter II

Objective

At the end of this course, student should be able to carry the prescribed experiments, analyse the resulting data and state the appropriate scientific inference(s).

NCE II SECOND SEMESTER

PHY 221 WORKSHOP PRACTICE 1 Credit Compulsory

Organization and safety in the workshop
Classification and use of tools (Basic tools e.g. glass, metals, plastics, etc.)
Construction and improvisation of some basic teaching aids e.g. lens holders, ray boxes, metre bridge, manometer, etc. (the constructions and improvisations, should involve the use of woods, metals, glass, etc.)
Design of simple electrical/electronics circuits (half, full wave's rectifiers, etc.)
Basic skills in Technical Drawing (Simple treatment only~ e.g. drawing of angles, isomeric drawing, orthorhombic drawing, etc)

NOTE:
Lecturer(s) may be assigned to guide and supervise the course and also assess the works. However, the students are expected to produce individual construction works which will be defended by the students before all the lecturers in the department and this earns the students the (70%) of the total score for the course. Excursion to a manufacturing company and an excursion report to be submitted for assessment. (30%)

Objective

By the end of this course, the student should be able to construct basic physics teaching aids using locally available materials.

PHY 222 OPTICS 2 Credits Compulsory

WAVE THEORY OF LIGHT
Determination of the velocity of light using the Michelson - Morley method
Wave nature of light (Huygen's Principle).

INTERFERENCE AND ITS APPLICATION
Conditions for interference
Young's double slit experiment
Newton's rings
Thin-films and wedges, blooming of lenses
Simple problems relating to them

DIFFRACTION AND ITS EFFECTS
Fraunhofer and Fresnel's diffraction
Diffraction gratings, criterion for optical resolution

POLARIZATION OF LIGHT
Polarization by reflection
Qualitative description and applications of polarization

LASERS and its applications - Qualitative treatment only.

Objective

At the end of this course, the student should be able to list and discuss:

i. The properties of light.
ii. Discuss LASER and its applications.

PHY 223: THERMAL PHYSICS II 2 Credits Compulsory

Application of the concept of kinetic theory to: transport phenomenon in fluids - thermal conductivity, viscosity, diffusion, osmosis and specific heat capacities.
Second law of thermodynamics including Carnot Cycle and Car not Engine
Application of Van da Waal's equation
Derivation to include partial derivatives
Further treatment of molecular speed (solving more problems in molecular speed and RM.S.).
Degree of freedom and further applications of ideal gas equations
Isothermal and adiabatic changes.

Objective

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

i. The concept of kinetic theory and its applications.
ii. Second law of thermodynamics.
iii. Apply the ideal gas and Van der waals equations.

PHY 224 PHYSICS METHODOLOGY 1 Credits Compulsory

Philosophy of Science:-
What is Science?
What is Physics?
Different aspects of Physics?
Uses of Physics in society (why Physics?)
Concepts, theories, laws and principles in physics
Jobs for the physicists
Assessment in Physics (theory and practical)
Methods of teaching Physics (e.g. process, inquiry etc)
Lesson plans and lesson notes in Physics

The teaching of electricity and magnetism
The teaching of radioactivity and atomic structure
The teaching of electronics.
Physics teaching aids
Computer - assisted learning in Physics
Gender and Physics
Use of Physics Laboratory - Ordering, Cataloguing, storing of equipment; safety rules and First Aid, maintenance of equipment,
Design of Physics Laboratory
Micro-teaching
FLHE- Decision making - Communication, Assertiveness, Negotiation and Finding Help.

History of Physics - Galileo, Boyle, Newton
Einstein, Faraday, Von Neumann, James Clark Maxwell, etc.
(Emphasis should be on how their contributions revolutionized physics)

The development Physics Education in Nigerian General Science Education Resources for teaching the following Physics concepts;
Motion; energy, light, kinetic theory and waves.

National Policy on Education and the Objectives of Science Education.
The role of Physics in Science Education
FLHE - Human Development - Body care, Body abuse and Drug abuse.
STLs/HIV - Abstinence, Puberty and Self esteem.

Objective

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

i. Discuss methods of teaching Physics.
ii. Write lesson plans and notes in Physics.

NCE III SECOND SEMESTER

PHY 321 ELECTROMAGNETISM III 2 Credits Compulsory

A. C. theory and its applications (phase and vector diagrams)
A. C AND ELECTRICAL NETWORK
Reactance, impedance, power in A.C. circuit, power factor, quality factor, concept of resonance and applications.
Rectification (half wave and full wave) and smoothing (show how the inductive - time constant, capacitive-time constant are used as wave sharpers).
Concept of electrical oscillation with respect to L/C circuits - generation of radio wave - TUNED circuit - A.M., F.M.
MAGNETIC PROPERTIES AND THEIR APPLICATIONS
Diamagnetism, ferromagnetism, and paramagnetism
Magnetic induction (B), magnetic Intensity (H), hysteresis
Domain theory.

Objective

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

i. Alternative current circuit theories and its applications.

Magnetic properties and their applications

PHY 322 ATOMIC AND QUANTUM PHYSICS II 1 Credits Compulsory

X-RAYS

Origin, production and properties of X-rays - Bragg's and Moseley's Laws and their applications
X-ray spectra

Applications of X-rays.

RADIOACTIVITY AND ITS APPLICATIONS
Concept of Radioactivity's
Types of radioactivity
Nuture and properties of nuclear radiations
Detection of nuclear radiation. Radiation damage, unit and safety precautions
Decay laws and half-life
Radioactive transformation and series
"Geiger - Nuttal law" detection of nuclear radiations
"Radiation detection instruments" (GM tube, cloud chamber, etc).

ARTIFICIAL RADIOACTIVITY
Production and uses of radioisotopes (e.g. carbon dating, and medical)
Nuclear atom - history and features (nucleus, nuclide, nuclei, nucleon, atomic number, mass number, neutron, isotopes).
Binding energy and stability (Apply mass-energy relation) - differentiate between atomic and nuclear binding energies.

NUCLEAR REACTIONS
Nuclear fission and fusion
Chain reactions and their applications

WAVE - PARTICLE DUALITY
Uncertainty theory (principle)
Application (Qualitative treatment only)
Objective

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

i. Discuss the origin production and the applications of X – rays'.
ii. Discuss concept of radioactivity and its applications.
iii. Discuss the concept of wave – partible duality of matter.

PHY 323 PHYSICS PRACTICALS III 1 Credit Compulsory
Select experiments spanning through the courses taught with at least two (2) experiments from each course
Objective

At the end of this course, student should be able to carry the prescribed experiments, analyse the resulting data and state the appropriate scientific inference(s).

PHYSICAL AND HEALTH EDUCATION (DOUBLE MAJOR)

PHILOSOPHY

The philosophy of Physical and Health Education is to develop academic and professional competency which will enable individuals earn a living and render unique services to the society and also provide good basis of knowledge and experience that characterize an educated and fully developed person through physical activities.

2. **OBJECTIVES**

The objectives of Physical and Health Education programmes are as follows:

- Producing teachers who can inculcate and promote sound health attitude and practical at the Basic Education Levels.
- Producing teachers who can organize and administer sports programmes (both intramurals and extra murals)
- Preparing teachers so as to qualify them for a 2- or 3-years post- NCE degree programme (full time) in Physical and Health Education in Nigerian universities and abroad.

3. ADMISSION REQUIREMENTS

(I) GENERAL

a) Senior Secondary School Certificate of WAEC or NECO or any other equivalent Certificate from recognized examination bodies with credit passes in four (4) subjects including English Language and Mathematics at not more than two sittings.

b) A Grade II Teacher's Certificate (TC II) with credit or merit in four (4) subjects, two of which must be relevant to the course the candidate wishes to offer. Credits/Merits in English Language and Mathematics are required.

c) All candidates wishing to be considered for direct admission must enroll for and write the selected examination organized by an accredited body such as JAMB.

d) It should be noted that some colleges may in addition to all the above, administer their own elimination tests and/or interviews for some courses. This is legitimate.

Note ;

I) A credit in Mathematics and credit in English Language at the Senior secondary School Certificate/equivalent are required of all science-based specializations.

(ii) ADDITIONAL REQUIREMENTS

a) Senior Secondary School Certificate (SSSC) of WAEC/NECO with at least four (4) credits, two credit, of which shall be in Physical Educalion, Health Science and Biology.

b) GCE 0/L with at least four (4) credits in two sittings, two of which shall be in Biology or Health Science or Physical & Health Education.
c) Teachers Grade Two Certificate (TC II) with at least four (4) credits/merits one of which shall be in Physical and Health Education, Health Science or Biology
d) Candidates should pass a physical fitness skill test to be conducted by the Department of Physical and Health Education of his/her choice College of Education.
e) Any other qualification approved by NCCE.

4. (i) FACILITIES AND EQUIPMENT

(a) PLAY AREAS, COURTS AND FIELDS

ITEM	**MINIMUM NO. REQUIRED**
Football field	1
Basketball court	1
Volleyball court	1
Handball court	1
Badminton courts (indoor)	1
Tennis courts	2
Large indoor teaching space of 40mx50, for gymnastics,	
Swimming pool (where local resource permit)	
Squash court	
Hockey field	
Gymnasium	
Lecture Theatre (large, well ventilated)	
Storage room (large, well ventilated)	
Equipped Exercise Physiology Laboratory	
6-8 lane athletic tracks	
PHE Resource Centre (for Audio-Visual equipment for	
Effective teaching of skills)	

(b) EQUIPMENT AND SUPPLIES

(A) GYMNASTICS

ITEM	
Tripod (horses)	2
Agility boxes	2
Bucks	3
Landing mats	15
Take-off boards	2
Trampolines	2
Long benches	2
Agility mattresses	20
Horizontal bars	2
Agility rings	4

b) EXERCISE PHYSIOLOGY LABORATORY EQUIPMENT

Digital sphygmomanometer	2
Bicycle Ergometer	2
Skinfold calipers	2
Stethoscopes	2
Weights	2
Balance Beam	2
Flexometers	2
Padded tables	2
Step Benches	2
Tapes, 30m, 50m, & 100m	3 each
Stop watches etc	15

C) ATHLETICS

Starting blocks	10
Starting guns	4
Javelins (male)	4
Javelins (female)	4
Shot puts	4
Discus (male)	4
Discus (female)	4
Track suits	6
Pairs of high jump stand	4
Aluminum cross bars	4
Landing foams for high jump and pole-vaults	40 pairs
Canvases	20 pairs
Shin guards	20 pairs
Stockings etc	8
Exchange batons	60
Hurdle stands	10

D) BALL GAMES

Soccer balls	10
Inflators	2
Handballs (male)	10
Handballs (female)	10
Volleyballs	10
Basket Ball (Male)	10
Hockey balls	10
Handball Protectors	6
Table Tennis tables	4
Table Tennis eggs	12

E) RACKET GAMES, ETC

Tennis rackets	12
Badminton rackets	12
Hockey sticks	30
Table tennis bats	20
Hockey keepers kits	2 Sets

F) BOOKS, JOURNALS AND PERIODICALS

It is recommended that at least fifteen (15) books on each of the following areas and six (6) journals in each area be made available to supplement the teachers' efforts:

Exercise Physiology
Principles of physical education
Nutrition and sports
Women in sports
Sports psychology
Movement education
Administration of sports
Coaching techniques (all sports)
Sport officiating (all sports)
Health Education
Sociology of sports
Biomechanics of sports
Human anatomy
Human physiology
Drug education
Adapted Physical Education
Sports Injuries and Management
Recreation
Methods and materials in physical education
Tests and measurements

G) GENERAL SUPPLIES FOR ALL SPORTS

1.	Stop watches	10
2.	Tape measures	2
3.	Weighing scales	5
4.	Maintenance equipment	5
5.	Whistles (all kinds)	12
6.	Recording sheets	For all sports
7.	Sleeping bags	160
8.	Mosquito nets	35
9.	Tents	160
10.	Camp bed	160
11.	Life jackets	3
12.	First Aid boxes	30
13.	Multi Gym	35
14.	Back Packs	2
15.	Tape recorders	20

16.	Empty tapes	all systems
17.	Anatomy and Physiology charts	all systems
18.	Physiology moulds	5
19.	Stove	35
20.	Lanterns	160
21.	Camping boots	1 set
22.	Television set	1 set
23.	Video set	1 set
24.	A set of multimedia computer + CD's	2
25.	Lawn mowers	5
26.	Wheel Barrows	5
27.	Flags (various colors)	
28.	Scoring boards for various games	

4. (ii) Staff Offices: Each senior staff should have a comfortably furnished office to himself/herself. There should also be an office for support staff (typists, clerks) with relevant equipment e.g. typewriters, duplicating machines, Computers, Photocopier.
III) Books in the Library: There must be enough books to cover all the areas of subject in the ratio of one student to ten books minimum. The conditions under F above should be adhered to in all cases.

5. PERSONNEL

i. Academic-

A minimum of ten (10) academic staff, for Double major subject combination each with a qualification of not less than a Bachelor's degree in Physical and Health Education. The Head of Department should have a Higher Degree and at least of the rank of a Senior Lecturer. It is encouraged to have at least one female Lecturer in the Department. The qualification should not be lower than Second Class Lower degree.

i. Academic-

SUGGESTIONS: The panel suggesting that a department should have a least two (2) female lecturers instead of one (1) as provided in the minimum standard.

ii. Again, that training and retraining of personnel in PHE should take cognizance of the various areas of specialization i.e. Health, Physical Education, Exercise physiology, Sport Management Recreation etc.

ii. OTHERS

i) A minimum of 5 ground men
ii) A minimum of 1 lab attendant/assistant
iii) A minimum of 1 sports equipment curator
iv) A typist
v) A Secretary
vi) One Office Assistant/attendant
vii) One Cleaner
viii) A Sports instructor should be attached to PHE department

6. MODE OF TEACHING

i) Mode of teaching is practical and theory, depending on the course except physical activity (sports skills) that must be practice and theory, plus camping, field trips, excursion/educational visits.

ii) Students certified unfit for sports practical e.g. pregnant women, should terminate the programme until after delivery.

iii) Medically unfit students e.g. an epileptic student shall not be allowed to participate in any practical field activities.

7. ASSESSMENTS AND CETIFICATION

Practical should *be* 60% and theory to attract 40% of overall assessment.

8. GRADUATION REQUIREMENTS

i) Successful completion of Teaching Practice and outdoor Education programmes.

ii) Successful completion of project for the award of NCE Certificate.

Physical and Health Education (DM)	-	Minimum	64	Maximum	66	Credits
Education including TP	-	Minimum	36	Maximum	36	Credits
General Study	-	Minimum	18	Maximum	18	Credits
Total	=	**Minimum**	**118**	**Maximum**	**120**	**Credits**

TEACHING PRACTICE

Teaching Practice is compulsory for every student to graduate. Teaching practice earns 6 credits under Education 311

RESEARCH PROJECT 323

The Final Year Project which earns 2 credits is compulsory and cannot be waived for any student and shall be credited to EDU 323.

COURSE CODES, TITLES CREDIT UNITS AND STATUS NCE I FIRST SEMESTER

COURSE CODE	TITLE	CREDIT	STATUS
PHE 111	Theory and techniques of Football.	2	Compulsory
PHE 112	Theory and techniques of Handball	2	Compulsory
PHE 113	Physical Fitness	1	Compulsory
PHE 114	History and Philosophy of Physical Education	2	Compulsory
PHE 115	Recreation Education	1	Compulsory
PHE 116	Concepts of School and Community Health Education	2	Compulsory
PHE 117	Anatomy and Physiology 1	3	Compulsory
	Total	13 C	

	SECOND SEMESTER		
PHE 121	Theory and Techniques of Athletics (Track Events)	2	Compulsory
PHE 122	Theory and Techniques Gymnastics	2	Compulsory
PHE 123	Theory and Techniques of Swimming	1	Elective
PHE 124	Method of Teaching Physical and Health Education	2	Compulsory
PHE 125	First Aid and Safety Education	1	Compulsory
PHE 126	Personal, Mental and Emotional Health	3	Compulsory
PHE 127	Anatomy and Physiology 11	2	Compulsory
	Total	12C+1E=13	

	NCE II FIRST SEMESTER		
PHE 211	Theory and Techniques of Basketball	2	Compulsory
PHE 212	Theory and Techniques of Volleyball	2	Compulsory
PHE 213	Theory and Techniques of Cricket	1	Elective
PHE 214	Introduction to Sport Management	2	Compulsory
PHE 215	Coaching and Officiating	2	Compulsory
PHE 216	Nutrition and Drug Education	2	Compulsory
PHE 217	Citizenship and Leadership Training	2	Compulsory
	Total	12C+1E=13	

	SECOND SEMESTER		
PHE 221	Theory and Techniques of Tennis	2	Compulsory
PHE 222	Theory and Techniques of Athletics(Field Events)	2	Compulsory
PHE 223	Theory and Techniques of Hockey	1	Elective
PHE 224	Seminars in Physical and Health Education	1	Compulsory
PHE 225	Physical and Health Education Curriculum	2	Compulsory
PHE 226	Introduction to Sociology of Sport	1	Compulsory
PHE 227	Research Methodology in PHE	2	Compulsory
PHE 228	Test & Measurement in Physical & Health Education	2	Compulsory
PHE 229	Introduction to Kinesiology	1	Compulsory
	Total	13 C 1 E	

	NCE III FIRST SEMESTER		
EDU 323	Research Project	2	C
EDU 324	Teaching Practice	6	C
	Total	8 C	

	SECOND SEMESTER		
PHE 321	Theory and Techniques of Badminton	2	Compulsory
PHE 322	Theory and Techniques of Table Tennis	2	Compulsory
PHE 323	Exercise Physiology	1	Compulsory

PHE 324	Communicable and Non-Communicable Diseases	1	Compulsory
PHE 325	Introduction to Psychology of Sport	1	Compulsory
PHE 326	Adapted Physical Education and Sport	1	Compulsory
PHE 327	Family Life and Reproductive Health Education	2	Compulsory
PHE 328	Combat Sport, Traditional Sport and Dance Education	1	Elective
PHE 329	Practicum Physical Conditioning (Circuit Training)	2	Compulsory
	Total	12C+1E=14	

SUMMARY

Study Status	First year credit units	Second year credit units	Third year credit units	TOTAL
Compulsory	25	25	12	62
Elective (Optional)	1	2	1	4
Total	26	27	13	66

*The project must be done in Physical and Health Education Department but it will be credited to EDU 323

Minimum Credit Units Required for Graduation

Compulsory = 62 Credits
Elective = 2 Credits
Total = 64 Credits

NCE I - FIRST SEMESTER

PHE 111 THEORY AND TECHNIQUES OF FOOTBALL
OBJECTIVES 2 Credits Compulsory
At the end of the course, students should be able to achieve the following among others:-

1. Discuss the historical development of football
2. Acquire basic skills and techniques of football
3. Explain the basic skills of football
4. Construct football pitch.
5. Discuss the officiating official's roles and their duties etc

COURSE CONTENT

- History and development of football,
- Basic skills,
- Tactics, and strategies.
- Rules of the game.
- Construction of the pitch.
- Officials and officiating.
- Terminologies and record keeping.

PHE 112 THEORY AND TECHNIQUES OF HANDBALL
OBJECTIVES 2CREDIT: COMPULSORY
At the end of the course, students should be able to achieve the following among others:-

1. Discuss the historical development of handball
2. Acquire basic skills and techniques of handball
3. Explain the basic skills of handball
4. Construct handball pitch.
5. Discuss the officiating official's roles and their duties etc

COURSE CONTENT

- History and development of handball,
- Basic skills,
- Tactics, and strategies.
- Rules of the game.
- Construction of the pitch.
- Officials and officiating.
- Terminologies and record keeping.

PHE 113 PHYSICAL FITNESS (1 Credit) C
OBJECTIVE
At the end of the course, students should be able to achieve the following among others:-

1. Identify the values of physical fitness
2. Distinguish between health related and performance related omponents
3. Explain the specialize terms-High blood pressure, BMI etc.
4. Acquire knowledge in prescribing physical fitness exercises
5. Should be able to conduct physical fitness.

COURSE CONTENT:

- Meaning of physical fitness
- Components of physical fitness
- Values of physical fitness
- Effects of physical fitness on heart rate, blood pressure and physical characteristics of physical fitness (height and weight)
- Test for physical fitness
- Measures to be taken in conducting physical fitness test
- Gender participation in physical fitness
- Guidelines in selecting physical fitness exercises.
- Characteristics of physically fit and physically unfit persons.

PHE 114 HISTORY AND PHILOSOPHY OF PHYSICAL EDUCATION
OBJECTIVES **2 Credit Compulsory**

1. Discuss the nature of contemporary P.E. and showed how it has evolved from the ancient time
2. Discuss the key concepts of the philosophy and their application to P.E.
3. Discuss the role of Ancient Greece, Rome, Germany, Sweden, England, USA, and Japan mode of P.E
4. Discuss the development of P.E. in Nigeria
5. Articulate the contribution of Nigerian sports heroes and professional
6. Identify the current trends and the likely future of P.E. in Nigeria
7. Identify the various agencies and career opportunities in physical education.
8. Discuss the history and Development of physical education in Africa

COURSE CONTENT:

- Meaning, definition, Scope and concept of Physical Education
- Aims and Objectives of Physical Education
- Philosophy of Physical Education
- History of Physical Education in Ancient Greece, Rome,
- Germany, Sweden, England, USA and Japan
- Development of Physical Education in Nigeria
- Nigerian Sports heroes and professionals
- Current Trends in Physical Education in Nigeria
- Future trends in physical Education in Nigeria
- Physical Education, Agencies and Career guidance and opportunities

PHE 115 RECREATIONS AND TOURISM EDUCATION
OBJECTIVES **1 Credit Compulsory**

At the end of the course, students should be able to achieve the following among others:-

1. Student should be able to achieve and explain in their own worse the terms recreation and education, tourism, leisure, outdoor, indoor, etc.
2. Identify and explain the values of recreation and leisure activities.
3. Explain the relationship between recreation and health

COURSE CONTENT:

- Definitions of Recreation
- Values of Recreation
- Purpose and objectives of Recreation
- Recreational activities under the component of Recreation
- Recreational Agencies: Private, Government etc
- Relationship between health and Recreation
- Relationship between Recreation and Leisure
- Organization and Administration of Recreation education
- Excursions/Visits to Recreation parks, tourist centre's (in fulfillment of the requirement of outdoor education)
- Computer games/Sport: type, value and Scales.
- Dramatic and Creative rhythm
- Career opportunities in Recreation and tourism education.

PHE 116: CONCEPT OF SCHOOLS AND COMMUNITY HEALTH EDUCATION

OBJECTIVES **2 Credits Compulsory**

At the end of the course, students should be able to achieve the following among others:-

1. Explain the holistic concepts of health
2. List and explain the factors that affect the health of an individual
3. Acquire and develop skills necessary for healthy living
4. Identify the various health agencies within and outside community and their functions(WHO, UNICEF, FAO, NAFDAC ETC)

COURSE CONTENT:

- Definition, scope, and concepts of Health and Health Education
- Aims, Purposes and Objectives of Health Education
- History and development of health education in Nigeria
- Theories of evolution
- Components of the Health Education Program: Consumer Health, Nutrition Education, Adult Health, contemporary issues in health and health education etc.
- Factors affecting the health of individuals such as heredity, environment, personal factors e.g. life style etc.
- Meaning and scope of School Health programme
- Component of School health programme
- Relationship between school and community health
- General principles and application of health. Emphasis should be on the following:-
- Meanings and methods of Sanitation, Housing, Sewage and refuse disposal
- Air, water supply, sources and qualities of good water environmental pollutions of air, waters, land and noise effect and prevention
- Control of Vectors both in rural and urban areas
- Health education, career guidance and opportunities
- Health problems in Nigerian communities
- Health Agencies e.g. WHO, UNICEF, FAO, NAFDAC etc.

PHE 117: HUMAN ANATOMY AND PHYSIOLOGY

OBJECTIVES **3 Credits Compulsory**

After studying this unit the students should be able to :-

1. Define Anatomy and Physiology and explain the importance of understanding the relationship between structure and functions
2. Describe levels of organization of the body and provide characteristic of each level
3. Identify organs system i.e. skeletal system, types of bones, body cavities, and types of divisions of the skeleton axial and appendicle.
4. Identify types of joints and their role in the body.
5. Discuss on muscular, nervous system and sense organs and their role in human body

COURSE CONTENT:

- Organization of the body structure
- Life characteristics of the body structure
- Skeletal system: types and functions of bones, body cavities, discretional terms; main divisions of the skeleton (axial and appendicle); Types of joints.
- Characteristics of joints and the possible movement at the joints; Bones as levers in human body
- Posture and postural defect, meaning, kinds, causes of postural defect.
- Muscular system, Types and characteristics, muscle tone and muscle contractions.
- Nervous systems: structure of nerve cells, structure and functions of sensory Nerves; Central nervous system
- Organization of the Central Nervous System: the reflex action.
- Sense organs: skin, eyes, ears, tongue and nose

NCE I SECOND SEMESTER.

PHE 121: THEORY AND TECHNIQUES OF ATHLETICS (TRACK EVENTS) (TRACK)

OBJECTIVES **2 Credits Compulsory**

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

1. Construct a standard athletic track
2. Explain track events
3. Identify the basic rules/regulations in track events
4. Demonstrate the basic athletic crouch starts
5. Distinguish among sprints, middle, and long distance races
6. Appreciate the importance of various athletic training methods
7. Identify the roles of officiating officials in athletic competitions

COURSE CONTENT:

- History and development of track events
- Tactics and strategies in track events performance
- Rules and Regulations in track athletics
- Construction/laying and maintenance of track
- Description of performance characteristics in: Sprints (100m, 200m, 400m); Middle distance races (800m, 1500m) and long distance races (5000m, l0.000m and Marathon).

- Description of types and performance characteristics in Relays and Hurdling.
- Officials and officiating in track events.
- Basic skills and techniques in the throwing events (discus, shot put, javelin and Hammer).
- Basic skills and techniques in the Jumps (High jump, Hop, Step and Jump (triple); Long Jump and pole vault;
- Rules governing the jumps, officials and officiating Terminology and Records.
- Combined events Pentathlon and Decathlon.

PHE 122: THEORY AND TECHNIQUES OF GYMNASTICS

OBJECTIVES **2 Credits Compulsory**

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

1. Explain the meaning of gymnastics
2. Distinguish the various types of gymnastics
3. Distinguish between locomotive movement and non-locomotive movement
4. Observe safety measures in the performance of gymnastics activities
5. Appreciate the values of safety measures in gymnastics activities
6. Explain the values of gymnastics

COURSE CONTENT:

- Fundamental of human movement (Locomotive and non-locomotive) with their examples:- walking, jogging, running, jumping, skipping, non locomotive e.g. stretching, bending, lifting, pushing, twisting.
- History and development of gymnastics
- Values of gymnastics and safety measures---
- Description of stunts and tumbling: forward Roll, backward Roll and apparatus works - etc.
- Types of gymnastics and distinction between the Olympic)and Educational gymnastics

PHE 123: THEORY AND TECHNIQUES OF SWIMMING

OBJECTIVES **1 Credit Elective**

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

1. Appreciate the importance of swimming as a survival sport
2. Enumerate the four basic swimming strokes- freestyle, butterfly, backstroke and breaststroke
3. Demonstrate the strokes
4. Appreciate swimming as a recreational and competitive sport
5. Appreciate safety precautions in swimming

COURSE CONTENT:

- Introduction to basic skills, buoyancy, arm and leg actions etc
- Fundamental and practical approaches of study of strokes: free style (crawl), backstroke, breastbone and butterfly (Dolphin); Diving.
- Safety precautions
- Values of swimming
- Maintenance of pool, equipment and facilities
- Use of swimming aids (floats) etc.

PHE124: METHODS OF TEACHING PHYSICAL & HEALTH EDUCATION

OBJECTIVES 2 **Credits Compulsory**

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

1. Identify the general format for writing lesson plans - (traditional and tabular)
2. Differentiate among the following concepts- introduction, development/body/presentation and evaluation
3. List the skills or strategies used for effective teaching
4. Apply each of them effectively in the teaching subject areas
5. Differentiate among; general objectives, specific/behavioral objectives, expressive objectives.

COURSE CONTENT:

- Aims and objectives of Teaching Physical education in Primary and Secondary Schools (Basic 1-9)
- Methods of Teaching Physical Education: Demonstration, manual guidance, Lecture, Fieldwork, verbalization, field trip etc.
- Materials for teaching Physical Education (Computer-based Training (CBT) and Improvisation.
- Minor Games and Sports: Perceptual skills refined motor skills and gross foot work.
- Content of the Physical Education syllabus in primary and secondary schools (Basic 1-9)
- Preparation of lesson notes in Physical Education: tabular and essay format with emphasis on preparation, organization, lesson presentation and evaluation.
- Aims and objectives of teaching Health Education in Primary and Secondary Schools (Basic 1-9).
- Methods of teaching Health Education: Incidental, discussion projects, field trip, audio Visual, demonstration, lecture, micro-teaching: use of filmstrips.
- Improvisation of materials
- Evaluation in Health Education
- Preparation of lesson notes (as above).

PHE 125: FIRST AID AND SAFETY EDUCATION

OBJECTIVES **1 Credit Compulsory**

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

1. Explain the definitions of first aids and safety education
2. Enumerate the aims/objectives of first and safety education
3. Enumerate the qualities expected of a first aider
4. Explain the aims and purpose of first aids administration
5. Identify some emergency situation and types of first aids required
6. Enumerate the duties of a first aider
7. Identify areas in the school, home and community that are prone to accident
8. Explain measures that can be taken to minimize the occurrence of accident in such area

COURSE CONTENT:

- Definition of First Aid Characteristics of a first aide, content of an aid box and their uses, Qualities of a first aides and meaning of safety education.
- Hazards at home, in school, at work on the road etc; fire drills.
- Action of a first Avider in emergencies such as bleeding, drowning, fainting, burns, scalds fire disasters, cuts, bruises, poisoning etc
- Description and analysis of sports injuries and management procedures: fractures, sprains, strains, dislocation etc.
- Fits and unconsciousness: Emphasis should be on practical's, and where possible, members of voluntary organizations like the Red Cross Society, Boys Brigade etc should be invited to give practical demonstrations and training in the following areas. Bandages and Bandaging Artificial Respiration.
- Safety and accident, safety measures, classification of accident, causes of road traffic accident and preventive measures.

PHE 126 PERSONAL, MENTAL AND EMOTIONAL HEALTHS

OBJECTIVES **3 Credits Compulsory**

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

1. Explain the meaning of personal, mental and emotional health
2. State the characteristics of a healthy person
3. Demonstrate the care of the teeth, skin, eyes, ears, nose and whole body
4. Take care of the clothes, the surroundings e.g. classrooms, toilets etc
5. Identify and appraise health problems
6. Distinguish between mentally and emotionally disturb person

COURSE CONTENT:

- Definitions and meanings of personal health, mental health and emotional health
- Characteristics, of a healthy person e.g. ability to work without being easily fatigued, ability to comprehend mental task and resistance to infection.
- Personal Hygiene: care of the teeth, skin, eyes, ears, nose and the entire body.
- Care of clothing and clothes
- Care of rooms, kitchens and surroundings
- Care of the school surroundings: classroom toilet etc
- Health Hazards and their preventions: flood, earthquakes, oil spillages etc.
- Health appraisal and understanding of health problems.
- Ways of achieving a satisfactory emotional and social adjustment -Problems of changes in health behavior and keeping of simple health records
- Maintenance and improvement of emotional and social health.
- Methods of handling the mentally and emotionally disturbed persons Excursions to psychiatric hospitals/Clinics/wards/homes

PHE 127: HUMAN ANATOMY AND PHYSIOLOGY II

OBJECTIVES **2 Credits Compulsory**

After studying this unit students should be able to:

1. Name the major organ system and list the organs associated with each
2. Name and describe the locations of organs of each system and their major part
3. Describe the general functions of each organs system
4. Explain the principle mechanism involve in each organ system – respiratory system, digestive system, circulatory system, blood composition, excretory system, endocrine system and reproductive system (male and female)

COURSE CONTENT:

- Respiratory system: breathing organs, mechanism and the control of respiration.
- Digestive system: Organs mechanism of digestion, assimilation and absorption
- Circulatory system: Organs of circulation: structure and functions of the heart, pulmonary and general circulation etc.
- Blood composition: Blood groups, functions of blood and community.
- Excretory system: Organs of excretory system, functions of excretory system, functions of the excretory organs (kidney and skin).
- Endocrine system: Organization of the system, different endocrine glands; hormones secreted and their functions (hyper - and hypo-secretions).
- Reproductive system (Male and Female).

NCE II: FIRST SEMESTER

PHE 211: THEORY AND TECHNIQUES OF BASKETBALL

OBJECTIVES 2 Credits Compulsory

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

1. List and describe the basic skills of basketball game
2. Put the basic skills into play situation
3. Explain some the rules of the game
4. Draw and level the dimensions of basketball court
5. Explain the scoring system in the game of basketball
6. Explain the tactics and strategies in playing the game of basketball
7. Explain the terminologies of the game e.g. charging; double foul, fast break, jump ball, personal foul, travelling, rebounding etc.
8. Practical officiating in the game of basketball

COURSE CONTENT:

- History and development of basketball
- Court dimension and maintenance
- Basic Skills
- Tactics and strategies of the game
- Rules of the game
- Officials and Officiating
- Terminologies and Records

PHE 212: THEORY AND TECHNIQUES OF VOLLEYBALL

OBJECTIVES **2 Credits Compulsory**

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

1. Explain the basic skills of volleyball
2. List and explain the rules of volleyball
3. Demonstrate the techniques of the skills of volleyball
4. Draw and level the dimension of the volleyball court
5. Draw a volleyball court and indicate the positions of the players at the start of the game and rotational order during play
6. Enumerate the defensive and offensive play strategies of the game
7. Explain the terminologies of the game e.g. rotation, set, block, attack, held ball, switch, smash etc.
8. Practical officiating in the game of volleyball

COURSE CONTENT:

- History and development of volleyball
- Court dimension and maintenance
- Basic Skills
- Tactics and strategies of the game
- Rules of the game
- Officials and Officiating
- Terminologies and Records

PHE 213: THEORY AND TECHNIQUES OF CRICKET

OBJECTIVES 1 **Credit Elective**

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

1. Discuss the historical development of cricket
2. Demonstrate the basic skills in cricket
3. Batting strokes, over's, boundaries, bowling etc
4. State the rules and regulations governing the game
5. Identify the roles of the officiating officials in cricket

COURSE CONTENT:

- History and development of cricket
- Layout and maintenance of cricket
- Facilities, equipment and supplies
- Basic Skills and Techniques in Cricket: Battling, Bawling and Fielding
- Terminologies and Records: Inning, Over's, boundaries etc
- Rules and Regulations,
- Officials and Officiating

PHE 214: INTRODUCTION TO SPORTS MANAGEMENT

OBJECTIVES **2 Credits Compulsory**

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

1. Think intelligently and make decision about issues they will face in the dynamic world of managing a sport enterprise
2. Develop critical/reflective competencies
3. Conduct themselves with professionalism
4. Discuss the foundations on which the international sport organization has developed with respect to international sport federations, leagues, corporation and events
5. Discuss trends in the field of international sport.

COURSE CONTENT:

- Meaning and Definition of organization and administration
- Types of leadership styles
- Organization and administration of tournaments and meets; types of tournaments, factors to be considered during organization of tournaments.
- Purchase, care and maintenance of sports equipment, facilities and supplies
- Legal liabilities in physical education
- Concept of sports management and duties of sports managers
- The school Intramural sports programme organization and record Keeping
- Inter college Sports Organization and Management:- Violence in Sport
- Sports and society marketing and promotions
- Human rights issues in sports; child abuse, gender participation in sports, human trafficking in sports.

PHE 215: COACHING AND OFFICIATING OF SPORT

OBJECTIVES **2 Credits Compulsory**

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

1. Explain the meanings of coaching, officiating and teaching
2. Distinguish between coaching and teaching
3. Appreciate the importance of coaching and officiating in sport performance
4. Described the qualities of a good coach and officiating official
5. Mention the officiating officials in different sporting events and explain their role or duties
6. Acquire and develop different coaching skills and officiating in different sporting activities
7. Design and implement training programme etc.

COURSE CONTENT:

- Definition of coaching and officiating
- Distinction between teaching and coaching
- Importance of coaching and officiating
- Qualities of a coach, qualification and functions of specialists in physical and Health Education
- Officials needed in sporting events
- Principles of officiating in sport
- Students exposure to practical officiating in sport competitions

PHE 216: NUTRITION AND DRUGS EDUCATION IN SPORTS

OBJECTIVES 2 **Credits Compulsory**

After studying this unit the students should be able to:

1. Explain the meaning of nutrition, drugs, drugs used, drugs abuse etc
2. Understand the various classes of food and their values to the athletic performance
3. Define consumer health education with specific example
4. List the classes of food and explain what balance diet means
5. Understand methods of food preservation
6. Understand classification of drugs in relation to international standard
7. Appreciate the plight of alcoholic in the society
8. Acquire knowledge on how to prepare nutrition for athletes as a form of career opportunity.

COURSE CONTENT:

- Consumer Health; Meaning, examples of Consumer rights
- Meaning, Classes, types and importance of food: referenced to be made to local foodstuffs and their values to athletes well-being.
- Balanced diet, its values and preservations of food; deficiency diseases; food fads and fallacies, food and the digestive system; role of nutrition in sports performance
- Preparation of simple meal for athletes in camp and during competitions.
- Nutrition for special groups e.g. School children, adolescence, and sick
- Pre-game meal glycogen loading techniques
- Effects of glycogen loading on health and performance
- Definition of Drugs: Classification of drugs and alcohol?
- Drug use and abuse in sports
- Alcoholism: caress and treatment therapy
- Importance of labels and expiry date of drugs
- Quacks and Quackery in drug production and dispensing
- Effects of the use of drugs in sports.

PHE 217 CITIZENSHIP AND LEADERSHIP TRAINING

OBJECTIVES **2 Credits Compulsory**

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

- Appreciate the motto of the centers for citizenship and leadership training in Nigeria (build the man and the community)
- Appreciate the role of the course in developing endurance, courage, perseverance, etc in Nigerian youth
- Demonstrate good leadership and followership qualities
- List and explain types of leadership styles
- Acquire different life – saving skills in different situations
- Appreciate its role in the total development of individuals
- Explain its relevance to Physical Education and General Education etc

COURSE CONTENT:

- Aims and objectives of the programme
- Mountaineering
- Camping and Hiking
- Origin of outdoor education
- Leadership skills: Inculcation and evaluation (display)
- Followership skills: Patriotism through citizenship and leadership training
- National Agencies: NOA, Man-O-War (Students are expected to attend a two-week camping in any of the leadership training centers in share Hills (Mountain School) Jos; Sea School, Lagos; Forest School, Port Harcourt; Hill Top NYSC Camp Awgu Enugu State etc.
- Emphasis. At least two accompanying PHE staff should stay with the students for the duration of the training and camping.
- Institutions should attend leadership training centers of their choice; and practical aspects should carry greater weights in evaluation/assessment.

SECOND SEMESTER

PHE 221: THEORY AND TECHNIQUES OF TENNIS

OBJECTIVES 2 **Credits Compulsory**

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

1. Give much accounts of the development of Tennis
2. Correctly construct and draw Tennis court
3. Acquire the tactics and strategies of the game
4. Describe various equipment use in playing Tennis
5. Impartially officiate the game of Tennis.

COURSE CONTENT:

- History and development of tennis
- Court construction and maintenance of the games
- Basic Skills and Techniques of the games
- Tactics and strategies of the games
- Rules of the games
- Officials and officiating of the games
- Terminologies and Records.

PHE 222: THEORY AND TECHNIQUES OF ATHLETICS (FIELD EVENTS)

OBJECTIVES 2 **Credits Compulsory**

After studying this unit, the students should be able to :-

1. Explain and mention all various Field Events in Athletics
2. Acquire the basic skills in Field Events i.e. Discus, Shot put, Javelin, Hammer (Throwing Events) and High jump, Long jump, Triple jump and Pole vault (Jumping events)
3. Discuss the roles of Officiating officials.

COURSE CONTENT:

- Basic Skills in throwing events (discus, short put, javelin, hammer)
- Basic skills in jumps (High jump, Triple jump, and pole vault)
- Rules and officiating field events
- Terminologies and Records
- Practical exposure to the skills.

PHE 223: THEORY AND TECHNIQUES OF HOCKEY

OBJECTIVES 1 **Credit Elective**

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

- Discuss the origin of Hockey/ Development
- Acquire the basic skill of Hockey
- Explain the team formation, tactics and strategies of playing Hockey
- Construct Hockey pitch
- Officiate matches/ Administers the roles correctly
- Explain different terminologies in the game of Hockey

COURSE CONTENT:

- History and development of hockey
- Court construction and maintenance of the games
- Basic Skills and Techniques of the games
- Tactics and strategies of the games
- Rules of the games
- Officials and officiating of the games
- Terminologies and Records.

PHE 224: SEMINARS IN PHYSICAL & HEALTH EDUCATION

OBJECTIVES 1 **Credit Compulsory**

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

1. Discuss contemporary issues in the field of Physical and Health Education
2. Equip students the skills require for academic papers presentations
3. Enable students to have a wider scope in matters related to physical and Health Education
4. Present and defend a proposal on related topics of choice – (Practical presentation)

COURSE CONTENT:

The lecturers teaching the course should expose students to current Issues in physical and Health Education Sports and Dance in order to develop their art of writing and paper presentation.

PHE 225: PHYSICAL AND HEALTH EDUCATION CURRICULUM

OBJECTIVE **2 Credits Compulsory**

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

1. Acquire the learning experiences relevant to the scope of Physical and Health Education
2. curriculum designing i.e. guiding principle
3. Understand the factors to consider in designing a physical and Health Education
4. curriculum

5. Understand the Philosophy and Need for designing a standard Physical and Health
6. Education curriculum
7. Provide some instructional materials in Physical and Health Education curriculum

COURSE CONTENT:

- Definition of curriculum
- Principles guiding curriculum development
- Types of curriculum: Subject - centered; child-centered and community centered
- Factors to consider in Designing a Physical and Health Education Curriculum
- Steps involved in designing a curriculum for PHE
- Facilities and instructional materials in Physical and Health Education curriculum

PHE 226: INTRODUCTION TO SOCIOLOGY OF SPORT

OBJECTIVE **1 Credit Compulsory**

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

1. Define Sociology as related to sport, Politics, Religion, Culture, Race/Ethnicity etc
2. Understand the group dynamics and sport collective behavior
3. Explain the values of sport in the society
4. Explain the theory of play, Women and sport etc
5. Understand the institutional sport across the world

COURSE CONTENT:

- Definition of sociology
- Sociology and sport
- Group dynamics and sports collective behavior
- Values of sport in the society
- Sport and politics
- Sport and religion
- Sport and institutions e.g. National sport commission (NSC), National Institute of sport (NIS),Sport Council/Sport Commission, Nigeria sport Federation etc
- Sport and Race/Ethnicity
- Sport and Culture
- Theory of play
- Women and Sport

PHE 227: RESEARCH METHODOLOGY IN PHYSICAL AND HEALTH EDUCATION

OBJECTIVES **2 Credits Compulsory**

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

1. Define the concept of research
2. List and explain types and nature of research
3. Explain the component of research e.g. Population, Research design, Sample and Sampling techniques research instrument, Element and types of statistical data
4. Explain the importance of review of literature
5. Understand correct methods of referencing

COURSE CONTENT:

- Meaning and definition of Research
- Types and nature of research: Historical, experimental, survey, casual – comparative
- Elements of the Problem Statement
- Formulation of Hypothesis: Relationship with Research Questions; types of hypothesis, and testing of tested hypothesis
- Literature Review in Research report.
- Sampling technique and data analysis
- States and steps involved in research report writing
- Elements and types OF statistical analysis
- Questionnaire: Types, role of research question; and relationship with statistical analysis.

PHE 228: TESTS AND MEASUREMENT IN PHYSICAL AND HEALTH EDUCATION

OBJECTIVES 2 **Credits Compulsory**

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

1. Define the Terms, Test, Measurement and Evaluation as they applied to PHE
2. Justify the need for Test, Measurement and Evaluation in PHE
3. Recognize statistical symbol as %,x, , $\varkappa$, $\bar{x}$,F, F, R, r etc
4. Apply descriptive statistical tools (Tests) of percentage, frequency, mean, median, mode, etc in data analyses
5. Sketch statistical diagrammatical presentations such as graph :- Histogram, Polygon, Pie chart etc
6. Appreciate the use of statistics in simplifying data in research

COURSE CONTENT:

- Definition of test, measurement and evaluation
- The need for tests, measurement and evaluation in PHE
- Evaluation of tests and criteria for evaluation
- Elementary statistical analysis: Mean, Median, Mode, standard deviation, correlation coefficient, student t-test and chi square.
- Measurement of sport skills.
- Sociometric tests.

PHE 229: INTRODUCTION TO KINESIOLOGY

OBJECTIVES **1Credit Compulsory**

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

1. Define the term kinesiology
2. Identify the values of kinesiology to Physical Educator s Sport Professionals
3. Understand some terminologies e.g. Agonist, Antagonist, Neutralizes, Stabilizes, Synergist etc
4. Identify special muscles groups, uses and roles in motion
5. Understand Newton's laws of motion as they relate to sporting activities
6. Describe projectiles, trajectory of projectile and factors influencing the flight of projectile

COURSE CONTENT:

- Definition of Kinesiology
- Important of Kinesiology to the PHE
- Special muscles, uses and role e.g. Agonist (mover) muscle Antagonist, Neutralizer, Stabilizer, Synergist.
- Muscular Analysis of movement at joints
- Equilibrium/definition types: i.e. stable, unstable, neutral
- Motion/Newton's Laws of Motion as they relate to sporting activities
- Types of Motion: Linear, angular, general, curvilinear
- Projectile: definition
- Trajectory of Projectile
- Factors influencing the flight of projectile, e.g. gravity, air resistance, angle of release.

NCE YEAR 3 - FIRST SEMESTER

EDU 311
TEACHING PRACTICE

NCE III SECOND SEMESTER

PHE 321: THEORY AND TECHNIQUES OF BADMINTON
OBJECTIVES **2 Credits Compulsory**

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

1. State the origin and development of Badminton
2. Acquire and demonstrate the basic skills in Badminton
3. Understand the tactics and strategies of playing the game
4. Impact the rules, regulations and official needed to the elementary scopes
5. Enumerate the equipment needed for the game of Badminton
6. Construct a standard Badminton court

COURSE CONTENT:

- History and development of the badminton
- Dimensions and Construction of badminton court
- Basic skills of badminton
- Tactics and Strategies of the games
- Rules of the game
- Maintenance of badminton court
- Officials and officiating
- Terminologies and Records of the games.

PHE 322: THEORY AND TECHNIQUES OF TABLE TENNIS

OBJECTIVES **2 Credits Compulsory**

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

1. State the origin and development of table tennis
2. Enumerate the equipment needed for the game of table tennis
3. Specify the accurate standard measurement of a table tennis board
4. Demonstrate the basic skills in table tennis
5. Understand the tactics strategies and rules governing the game of table tennis
6. Enumerate the physical and socio-economics and emotional benefit of participating in the game of table tennis

COURSE CONTENT:

- History and development of the table tennis
- Dimensions of the tennis table
- Basic skills of table tennis
- Tactics and Strategies of the games
- Rules of the game
- Terminologies and Records
- Officials and officiating

PHE 323: EXERCISE PHYSIOLOGY **1 Credit Compulsory**

OBJECTIVES

After studying this unit, the students should be able to:-

1. Discuss the nature of cotemporary, concept and scope of exercise physiology
2. Define some specialized areas in exercise physiology
3. Understand and appreciate the roles of exercise physiology to Health promotion
4. Understand types of energy systems and their relevant in sport

COURSE CONTENT:

- The concept and scope of exercise physiology
- Meaning of exercise, physiology and physiology of sports
- Physiological effects of training: Biochemical changes, cardio respiratory changes, other training effects and retraining
- Biological energy cycle and energy sources during physical activities
- Meaning and types of energy; sources of energy for physical activities
- Types of energy systems: Phosphate, lactic Acid system and aerobic system Anaerobic energy system/metabolism
- Factors affecting energy uptake and their relevance in PHE

PHE 324: COMMUNICABLE AND NON-COMMUNICABLE DISEASES

OBJECTIVES 1 **Credit Compulsory**

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

1. Explain the meaning of communicable and non-communicable diseases

2. Define these terms as related to communicable and non-communicable diseases; epidemic, endemic, pandemic ,etc
3. Identify the types, causative agents, mode of transmission and preventive measure of these diseases
4. Identify National and International interventions of controlling the spread of these diseases

COURSE CONTENT:

- Definition of communicable and non-communicable disease
- Causes, symptoms, prevention and control of communicable diseases such as malaria, cholera, small pox, chicken pox Tuberculosis, sexually transmitted infections (STI) e g. gonorrhea, syphilis and HIV/AIDS
- Causes, signs, prevention and control of non-communicable diseases such as hypertension, asthma, cancer, epilepsy, diabetes, sickle - cell anemia and other several diseases of the body systems.

PHE 325: INTRODUCTION TO PSYCHOLOGY OF SPORT

OBJECTIVES **1 Credit Compulsory**

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

1. Define different terms and terminology relevant to psychology of sport
2. Understand the psychological theories and principles relating to athletes' behaviors in sport participation e .g psyching up, psyching down and psyching off
3. Understand the psychological variables in sport performance and preparation of athletes
4. State the history of sport psychology association in Nigeria

COURSE CONTENT:

- Definition of terms and terminologies
- The relevance of psychology to sport
- Psychological theories and principles relating athletes' behavior in sports participation
- Psyching up, psyching down and psyching off
- The role of sport psychologists
- Psychological factors affecting individuals and group performance i.e. personality, stress, anxiety, etc.
- Psychological variables in sport performance
- Psychological preparation of athletes
- Phases in skill acquisition
- Motivation
- History of sport Psychology Association of Nigeria.

PHE 326: ADAPTED PHYSICAL EDUCATION AND SPORTS

OBJECTIVES **1 Credit Compulsory**

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

1. State the history of adapted Physical Education
2. Define some terms related to adapted Physical Education
3. Understand the types, courses and needs of physically challenge people/handicapped

4. Design programme for the handicapped individual
5. State the role of Physical Education and sport for the disable

COURSE CONTENT:

- Brief history of adapted physical education and Sports
- Meaning and definition of adapted Physical Education and Sports
- Types and causes of handicapping conditions e.g. hearing defects (deafness, hard of hearing); mental retardation, eye defects (partial blindness, total blindness), orthopedic conditions, speech defects etc.
- Needs of the handicapped
- Integrating and programming Physical Education and sports for the challenged individuals
- The role of physical education and sports for the challenged persons
- Agencies responsible for ensuring adequate care and integration of the challenged persons in the society.

PHE 327: FAMILY LIFE AND REPRODUCTIVE HEALTH EDUCTION

OBJECTIVES **2 Credits Compulsory**

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

1. Explain the concept of Sex and Family life Education
2. Identify the scope of family life and reproductive Health Education
3. Explain the functions of reproductive system
4. Explain the sexually transmitted disease including HIV/AIDS and prevention
5. Explain the principles of Ageing and Death Education

COURSE CONTENT:

- Definition and need for reproductive health education
- Functions of the reproductive system
- Socio cultural aspects of reproductive health education: courting, marriage, family planning (use of different contraceptive devices), divorce etc.
- Children's concept of reproduction and pregnancy and birth
- Sexually Transmitted Disease including HIV/AIDS Prevention
- Issues and opinions about reproductive Health education in public schools
- Religion and family life education and reproductive health Family relationships.
- Ageing and Death Education

PHE 328: COMBAT SPORT, TRADITIONAL SPORT AND DANCE EDUCATION

OBJECTIVES **1 Credit Elective**

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

1. Enumerate the various skills and techniques needed for any of the sport chosen i.e. Combat,
2. Traditional sport and Dance Education
3. Discuss the historical development of any of the sport
4. List the various equipment, facilities and supplies for any selected sport
5. Demonstrate the skills and techniques for any of the chosen sport
6. Identify some of the events in any of the sport
7. Appreciate the relationship between modern traditional combat or traditional sport or Dance education

COURSE CONTENT:

Combat Sport: - Emphasis should be centered on any two of: Judo, Karate, Wrestling, Boxing and Taekwondo and target as follows:

- History of combat sport in Nigeria
- The importance of combat sport in general
- Basic skills of selected combat sport,
- Rules of combat sport.
- Officials and officiating in combat sport practical.

OR

Traditional Sport (Including Dances).

Emphasis should be on learning and performance of traditional Sport and Dances within the locality. Types, origin, significance and facilities/equipment.

- Dambe (local boxing) in the North
- Langa (North)
- Local Wrestling
- Local hockey and golf
- Local shooting
- Arin (West)
- Abula
- Boat Regatta
- Each: Local draught (East): Any ONE of these to be taught as obtained in locality and two others from other localities in line with the Federal Government policy of uniting Nigeria through Sports. They should be taught under the following sub-headings.
- Basic skills
- History and Development
- Playing area
- Rules and Regulations
- Officials and Officiating

OR

DANCE EDUCATION

- Origin of Dance, Types of Dance and dance steps.
- Dance Formations: African Dance and contemporary/social dances
- Nigerian traditional dance/acrobatic displays
- Basic Dance Movement etiquettes
- Teaching dancing steps: Methodology
- Dance Response to talking drums etc
- The origin of dance
- Dance formations
- Dance Drama i.e.

PHE 329: PRACTICUM PHYSICAL CONDITIONING (CIRCUIT TRAINING)

OBJECTIVES **2 Credits Compulsory**

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

1. Discuss the historical development of those game they have being thought
2. Demonstrate the skills and techniques of performing the selected games

3. Apply circuit training to the development of physical fitness, components and sport skills

COURSE CONTENT:

- Mode of Operation: The circuit training method should be adopted for practicum
- The number of participant are divided into even number
- Strength and ability, the number of activities will be equal to number of groups as each team will operate on a specific activity
- The team will move round on time basis until the whole circuit is completed
- Formation and Skills to be based on the physical activities/sport previously learnt
- Application of circuit training to development of physical fitness components and sport skills
- For C.O.E. Special: Practicum to be adapted to the disabled and the intensity of performance should vary from one station to another.

MATHEMATICS

1.0 PHILOSOPHY

The philosophy of the NCE Mathematics is inspired by:
The desire to help students become intellectually informed in mathematical ideas, notations and skills for logical reasoning, scientific enquiry and for the pursuit of techno-scientific education.
The need to produce non-graduates but well-groomed and qualified professional teachers of mathematics for the Basic Education Levels.

2.0 OBJECTIVES

By the end of the programme the students should be able to:

a) Discuss with confidence the historical development of mathematics as a discipline
b) Solve abstract problems through the use of mathematic skills and ideas
c) Stimulate pupils interests in mathematics by the use of appropriate teaching/learning strategies particularly at the Basic education levels
d) Make learners appreciate the use of computers in solving mathematical problems
e) Use mathematics to solve day to day problems
f) Teach mathematics in a way that learners can apply mathematics principles in solving daily problems
g) Make the teaching of mathematics learner friendly through games and simulations
h) Set up a mathematics laboratory
i) Improvise materials for effective teaching/learning of mathematics
j) To prepare the learners for further studies in mathematics and related courses.

3. GENERAL ADMISSION REQUIREMENTS

a) Senior Secondary School Certificate of WAEC or NECO or any other equivalent Certificate from recognized examination bodies with credit passes in four (4) subjects including English Language and Mathematics at not more than two sittings. Two of the credits must be in the subjects making up the combinations the candidates wish to offer

b) A Grade II Teacher's Certificate (TC II) with credit or merit in four (4) subjects, two of which must be relevant to the course the candidate wishes to offer. Credits/Merits in English Language and Mathematics are required for candidates wishing to study Chemistry.

c) A pass in Pre-NCE Chemistry final examination or a pass in IJMB Chemistry final examination and a pass in JAMB is required for admission.

d) All candidates wishing to be considered for direct admission must enroll for and write the selected examination organized by an accredited body such as JAMB.

e) It should be noted that some colleges may in addition to all the above, administer their own elimination tests and/or interviews for some courses. This is legitimate.

3.2 SUMMARY OF ADMISSION REQUIREMENTS INTO NCE MATHEMATICS

Candidates seeking for admission to NCE Mathematics should obtain a credit pass in Mathematics at SSCE (WAEC or NECO) or GCE 'O' Level or merit or a credit pass in Pre-NCE or a credit pass in Interim Joint Matriculation Board (IJMB) examinations. Candidates should also sit and pass UTME Examination.

4. FACILITIES

a) Classroom

At least three (3) lecture rooms and a lecture theatre.

b) Laboratory

There must be a fully air-conditioned mathematic laboratory with mini micro computers of not more than three students per one, an overhead projector or multimedia projectors.

c) Workshop: There must be a mathematics workshop where students can make their own instructional materials.

i) Equipment Required in the Workshop

S/No.	Description	Quantity Required
1)	Work benches	4
2)	Vice	4
3)	Drilling Machine(manual/electric	4
4)	Drill bit (various sizes)	4 sets
5)	Hand saw (various sizes)	6
6)	Solid shapes (Prisms,Cube,Cuboid,Cylinders,etc	5 each
7)	Engraving machine	2
8)	Cutting knives	4
9)	Hammer (different sizes)	6
10)	Screwdrivers	3 sets
11)	Mathematical sets	20
12)	Mathematical sets (black board size)	5 sets
13)	Weighing scale	5
14)	Scientific Calculators	20
15)	Scissors (different sizes)	10
16)	Pinchers (big and small)	4
17)	Jack and plane	4
18)	Electronic Organizers	4

ii) **Consumables**

Cardboard papers	1 ream		
Plywood (assorted ¼", ½" ¾")	10 sheets	Nails (assorted)	as required
Binding wire			5
Glue (wood)			5
Gum (liquid)			5
Celotapes			5

Metal sheets	5
Transparences	5
Graph sheets	20
Beads (assorted sizes and colours)	20
Thread etc.	2 Rolls

d) Staff Offices

The comfort of teaching staff must be taken into consideration. Ideally, there should be an office per Lecturer, equipped with bulletin boards, book shelves, visitors' seat and standard furniture.

e) The Head of Department should have an office, furnished with other conveniences and file cabinets. There should also be an office for the support staff i.e. typists and clerks.

f) **Books in the Library**

In addition to the college library, the mathematics department should have a departmental library with current text books and journals'.

g) **Computer Room**

There should be a fully air conditioned computer room for mathematics students.

5. PERSONNEL

a) Academic

A minimum of eight (8) academic staff are specifically required for the NCE Mathematics Programme. (The department services other departments). All the academic staff must have an Educational background with a minimum of second class lower Bachelor of Education degree in Mathematics, ie B.Sc (Ed) or Second Class Lower (Honours) Degree in Mathematics (B.Sc (Hons) plus either of the following NCE, TTC, PDE,or PGDE .

Non-Academic

i) A Computer Technical Data Operator
ii) 2 Library Assistant/Attendant
iii) 1 Laboratory Assistant/Attendant
iv) 1 Typist/Secretary
v) 1 office assistant

6. MODE OF TEACHING

i) Lectures
ii) Tutorials
iii) Problem-solving
iv) Seminar
v) Demonstration
vi) Drill
vii) Experimentation
viii) Excursion
ix) Discovery Method
x) Laboratory Method and etc..

*Discovery method and laboratory work will be emphasized.

7. GRADUATION REQUIREMENTS

Mathematics	-	Minimum	32	Maximum	34	Credits
Second Teaching subjects	-	Minimum	32	Maximum	34	Credits
Education including TP	-	Minimum	36	Maximum	36	Credits
General Study	-	Minimum	18	Maximum	18	Credits
Total	=	**Minimum**	**118**	**Maximum**	**122**	**Credits**

8. TEACHING PRACTICE

Teaching Practice is compulsory for every student before graduation
Teaching Practice earns 6 credits under (EDU 311).

9. PROJECT

The Final Year Project is compulsory for all students. The Project may be written and supervised in any of the student's chosen subject areas and the grade for Project must be credited to EDU 323. Project carries 2 credits.

10. ASSESSMENT AND CERTIFICATION

Continuous Assessment, CA = 40%, Exam 60%

12. **COURSE CODES, TITLES CREDIT UNITS AND STATUS**

Year	Semester	Code Course Title	Credit	Status
NCE I	First Semester	MAT 111 Algebra	2	C
		MAT 112 Trigonometry	2	C
		MAT 113 History of Mathematics	1	C
		MAT 114 Complex Numbers	1	C
		MAT 115 Statistics	2	C
		Total	8	
	Second Semester	MAT 121 Different Calculus	2	C
		MAT 122 Co-ordinate Geometry	2	C
		MAT 123 Maths. Methodology	2	C
		MAT 124 Maths Lab. Practicals	1	C
		MAT 125 Introduction to Computer	1	E
		Total	8	
Year	Semester	Code Course Title	Credit	Status
NCE II	First Semester	MAT 211 Integral Calculus	2	C
		MAT 212 Problem solving	1	C
		MAT 213 Number Theory	1	C
		MAT 214 Probability	2	C
		Total	6	
	Second Semester	MAT 221 Dynamics	1	C
		MAT 222 Vector Analysis	2	C
		MAT 223 Real Analysis	1	C
		MAT 224 JSS contents	1	C

		MAT 225 Research Methodology Total	1 6	C
NCE III	First Semester	TEACHING PRACTICE		
	Second Semester	MAT 321 Static MAT 322 Linear Algebra MAT 323 Real Analysis II MAT 324 Abstract Algebra MAT 325 Differential Equations Total	1 1 2 1 1 4	C C E E C

SUMMARY

Study Status	First year credit units	Second year credit units	Third year credit units	TOTAL
Compulsory	15	12	3	30
Elective (Optional)	1	-	3	4
Total	16	12	6	34

*The project may be done in either Mathematics or the other teaching subject but it will be credited to EDU 323

Minimum Credit Units Required for Graduation

Compulsory = 30 Credits
Elective = 2 Credits
Total = 32 Credits

NCE I FIRST SEMESTER

13. **COURSE CODES, TITLES CREDIT UNITS AND STATUS**

MAT 111 ALGEBRA 2 Credits Compulsory

At the end of course the student should be able to discuss and solve simple problems in algebra.

- Real number system
- Integers, rational and irrational numbers
- Set theory, intersection, complement of set, venn diagram, Algebra of sets.
- Theory of indices
- Theory of logarithms
- Surds
- Linear inequalities
- Partial fractions
- Theory of quadratic equations

- Permultations and Combinations
- Binomial Theorem
- Mathematical Induction
- Remainder and Factor Theorems
- Arithmetic progression
- Geometric Progression

MAT 112 TRIGONOMETRY 2 Credits Compulsory

At the end of course the student should be able to:

i)discuss with confidence the basic concepts and definition in trigonometry.

ii) Solve simple problems using the concepts

- Angle and its measurements
- Basic trigonometric functions and equations
- Trigonometric ratios in each of the 4 quadrants. Applications to bearing, angle of elevation, depression and projectile
- Graphs of trigonometric functions and their applications
- Inverse trigonometric functions
- Half angle formulae
- Addition of factor formulae
- Solution of triangles
- Hyperbolic functions and their identities

MAT 113 HISTORY OF MATHEMATICS 1 Credit Compulsory

At the end of course the student should be able to:

i) Discuss and narrate the historical development of mathematics as a discipline.

ii) Identity the early contributors to the development of mathematics.

- Pre-history Mathematics
- Development of Mathematics in the Ancient times
- Contributions of Babylonians, Greeks, Egyptians, Romans, Hindus, Arabs and Chinese.
- Prominent Ancient Mathematicians and their contributions (Archimedes, Pythagoras, Euclid, Apollonius, etc.)
- Development of mathematics in the Middle Ages and prominent Mathematicians of the period
- The Renaissance and Mathematics (16^{th} to 20^{th} Centuries) and prominent mathematicians and their contributions (Napier, Fermat, Euler, Riemann, Lebesque, Lagrnge, Hilbert, Bannach, Cauchy)
- The use of mathematics in everyday life including its place in Natural and Applied science
- History of African and Nigerian mathematics

MAT 114 COMPLEX NUMBERS 1 Credit Compulsory

At the end of course the student should be able to:

i) Explain the concepts of complex numbers

ii) Discuss the algebra of complex numbers

iii) Represent complex numbers in argand diagrams

v) State De-moiré theorem.
V) Solve problems on complex numbers.
vi) Approve the important of complex number in science and technology.

- complex Numbers
- Algebra of Complex numbers
- Argand Diagram
- De Movie's theorem
- N^{th} root of Unity

MAT 115 STATISTICS **2 Credits** **Compulsory**

At the end of course the student should be able to:
i) Define the meaning of statistics
ii) Discuss the importance of statistics
iii) Formation of frequency distribution table
iv Calculation of measure of location, partition and dispersion
v) Explain the meaning of correlation and regression
vi) Define sample space and sample point
vii State and draw normal distribution curve and skewness
viii) Carry out test of hypothesis and significance on sample data

- Frequency distribution
- Measures of location
- Measures of dispersion
- Correlation and Regression
- Sample Space and Sample point
- Data Representations in statistics
- Normal Distribution Curves
- Skewness
- Standardized Normal Curve
- t-scores and Z-scores
- Test of Hypothesis and significance

NCE 1 SECOND SEMESTER

Mat 121 DIFFERENTIAL CALCULUS **2 Credits Compulsory**

At the end of course the student should be able to:
a) Differentiate some given function
ii) Apply differentiation in solving physical problems.

- Functions
- Limit of a function at a point
- Continuity of a function at a point
- Gradient of a function
- The differential co-efficient as a gradient of a function at a point

- Differential product and quotient
- The chain rule and the function of a function
- Differentiations of logarithmic functions
- Trigonometric functions, exponential functions and hyperbolic functions
- Implicit differentiation
- Applications: maximal, minimal, velocity, acceleration and rate of change

MAT 122 CO-ORDINATE GEOMETRY 2 Credits Compulsory

At the end of course the student should be able to:

i) Obtain the equation of straight line and circle

ii) write the equation of parabola, ellipse and hyperbola in Cartesian polar and parameter coordinator.

iii) Change Cartesian coordinates to polar & vice versa

iv) Apply the knowledge of coordinate geometry in solving real life problems.

- Basic Geometry :point' line segment, angle, curve
- Straight lines and circles
- Parabola, Ellipse and Hyperbola in Cartesian, parametric and polar co-ordinates
- Tangents and Normal to the circle, parabola, eclipse and hyperbola (the use of differentiation is acceptable

M**AT 123 MATHEMATICS METHODOLOGY 2 Credits Compulsory**

At the end of course the student should be able to:

i) Learn the most current method of teaching mathematics

ii) Write lesson plan & lesson notes in mathematics

- History of Mathematics teaching in Nigeria and the philosophy of current Nigerian Mathematics curricula
- Teaching and learning mathematics, including works of Bruner, Gagne, Piaget and Dienes
- Teaching of concepts, principles, skills and proofs: strategies, nature, definitions and types.
- Inductive, deductive, analytic and synthetic approaches in Mathematics teaching
- Content analysis of upper basic education (JSS 1-3) curriculum
- Work tools(scheme of work, Lesson plan, lesson presentation and Assessment)
- Item construction and development of marking scheme
- Diagnosis and remediation of difficulty concepts and topics in teaching and learning of upper basic Mathematics curriculum
- Problems and prospects of mathematics education in Nigeria

MAT 124 MATHS LABORATORY PRACTICAL 1 Credit Compulsory

At the end of course the student should be able to:

i) Construct, design and improvise some basic mathematical teaching aids.

ii) Construct triangle, quadrilaterals loci etc. using pair of compass and rulers.

- Construction, design and improvisation of some basic mathematical teaching aids in relation to primary, junior secondary school and senior secondary school courses. (Using cardboard sheets, clay wood, wires, etc)

- Geometrical construct: construction of triangles, quadrilaterals, bisection of lines, angles and construction of locus.

MAT 125 INTRODUCTIONS TO COMPUTER STUDIES 1 Credit Elective

i. State fundamental operations in mathematics structures and their uses in computer studies
ii. Define with example binary logic, compound statement and binary operations.
iii. Discuss historical development of the computer studies
iv. Differentiate between software and hard ware
v. Write simple programme using basic.
vi. Apply the application to data processing plus operating systems e.g. Dos, windows

- Historical development of the Computer
- Essential components of the Computer and their functions
- Number presentation in a Computer
- Logic:- Binary logic, compound statement-logic relations, methods of proofs, binary operations.
- Number bases other than 10
- Data structure and their uses in a Computer
- Computer software and types of software, Basic Programming
- Illustration and the application of simple techniques to Data processing plus-
- Operating systems: Dos, Windows etc.(Emphasis on practical)

NCE II FIRST SEMESTER

MAT 211 INTEGRAL CALCULUS 2 Credits Compulsory

At the end of course the student should be able to:

a) See the link between differentiation and integration.
b) See the link between integration and area
c) Identify and use of different integration methods.
d) Use the different methods of integration in real engineering problems.
e) Appreciate the importance of integration in engineering and science generally.

- Integration as a reverse process of differentiation
- Integration as area under the curve
- Integration of algebraic functions using different methods, like partial fractions, substitution, etc.
- Integration of non-algebraic functions e.g. logarithmic functions, exponential functions, trigonometric functions, etc.
- Special methods of integrations; substitution and transformation, the reduction formula and other types of systematic integration.
- Integration by parts. Approximate integration by Trapezoidal rule and Simpson's Rule
- Application of integration in determining volumes of solids of revolution and solution to other problems

MAT 212 PROBLEM-SOLVING (JSS & SSS) 1 Credit Compulsory

(Textbooks on these levels should be provided at least two students to a copy of each)

At the end of course the student should be able to:

a) Identify what is a problem, and decide on the most appropriate approach to the solving problem.
b) Identify as many methods as possible to the solving of identified problems eg discovery, expository child centre approach etc.
c) See that life itself is problem, and always have solutions if given the right approach. Appreciate the different techniques so identified in solving day to day problems.

- Definitions of problem, problem solving
- Basic elements of a mathematics problem
- Common errors in Mathematics
- Discovery and expository approaches to problem solving techniques
- Functions of questions in the Mathematics class
- Characteristics of a good problem solver
- Polya's problem solving heuristics and application to solving topics in J.S.S. and
- S.S.S. Mathematics
- Problem solving of selected difficult topics in Mathematics and further
- Mathematics e.g. solid figures, great cycles, application of the cosine rule to triangles (acute and obtuse angle) e.t.c.

MAT 213 NUMBER THEORY 1 Credit Compulsory

At the end of course the student should be able to:

a) Be able to exhibit the proper concept of number system by correctly showing the direction and magnitude of numbers.
b) Be able to play and manipulate different ideas as to the use of numbers, eg : ordering of numbers, mathematical inductions, basic facts on numbers(theorem), congruence etc.
c) Be able to see and appreciate the use of numbers in the real life situations.

- Process of counting, Piano's Axons using ordered pairs
- Fundamental operations in Mathematical Structures
- Group – Group properties
- Further properties of Integers
- Well ordering principle
- Mathematical Induction
- Laws of tracheotomy
- Divisibility (Basic definitions, divisions, primes god)
- Basic theorems on god
- (proofs may be required)
- Relatively prime integers (unique factorization)
- The fundamental theorem of arithmetic (proof may be required)
- Congruences
- Basic definitions and examples
- Properties of Congruence (reflexive symmetric and transitive: the equivalence relation)
- Residue classes

- Linear Congruences
- Basic theorems and solutions of linear Congruences
- Proofs of the main theorem may be required
- Fermat's theorem and applications, the proof of Fermat's theorem may be required
- Euler function and number (proof not required)
- Application to linear Congruences
- Fundamental operation in mathematical structures
- Group properties.

MAT 214 PROBABILITY THEORY **2 Credits** **Compulsory**

At the end of course the student should be able to:

I. Learn the concepts of probability
II. Solve problems involving addition law, multiplication law of probabilities.
III. Formulate hypotheses and arrive at the right decision
IV Apply the knowledge of probability in other relevant situation

- Concept of probability
- Sampling and sampling techniques
- Types of probability
- The concept of expectation
- Mutually exclusive and non-mutually exclusive events
- Addition law of probability
- Independent events and dependent events
- Multiplication law of probability
- Conditional probability
- Discrete probabilities
- Continuous probabilities
- Functions of a random variable
- The Binomial Poisson and normal distribution with various properties;
- Permutations and combination.

NCE II SECOND SEMESTER

MAT 221 DYNAMICS **1 Credits Compulsory**

At the end of course the student should be able to:

i. Explain the concept of displacement , speed, velocity and acceleration in Cartesian and polar co-ordinate.
ii. Discuss relative velocity motion of particles in straight lines.
iii. State the principle of conservation of energy.
iv. State and discuss types of collision
v. Discuss the concept of projectiles, momentum vertical motion under gravity.
vi. Solve problems on dynamics.

- Displacement, Speed, Velocity and acceleration in Cartesian and Polar co-ordinates
- Velocity and acceleration along the tangent and normal to it
- Relative velocity, motion of particles in straight lines
- Vertical motion under gravity (laws of motion)

- Projectiles: Time of flight, range on a horizontal plane, greatest height reached, the part of a projectile as parabola.
- The momentum equation and derivation of the impulse
- Angular momentum principles
- Impact of two small spheres (direct and oblique)
- The principle of conservation of energy.

MAT 222 VECTOR ANALYSIS 2 Credits Compulsory

At the end of course the student should be able:

i. Represent vectors in 2-3 dimensions
ii. Solve problems in vector algebra
iii. Apply the knowledge of vector analysis in solving real life problems.

- Representation of vectors in 1-3 Dimensions
- Equality of vectors, position vectors (explain using the model of space co-ordinate)
- Triangular, parallelogram and polygon laws of vector addition
- Resultant of vectors
- Associative law of vectors
- Negative and unit vectors
- Magnitude or length of a vector
- Commutative and distribution laws of vectors, Scalar or dot product of vectors
- The vector or cross product of two vectors
- The cosine of angles between two vectors
- Direction cosines
- Relations between dot product and component of work done in a force field
- Triple product of vectors
- Plane and space curves and their vector equations
- Vector differentiation
- The grad notation
- The del (or vector operator notation)
- The divergence of a curve vector and the divergence theorem
- Frener –Serret formulae for solution of problems

MAT 223 REAL ANALYSIS I 1 Credit Compulsory

At the end of course the student should be able to:

1. Solve abstract problems through the use of mathematical skills.
2. Use correctly the methods of proofs in mathematics.

- Basic properties of real number system including boundedness and completeness
- Concept of neighbourhood
- Open and close sets
- Basic theorems on open and closed sets
- De Morgan laws
- Function and functional notation
- Rigorous treatment of limits and continuity
- L'Hospital's rule (proof may be required)

- Consequences of differentiation
- Rolle's theorem
- Mean value theorem and Taylor's theorem (proof may be required)
- Successive differentiation
- Leibnitz's formula for nth derivative (proof not required)
- Functions of several variables
- Partial differentiation
- Lagrange's multipliers

MAT 224 JUNIOR SECONDARY SCHOOL CONTENT 1 Credit compulsory

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

i. Learn by heart the sequential arrangements of all the topics in junior secondary school mathematics.

ii. Solve difficult problems in junior secondary school mathematics.

- Fractions decimals and approximation:-harder word problems involving fractions decimals and approximations.
- Expansion & factorization
- Simultaneous linear equations:-elimination, substitutions, graphical methods word problems leading to simultaneous equations.
- Quadratic equation by factorization only, word problems involving quadratic equations.
- Algebraic fractions & Algebraic equations, word problems involving algebraic equations
- Pythagoras theorem and its applications
- Angles of elevation and depression
- Properties of plane shapes:- cubes, cuboid, cylinder, spheres, pyramid and cones
- Areas and perimeters of plane shapes:- problems involving areas and perimeters, surface areas and volumes of solid shapes
- Variations :- Direct inverse, joint and partial variation including word problems
- Trigonometric ratios and their application
- Commercial Arithmetic (profit and loss, discount hire purchase, commission) ,number basis.
- Scale drawing
- Areas and volumes of similar shapes.

MAT 225 RESEARCH METHODOLOGY 1 Credit compulsory

(Note: This course should be taken by students wishing to write their project in Mathematics Education)

Aim: the teaching of this course is aimed at preparing students to learn how to carry out research works in Mathematics Education without much difficulty.

1. **Research Study**
   a) Background of the study
   b) Statement of problem
   c) Purpose of the study

d) Scope of the study
e) Area of the study
f) Significance of the study

2. Literature Review

The relevance of the review to the background of study must be clearly shown to the students.

3. Method of data organization

a) Techniques of getting the sample from sample population such as
   i) Simple ballot system
   ii) Use of table of random numbers and any other
   iii) Slating the population and the sample
b) Instrument for data collection
c) Validation of instrument
d) Analysis of data – Frequency table, percentages, t-test and z-test statistics,
e) Correlation coefficient
f) Results and Interpretation
g) Recommendation

NCE III FIRST SEMESTER

EDU 324
TEACHING PRACTICE

NCE III – SECOND SEMESTER

MAT 321 STATICS **1 Credits Compulsory**

At the end of course the student should be able to:

i. Explain with confidence the concept of statics.
ii. Solve simple problems on statics
iii. Justify the relevant of statics
iv. Resolution of forces and turning points practically
v. Apply the concepts in solving problems.

- General conditions of equilibrium
- Resolution of forces acting at a point
- Equilibrium conditions of moments
- Coplanar forces (centroids)
- Centre of gravity: centre of mass, simple forms, general formula for centre of gravity
- Compound bodies, centre of gravity by integration
- Friction: laws of friction and resistance, angle of friction, the least force problem involving sliding only

MAT 322 LINEAR ALGEBRA **1 Credit Compulsory**

At the end of course the student should be able to:

i) Discuss with confidence the concept and the meaning of linear algebra such as vector space over the real field, sub-space, linear independence, basis and dimension, linear transfunctions, eigenvalues etc.

ii) solve simple problem on the linear algebra.

iii) apply the knowledge of the concept to other areas.

- Matrices: definition, equality of matrices, addition, scalar multiplication, multiplication of matrices, inverse matrices, adjoint transpose, row equivalence and elementary row operations.
- Determinats:- up to 2x2 matrices. Application of matrices to solutions of linear equations.
- Determinants
- Vector space over the real field, sub-space, linear independence, basis and dimension
- Linear transformations and their representational matrices; range, null space, rank, singular and non-singular transformation and matrices.
- System of linear equations, change of basis, equivalence and similarities
- Eigen values (latent roots) and given vectors (latent vectors)
- Minimum and characteristic polynomials of a linear transformation (matrix)
- Cayley – Hamilton theorem

MAT 323 REAL ANALYSIS II **2 Credits Elective**

At the end of course the student should be able to:

i. Discus the meaning of anti-derivatives, reimann integral and its properties

ii. Define and solve problem on multiple integrations, series and sequence.

iii. Approve the relevant of real analysis in everyday life and for further studies

iv. Solve problems on real analysis

- Anti-derivative (Integration)
- Definition of Riemann integral
- Properties of Integrals and basic theorems (proof of the fundamental theorems of calculus may be required)
- Multiple Integration; elementary treatment of the Fubinis theorem in the plane
- Series and sequences
- Proof of boundedness; comparison, ratio and root test may be required
- Absolute and conditional convergence
- Radius of convergence
- Power series
- Uniform convergence

MAT 324 ABSTRACT ALGEBRA **1 Credit Elective**

ALGEBRAIC STRUCTURES

At the end of course the student should be able to:

i. Explain the meaning of algebraic structure

ii. Define the following : group , semi group , monoid, group and subgroup

iii. State lagrange theorem
iv. Explain the concepts of cyclic group, ring, integral domain, field
v. Solve problems on polynomials: HCF,LCM and factorization

- Grouped, semi group, monoid and group, subgroup
- Lagrange theorem, cyclic group, ring, integral domain, division, ring and field
- Polynomials: H.C.F and L.C.M of polynomials
- Factorization

MAT 325 DIFFERENTIAL EQUATIONS **1 Credit Compulsory**

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

i. Discuss the meaning of first-order differential equqations
ii. State the existence and uniqueness of solution.
iii. Apply different methods of solving differential equations
iv. State and solve second order differential equation
v. Approve the importance of differential equations in science and technology
vi. Formation of differential equation using physical and chemical situations.

- First – order differential equations
- Existence and Uniqueness of solution
- Example to be limited to equations of the types
- $\frac{dy}{dx} = f(x)$, $\frac{dy}{dx} = f(y)$
- Use of boundary separation restricted only to easy integral
- Homogeneous Equations.
- Exact equations and integrating factor for non-exact equations
- Solution of 2^{nd} – order differential equation. Example to be restricted to the equations of the type.

$$(a)\frac{d^2y}{dx^2} = f(x) \qquad (a)\frac{d^2y}{dx^2} = f(x)$$

Equations with constant co-efficient and Cauchy-Euler types should be treated.
Formation of equations from physical situations.