NATIONAL BOARD FOR TECHNICAL EDUCATION

Plot B, Bida Road, P.M.B. 2239, Kaduna Nigeria

CURRICULUM AND COURSE SPECIFICATIONS FOR

NATIONAL DIPLOMA (ND)

IN

SCIENCE LABORATORY TECHNOLOGY

MARCH 2019

GENERAL INFORMATION

1.0 CERTIFICATION AND TITLE OF THE PROGRAMME:

The certificate to be awarded and the programme title shall read: "**NATIONAL DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY"**

2.0 GOAL AND OBJECTIVES:

The National Diploma Programme in Science Laboratory Technology is designed to produce Technicians capable of assisting the Technologist in various laboratory analyses and practical work.

On completion of this programme, the diplomate should be able to:

i. Assist in chemical and biochemical analyses and quality control in: industry (oil, food, brewing, detergent, textiles, etc.), hospitals, schools, colleges and research institutions;
ii. Assist in physics and electronic laboratories with physical analyses and the maintenance of instruments;
iii. Assist in biological and microbiological analyses and experiments in hospitals, schools, colleges and research institutes;
iv. Work as sales, marketing, administration and management representative in the industries
v. Set up his/her own business

3.0 ENTRY REQUIREMENTS:

Entry requirements for the National Diploma in Science Laboratory Technology programme include at least a minimum score in the Unified Tertiary Matriculation Examination (UTME), five credit passes at not more than two sittings in West African Senior School Certificate Examination (WASSCE), Senior School Certificate Examination (SSCE), National Technical Certificate (NTC), General Certificate of Education (GCE) Ordinary level, or the West African Examination Certificate (WAEC) in relevant subjects. The relevant subjects are: English Language, Mathematics, Physics, Chemistry and one other subject from: Metal Work, Wood Work, Technical Drawing, Basic Electronics, Basic Electricity, Economics, Commerce, Statistics, Further Mathematics, Computer Studies, Geography and Biology or Agricultural Science. (Details of Admission requirements are obtainable in the NBTE annual Directory of Acceditated Programmes).

4.0 CURRICULUM

4.1 The curriculum of the ND SLT programme consists of the following four main components:

i. General Studies/Education
ii. Foundation courses
iii. Professional courses
iv Students Industrial Work Experience Scheme (SIWES)

4.2 The General Education Component shall include courses in:

- English Language and Communication, Citizenship Education, and Entrepreneurship Studies, others may include History, Political Science, Sociology, Geography, Philosophy etc

The General Education component shall account for not more than 15% of total contact hours for the programme.

4.3 Foundation Courses include courses in Mathematics, Pure Science, Technical Drawing, Descriptive Geometry, etc. The number of hours will be 10 -15% of the total contact hours.

4.4 Professional Courses are courses which give the student theory and practical skills he needs to practice at the Technician level. These may account for 60-70% of the contact hours.

4.5 Student Industrial Work Experience Scheme (SIWES) shall be taken during the long vacation following the end of the second semester of the first year. See details of SIWES at paragraph 9.0.

5.0 CURRICULUM STRUCTURE:

The structure of the ND Programme consists of four semesters of classroom, laboratory and workshop/field activities in the Institution and a semester (3-4 months) of student industrial work experience scheme (SIWES). Each semester shall be seventeen (17) weeks of duration made up of:

- 15 contact weeks of teaching, i.e. recitation, practical exercises, quizzes, test, etc; and
- 2 weeks for registration and examinations.

SIWES shall take place at the end of the second semester of the first year.

6.0 PROJECT

Project shall be submitted at the end of the second semester of the final year.

7.0 ACCREDITATION

Each programme offered either at the ND or HND level shall be accredited by the NBTE before the diplomates can be awarded either of the two diploma certificates. Details about the process of accrediting a programme for the award of ND or HND are available from the Executive Secretary, National Board for Technical Education, Plot B Bida Road, P.M.B. 2239, Kaduna, Nigeria.

7.1 Conditions for the Award of ND:

Institutions offering accredited programmes will award the National Diploma to candidates who successfully completed the programme after passing prescribed course-work, examinations, diploma project and the students' industrial work experience scheme. Such candidates should have completed a minimum of 90 and 100 semester credit units. National Diploma Certificate shall be awarded based on the following:-

i. Grading of Courses: Courses shall be graded as follows:

MARKED	LETTER GRADE	WEIGHTING
75% and above	A	4.00
70% – 74%	AB	3.50
65% – 69%	B	3.25
60% – 64%	BC	3.00
55% – 59%	C	2.75
50% – 54%	CD	2.50
45% – 49%	D	2.25
40% – 44%	E	2.00
Below 40%	F	0.0

ii. Classification of Diplomas: Diploma Certificates shall be awarded based on the following classifications:

Distinction - CGPA 3.50-4.00
Upper Credit - CGPA 3.00-3.49
Lower Credit - CGPA 2.50-3.00
Pass - CGPA 2.00-2.49

8.0 GUIDANCE NOTES FOR TEACHERS OF THE PROGRAMME:

8.1 The new curriculum is drawn in unit courses. This is in keeping with the provisions of the National Policy on Education which stress the need to introduce the semester credit units which will enable a student, who so wish, to transfer the units already completed in an institution of similar standard from which he is transferring.

8.2 In designing the units, the principle of the modular system by product has been adopted, thus making each of the professional modules, when completed provides the student with technician operative skills, which can be used for employment purposes

8.3 As the success of the credit unit system depends on the articulation of programmes between the institution and industry, the Curriculum content has been written in behavioral objectives, so that it is clear to all the expected performance of the student who successfully completed some of the courses or the diplomates of the programme. There is a slight departure in the presentation of the performance based curriculum which requires the conditions under which the performance is expected to be carried out and the criteria for the acceptable levels of performance. It is a deliberate attempt to further involve the staff of the department teaching the programme to write their own curriculum stating the conditions existing in their institution under which the performance can take place and follow that with the criteria for determining an acceptable level of performance. Departmental submission on the final curriculum may be vetted by the Academic Board of the institution. Our aim is to continue to see to it that a solid internal Evaluation system exist in each institution for ensuring minimum standard and quality of education in the programmes offered throughout the polytechnic system.

8.4 The teaching of the theory and practical work should, as much as possible, be integrated. Practical exercises, especially those in professional courses and laboratory work should not be taught in isolation from the theory. For each course, there should be a balance of theory to practice in the ratio of 50:50 or 60:40 or the reverse

9.0 GUIDELINES ON SIWES PROGRAMME:

For the smooth operation of the SIWES the following guidelines shall apply

9.1 Responsibility for placement of students

a) Institutions offering the ND programme shall arrange to place the students in industry by April 30 of each year, six copies of the list showing where each student has been placed shall be submitted to the Executive Secretary, NBTE which shall in turn, authenticate the list and forward it to the industrial training fund, Jos
b) The placement Officer should discuss and agree with industry on the following:
    i. A task inventory of what the students should be expected to experience during the period of attachment. It may be wise to adopt the one already approved for each field
    ii. The industry-based supervisor of the students during the period, likewise the institution based supervisor
    iii. The evaluation of the student during the period. It should be noted that the final grading of the student during the period of the attachment should be weighted more on the evaluation by his industry-based supervisor

9.2 Evaluation of students during the SIWES

In the evaluation of the student, cognizance should be taken of the following items:

a) Punctuality
b) Attendance
c) General Attitude to Work
d) Respect for Authority
e) Interest in the Field/Technical area
f) Technical competence as a potential technician in his field

9.3 Grading of SIWES

To ensure uniformity of grading scales, the institution should ensure that the uniform grading of student's work which has been agreed to by polytechnics is adopted.

9.4 The Institution Based Supervisor

The Institution-based supervisor should initiate the log book during each visit. This will enable him to check and determine to what extent the objective of the scheme are being met and to assist students having any problems regarding the specific assignments given to them by their industry-based supervisor.

9.5 Frequency of Visit

Institution should ensure that students placed on attachment are visited within one month of their placement. Other visits shall be arranged so that:

1) There is another visit six weeks after the first; and
2) A final visit in the last month of the attachment

9.6 Stipends for Students in SIWES

The rate of stipend payable shall be determined from time to time by the Federal Government after due consultation with the Federal Ministry of Education, the Industrial Training Fund and the NBTE

9.7 SIWES as a Component of the Curriculum

The completion of SIWES is important in the final determination of whether the student is successful in the programme or not. Failure in the SIWES isan indication that the student has not shown sufficient interest in the field or has no potential to become a skilled technician in his field. The SIWES should be graded on a fail or pass basis. Where a student has satisfied all other requirements but failed SIWES, he may only be allowed to repeat another four months SIWES at his own expense.

10.0 OPERATIONAL TERMS

- STB Biology Courses
- STC Chemistry Courses
- STP Physics Courses
- GLT General Laboratory Techniques for the three components
- GNS General Studies Courses
- EED Entrepreneurships Education
- MTH Mathematics Course
- CH Credit Hours/Week
- CU Credit Units
- T Theoretical
- L Lecture Hour
- P Practical Hour
- Prerequisite - Course that must be taken and passed before taken another
- Specific Learning Outcome - What students should be able to do at the end of each lesson

- Teachers Activities - What the teacher should do to achieve the SLO
- Resources - The Instructional Materials needed to use for the lesson
- Evaluation- Formative assessment of the lesson

CURRICULUM TABLE

ND 1 SEMESTER ONE

S/N	Course Code	Course Title	L	P	CH	CU	Prerequisite
1	STB 111	Fungi, Plant and Animal Taxonomy	2		2	2	
2	STB 112	Morphology and Physiology of Living Things	2		2	2	
3	STB113	Practical (STB 111 and STB)	-	2	2	2	
4	STC 111	General Principles of Chemistry	2		2	2	
5	STC 112	Inorganic Chemistry l	2		2	2	
6	STC113	Practical (STC 111 & 112)	-	2	2	2	
7	STP 111	**Mechanics**	2		2	2	
8	STP 112	Heat Energy	1		1	2	
9	STC 113	**Electronic Logic for Science**	1		1	1	
10	STP 114	Practical (STP 111& 112	-	2	2	2	
11	**GLT 111**	General Laboratory Techniques 1	**1**	**1**	**2**	**2**	
12	MTH 113	**Algebra for Science**	1	-	1	1	
13	GNS 101	Use of English I	2	-	2	2	
14	GNS 111	**Citizenship Education l**	2	-	2	2	
		TOTAL	**18**	**7**	**25**	**26**	

ND 1 SEMESTER TWO

S/N	COURSE CODE	Course Title	L	P	CH	CU	Prerequisite
1	STB 121	Cell Biology	2		2	3	
2	STB 123	Practical (STB 121)	-	2	2	2	
3	STC 121	Organic Chemistry I	2	-	2	2	
4	STC 122	Physical Chemistry	2	-	2	2	
5	STC 123	Analytical Chemistry	2	-	2	2	
6	STC 124	Practical (STC 121&122)	-	2	2	2	
7	STP 121	Electrical Magnetism	2	-	2	2	
8	STP 122	Optics and Waves	2		2	2	
9	STP 123	Practical STP 121 & 122	-	2	2	2	
10	GLT 121	General Laboratory Techniques II	1	-	1	1	
11	COM 123	Computer Packages I	2	-	2	2	
12	GNS 126	Introduction to Entrepreneurship	2	-	2	2	
13	GNS 102	Communication in English l	2	-	2	2	
14	GNS 121	Citizenship Education ll	2	-	2	2	
		TOTAL	21	6	27	28	

ND II SEMESTER ONE

S/N	Course Code	Course Title	L	P	CH	CU	Prerequisite
1	STM 211	Introductory Microbiology	2	-	2	2	
2	STB 211	Pest and Pests Control	2	-	2	2	
3	STB 212	Pathology	1	-	1	1	
4	STB 213	Practical for STM 211, STB 211 & STB 212	-	2	2	2	
5	STC 211	Inorganic Chemistry II	1	-	1	1	
6	STC 212	Analytical Chemistry and Quality Control	2	-	2	2	
7	STC 213	Practical for STC 211, & STC 212	-	2	2	2	
8	STP 211	Introductory Electronics	2	-	2	2	
9	STP 212	Thermodynamics & Electromagnetism	1	-	1	1	
10	STP213	Practical for STP 211 & STP 212	-	2	2	2	
11	COM 215	Computer Package ll	1	-	1	1	
12	MTH213	Use of English II	2	-	2	2	
13	GNS 201	Use of English II	2	-	2	2	
14	GNS 228	Research Methods	2	-	2	2	
15	EED 216	Practice of Entrepreneurship	2	-	2	1	
Total			**20**	**6**	**26**	**25**	

ND II SEMESTER FOUR

S/N	Course Code	Course Title	L	P	CH	CU	Prerequisite
1	STB 221	Genetics	2	-	2	3	
2	STB 222	Ecology	2	-	2	2	
3	STB 223	Practical for STB 221 & STB 222	-	2	2	2	
4	STC 221	Organic Chemistry II	1	-	1	2	
5	STC 222	Introductory Biochemistry	1	-	1	2	
6	STC 223	Practical for STC 221 & STC 222	-	2	2	2	
7	STP 221	Maintenance and Repairs of Scientific and Electronic Equipment	1	-	1	2	
8	STP 222	Practical for STP 222	-	1	1	1	
6	GLT 222	General Laboratory Techniques III	1	1	2	2	
7	GNS 202	Communication in English II	2	0	2	2	
8	SLT 221	Project	1	3	4	4	
		TOTAL	11	9	20	23	

SEMESTER ONE

Course: FUNGI, PLANT AND ANIMAL TAXONOMY

Course: Fungi, Plant and Animal Taxonomy**: Semester: FIRST**	**Code:** STB 111 **Pre-requisite:**	**Total Hours: 2 Hours/Week** **Theoretical hours: 2 Hours/Week** **Practical hours: STB 113 PRACTICAL FOR STB 111 & 112: CH: 2 CU: 2**

Goal: This course is designed to provide students with knowledge of classification and naming of fungi, plants and animals.	
GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Know the general concept of classification
2	Know the general classification of Fungi
3	Know the distinguishing characteristics of the following divisions: Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota Deuteromycota
4	Know the general classification of plant kingdom
5	Know the distinguishing characteristics of the following divisions: Phycophyta, Bryophyta, Pteridophyta and Spermatophyta
6	Know the classification and identification of common fungi
7	Know the classification, identification and preservation of common flowering plants (angiosperms)
8	Know the general classification of the animal kingdom
9	Know the diagnostic features of the following phyla (Invertebrates): Protozoa, Porifera, Coelenterata, Platyhelmintha, Nematoda, Annelida, Arthropoda, Mollusca, Echinodermata, Chordata
10	Know the distinguished characteristics and identify the major classes of vertebrates (Pisces, Amphibia, Reptilia, Aves, Mammalia)

PROGRAMME: NATIONAL DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY						
COURSE TITLE: Fungi, Plant and Animal Taxonomy		**COURSE CODE: STB 111**			**CONTACT HOURS: 2- HRS/WEEK**	
COURSE SPECIFICATION: Theory 2 practical					**Practical hours: STB 113 PRACTICAL FOR STB 111 & 112: CH: 2 CU: 2**	
General Objective 1: Know the general concept of classification						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
1	1.1 Explain the principles of plant classification 1.2 Explain the principles of animal classification	Describe Binomial system of nomenclature	White board and marker			Describe the nomenclature in plant and animal
General Objective 2 Know the general classification of Fungi						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
2	2.1 List the major groups of the fungi kingdom: Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota Deuteromycota	Explain the 5 basic classes of fungi and how they are distinguished under the microscope	White board and marker Microscopes Hand held lens Fungi specimens	Identify at least 2 specific examples of the classes of fungi viz:- Chytridiomycetes, Zygomycetes etc	**Guide** students to identify representatives of the following Chytridiomycetes, Zygomycetes, Ascomycetes, Basidiomycetes Deuteromycetes **Supervise** practical examination	Differentiates the following groups Chytridiomycota Zygomycota, Ascomycota, Basidiomycota Deuteromycota
General Objective 3: Know the distinguishing characteristics of the following divisions: Chytridiomycota, Zygomycota, Ascomycota,						

Basidiomycota, Deuteromycota						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
3	3.1 Explain the 5 basic classes of fungi and how they are distinguished under the microscope 3.2 Describe the structure of two named examples of Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota Deuteromycota	Describe the structure of two named examples of common fungi.	White board and marker Microscopes Hand held lens Fungi specimens	Examine the petri dish culture of two examples from each of the classes listed in above using, staining, microscopes and hand lens where necessary. Identify the fungi in 2.1 above using the binomial system of nomenclature	Supervise practical identification of algae.	Describe the structure of two named examples of common fungi
General Objective 4: Know the general classification of the plant kingdom						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
4	4.1. List the major groups of the plant kingdom viz:- Phycophyta (algae) Bryophyta (mosses and liverwort) Pteridophyta (ferns) Spermatophyta (angiosperms and gymnosperms) 4.2. Outline the characteristics of each of the groups in above.	Enumerate the characteristics of the plant kingdom into: phycophyta bryophyta; pteridophyta; Spermatophyta (angiosperms and gymnosperms)	White board and marker Microscopes Hand held lens Plant specimens	Identify the major Divisions of the plant kingdom viz:- Phycophyta (algae) Bryophyta (mosses and liverwort) Pteridophyta (ferns) Spermatophyta (angiosperms and gymnosperms) Examine the external and internal structures	**Guide** students to identify representatives of the following divisions phycophyta bryophyta; pteridophyta; Spermatophyta **Supervise** practical examination	Differentiates the following groups Phycophyta (algae) Bryophyta (mosses and liverwort) Pteridophyta (ferns) Spermatophyta (angiosperms and

				of at least two examples from each of the groups listed in 4.1 above using microscopes and hand lens where necessary. Identify the plant in 4.1 above using the binomial system of nomenclature, name some identified plants with the binomial nomenclature		gymnosperms)
General Objective 5: Know the diagnostic features of the **Phycophyta**						
5	5.1 Identify the classes of algae. 5.2 Describe the structure of two named examples of common algae.	Describe the classes of algae Explain the structure of some examples of common algae found in our environment such as spirogyra	Microscopes Hand lens Trays Sample of algae Magnifying glasses	Differentiate between algae and the fungi.	Supervise practical identification of algae.	Describe the structure of two named examples of common algae found in your environment
General Objective 6: Know the distinguishing characteristics of the Bryophyta, Pteridophyta and Spermatophyta						
6	6.1.List classes of bryophytes 6.2. Describe the structure of one named example of bryophytes. 6.3. List the classes of pteridophytes. 6.4. Describe the structure	Explain phycophyta bryophyta, pteridophyta, spermatophyta. Describe the structure of an example of bryophytes and pteridophytes. Lecture on spermatophyta	Hand held magnifying lens. Bryophytes, pteridophytes and spermatophytes specimens	Differentiate between the bryophytes pteridophytes and spermatophytes.	Guide students through the garden proceedings to differentiate visually between the bryophytes, pteridophyte and spermatophytes.	List out the major plant types. Describe the structure of one named example of

	of one named example of a pteridophyte 6.5. Differenciate between the two subdivisions of the spermatophyta viz: gymnosperms and angiosperms. 6.6. List the classes of the Gymnosperms and the Angiosperms. 6.7.Describe the structure of one example each of a gymnosperm and an angiosperm	and explain the structure of one example of gymnosperm and angiosperm.				bryophyte
General Objective 7: Know the classification, identification and preservation of common flowering plants						
7	Outline the characteristics of common flowering plant families viz: monocotyledonous plants:- i).Graminease e.g. Grass, Bamboo, Palmae e.g. Palms ii).Liliaceae e.g. onions, Dico-tyledenous plants:- iii).Leguminosae e.g.Crotolaria, cassia, iv).Combretaceae e.g. combretum v). Sterculiaceae e.g. cola vi. Malvaceae e.g. Hibiscus vii. Bombacaceae e.g Bombax viii. Rutaceae e.g.	List out with explanation the characteristics of common flowering plant families viz: monocotyledonous plants:- i. Graminease e.g. Grass, Bamboo ii. Palmae e.g. Palms iii. Liliaceae e.g. onions, Dicotyledenous plants: iv. Leguminosae e.g. Crotolaria, cassia v. Combretaceae e.g. combretum vi. Sterculiaceae e.g. cola vii. Malvaceae e.g.	Botanical Garden with the required specimens Plant press. Cardboard, secateurs herbarium poisons. Magnifying glass Weed album and key for identification	Display monocotyledonous and dicotyledonous plants. Distinguish between the common families of flowering plants viz: monocotyledonous plants by making the specimens available to students: i.Graminease e.g. Grass, Bamboo ii. Palmae e.g.	Show monocotyledonous and dicotyledonous plants. Identify and distinguish between the common families of flowering plants viz: monocotyledonous plants by making the specimens available to students: i. Graminease e.g. Grass, Bamboo	Differentiate plants into monocotyledon and dicotyledons Preserve selected samples of Gymnosperms (e.g. *Cycas revolute*), monocotyledons (e.g. Guinea grass, maize, palms etc) and Dicotyledons (e.g. *Hibiscus*, *Crotolaria*,

	citrus ix. Anacardiaceae e.g. mango; cashew nuts x. Maliaceae e.g mahogamy xi. Compositae e.g. Tridax	Hibiscus viii. Bombacaceae e.g Bombax ix. Rutaceae e.g. citrus x. Anacardiaceae e.g. mango; cashew nuts xi. Maliaceae e.g mahogamy xii. Compositae e.g. Tridax		Palms iii. Liliaceae e.g. onions, iv. Dicotyledonous plants:- Leguminosae	ii.Palmae e.g. Palms iii.Liliaceae e.g. onions, iv. Dicotyledonous plants:- Leguminosa	citrus, tridax, mangoes, Cashews etc).

General Objective 8: Know the general classification of the animal kingdom						
8	Outline the characteristics of the following phyla invertebrates: Protozoa, Coelenterata, Platylminthes nematodes, Annelids Arthropods, Molluscs, Echinodermates and Chordates	Explain the two major groups of animal kingdom (Vertebrates and Invertebrates) and describe their characteristics	Microscopes, slides, charts with illustrations	Differentiates between vertebrates and invertebrates from groups of organisms	Show with aid of Identification the two major groups of animal kingdom (Vertebrates and Invertebrates) and describe their characteristics	List the differences between vertebrates and invertebrates from a given groups of organisms
General Objective 9: Know the diagnostic features of the following phyla: Protozoa, Platyhelmintha Coelenterata, Nematoda, Annelids, Arthropoda						
9	9.1 Classify the invertebrates into different phyla 9.2. List the distinguishing	Categorize the vertebrates and invertebrates List the distinguishing characteristics of the following phyla: Protozoa	Different charts and illustrations	Identify examples from each phylum in 9.2 above Describe	Guide students to list out the distinguishing characteristics of the following	Explain the characteristics of the following phyla:

	characteristics of the following phyla: Protozoa Porifera Coelenterates Platyhelminthes Nematodes, Annelids Arthropods and Molluscs Echinodermates and Chordates	Coelenterata Platyhelminthes, Nematodes, Annelids, Arthropoda, Mollusca, Echinodermates and Chordates		the external structure of some common examples from each phylum in 9.2 above. Identify, draw and label examples from 9.4 above.	phyla: Protozoa Porifera Coelenterata Platyhelmintha Nematodes Annelida Arthropoda Mollusca, Echinodermates and Chordates	Protozoa Porifera Coelenterata Platyhelminthes Nematodes Annelida Arthropoda Mollusca, Echinodermates and Chordates

General Objective 10: Know the distinguished characteristics the major classes of vertebrates (Pisces, Amphibia, Reptila, Mammalia)						
10	10.1.Describe the external features of the phylum Pisces, amphibian, reptilian, aves, mammalian 10.2. Explain the protochorodates as a link between invertebrates and vertebrates.	Explain the external features of some common examples from each of the phylum Pisces, Amphibian, reptilia,n Aves, Mammalian Explain the protochorodates as a link between invertebrates and vertebrates.	Specimens of Pisces amphibian, reptilian, aves mammalian	Draw the external features of organism as listed in specific objectives examples from 7.1 above Identify the protochorodates as a link between invertebrates and vertebrates	Identify the protochorodates as a link between invertebrates and vertebrates	Explain the external features of some common examples from each of the vertebrates Pisces, amphibia, Reptilia, Aves and Mammalia

Course: Morphology and Physiology of Ling Things	**Code:** STB 112 **Pre-requisite:**	**Total Hours: 2 Hours/Week** **Theoretical hours: 2 Hours/Week**

Semester: FIRST		Practical hours: STB 113 (PRACTICAL FOR STB 111 & 112) :C H:2 CU: 2
Goal: This course is intended to provide students with knowledge about the structures, features and their functions of living organisms.		
GENERAL OBJECTIVES		
On completion of this module students should be able to :		
1	Know the morphology of Bryophyta, Pteridophyta, Spermatophyta	
2	Know the life cycles of Bryophyta, Pteridophyta and Spermatophyte	
3	Recognize the economic importance of Bryophyta, Pteridophyta and spermatophyta	
4	Know the morphology of Protozoa, Coelenterate, Platy helminthes, Nematoda, Annelids, Arthropod, Mollusca.	
5	Know the life cycles of Protozoa, Coelenterate, Platy helminthes, Nematoda, Annelids, Arthropod, Mollusca.	
6	Recognize the economic importance of Protozoa, Coelenterate, Platyhelmintha, Nematoda, Annelids, Anthropoda, Mollusca.	

COURSE TITLE: Morphology and Physiology of Living Things.	**COURSE CODE: STB 112**	**CONTACT HOURS: 2- HRS/WEEK**
COURSE SPECIFICATION: Theory practical		**Practical hours: STB 113 (PRACTICAL FOR STB 111 & 112) : C H:2 CU: 2**

General Objective 1: Know the morphology of Bryophyta, Pteridophyta, Spermatophyta

WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
1- 4	1.1 Describe the general characteristics, and classification of the algae. 1.2 identifies the morphology of diatoms, euglena, spirogyra, ferns. 1.3 Enumerate the general characteristics and classification of fungi. 1.4 Describe the structure and classification of lichens. 1.5 Explain the general characteristics and classification of Bryophyta. 1.6 Explain the general characteristics, and	Explain the general characteristics of algae with examples of morphology of Diatoms, Euglena, Spirogyra, Ferns. Explain the general characteristics of fungi with the structure a saprophytic fungus e.g. *Mucor* and a parasitic fungus *Pythium*. Explain the general characteristics of Bryophyta. Describe the morphology and life cycles of a Liverwort e.g. *Marchantia*, Moss and *Funaria*. Explain the general characteristics of	Microscopes Slides Video clips Charts Live specimen of a representative. Live specimen of Pteridophytes	Identify the external features of the listed organisms in Specific learning outcome 1.1-1.3 Draw the external features of *Mucor/Pythium* Identifying the features of Bryophytes Identifying the features of Pteridophytes	Guide students to identify the listed organisms 1.1 – 1.4 Guide students in viewing the external features Show students real specimen of Bryophytes Guide students to uproot fern plant.	With the aid of diagram explain the external features Identify mycelium from the specimen What are the common features of Bryophytes Name other members of Pteridophytes

	classification of Pteridophytes 1.7 Describe the morphology of a club moss e.g. *Selaginella* and a fern 1.8 Explain the concept of heterospory as illustrated by Selaginella. 1.9 Exemplify the adaptive features of Pteriodphytes to plant and its evolutionary significance 1.10 Describe the general characteristics and classification of gymnosperms. 1.11 Describe the general characteristics and classification of angiosperms. 1.12 List the types of angiosperms- trees, herbs and shrubs around. 1.13 Outline the	Pteridophyta Explain the morphology of a club moss e.g. *Selaginella* and a fern Explain the concept of heterospory as illustrated by Selaginella. Explain the adaptive features of Pteriodphytes to plant and its evolutionary significance Explain the characteristics and classification of gymnosperms. Explain the characteristics and classification of angiosperms. List and describe the range of types of angiosperms- trees, herbs and shrubs. Outline the evolutionary	Live specimen moss Live specimens naked seed plants Live specimens of flowering plants	Identifying the features of moss. Identifying the features of gymnosperms. Identifying the features of angiosperms	Guide students to collect plants. Guide students to collect plants	Distinguish between moss and fern. Describe structures, habitat and adaptive features of moss, fern. Distinguish between gymnosperm and angiosperm State the differences between trees, herbs and shrubs. What are the common

	evolutionary relationship between the divisions in above.	relationship between the divisions.				features found in the divisions?
General Objective 2: Know the life cycles of Bryophyta, Pteridophyta and spermatophyta						
5-7	2.1 Describe the life cycles of diatoms, euglena, spirogyra and ferns. 2.2 Describe the life cycle of a saprophytic fungus e.g. *Muco*r and a parasitic fungus *Pythium*. 2.3 Describe the life cycles of a liverwort e.g. *marchanti*a and moss e.g. *Funaria*. 2.4 Explain the concept of alternation of generation in Bryophyta 2.5 Describe the life cycle of a club moss e.g. *Selaginella* and a fern. 2.6 Explain alternation of generation in Pteridophyta compare it with that of the Bryophyta. 2.7 Describe external	Explain the life cycles of Diatoms, Euglena, Spirogyra, Ferns. Explain the life cycle of a saprophytic fungus e.g. *Mucor* and a parasitic fungus *Pythium*. Explain the life cycles of Liverwort e.g. *Marchantia*, Moss And *Funaria*. Explain the concept of alternation of generation in Bryophyta 1.15 Explain alternation of generation in Pteridophyta compare it with that of the Bryophyta. Explain Cycads	Charts Prepared slide. Charts Charts			Differentiate between the life cycle of Euglena and Spirogyra. Name other examples of fungi. Distinguish the alternation of generation in Bryophytes and Pteridophytes

	features and life cycle of cycads					
General Objective 3 : Recognize the economic importance of Bryophyta, Pteridophyta and spermatophyta						
8-11	3.1 Enumerate the economic importance of algae. 3.2 List the economic importance of fungi. 3.3 Explain the economic importance of lichens. 3.4 Explain the economic importance of gymnosperm. 3.5 Explain the adaptations and economic importance of the angiosperms.	Explain the economic importance of algae. Explain the economic importance of fungi. List the economic importance of fungi List the economic importance of lichens. Explain the adaptations of gymnosperm and angiosperms.				What are the economic importance of algae, fungi and lichens? Enumerate the adaptations of gymnosperms and angiosperms
General Objective 4: Know the morphology of Protozoa, Coelenterate, Platyhelminthes ,Nematodes, Annelida, Anthropoda, Mollusca						
12-15	3.6 List the general characteristics of the major classes of protozoa. 2.4 Describe the general characteristics of the major classes of the phylum Coelenterata to illustrate diploblastic organization. 2.8 List the general characteristics of the major classes of the Platyhelminthes. 2.10 Describe the	Explain the characteristics of protozoa-Amoeba and Paramecium. Explain the characteristics of Hydra and Obelia. List the differences between Hydra and Obelia. List the general characteristics of Platyhelminthes. Explain the parasitic adaptations of *Fasciola* and *Schistosoma*.	Pond water, microscope and prepared slides. Charts, prepared slide. Live specimen, chart and prepared slide. Prepared slide, preserved	Identifying the features of Protozoa. Identifying the features Hydra and Obelia. Identifying the features of Platyhelminthes	Guide students to viewing the features under the microscope Assist students to view the features using hand lens.	What are the features common with protozoa? State the differences Hydra and Obelia. Distinguish between Fasciola and Schistosoma

	parasitic adaptations of *Fasciola* and *Schistosoma*. 2.12 Describe the general characteristics of the major classes of the phylum Nematoda. 2.16 List the general characteristics of the major classes of the plylum annelida. 2.20 Describe the characteristics of the major classes of the phylum mollusca. 2.23 Describe the characteristics of the major classes of the phylum Arthropoda 2.24 List the classes of the phylum Arthropoda. 2.25 List the common orders of the phylum Arthropda and give examples e.g. diptera orthoptera, coleoptera, hemipters, leidoptera hymenoptera, odonata, isoptera, dictyoptera and nenroptera. 2.27 Classify the phylum Echinodermata into its major classes with some examples	Explain the characteristics- *Ascaris*, Guinea worm. Explain the characteristics of Annelida. Describe the structure of *Lumbricus*, Nereis And Hirodo. Explain the characteristics of Mollusca. Explain the characteristics of the major classes of the phylum Arthropoda Explain the classes of the phylum Arthropoda. Explain the common orders of the phylum Arthropda and give examples e.g. Diptera Orthoptera, Coleoptera, Hemipters, Leidoptera Hymenoptera, Odonata, Isoptera, Dictyoptera And Nenroptera. Explain the characteristics and classify the phylum Echinodermata into its major classes with some	specimen. Live specimen, prepared slide, preserved specimen. Live specimen, chart. Chart, preserved specimen	Illustrate the external features of annelid. Illustrate the features of Mollusca. Illustrate the features of Arthropod.	Show the illustration of the annelid. Show the illustration of the annelid. Assist students to collect specimens	Describe the characteristics of the major classes of the phylum Nematoda. List the major characteristics of earthworm. State the characteristics of Mollusca. What are the characteristics of Arthropod?

	2.30 Outline the evolutionary relationship between the phyla and within each phylum from 2.1 to 2.28	examples Outline the evolutionary relationship between the phyla and within each phylum.				

GENERAL PRINCIPLES OF CHEMISTRY & PRACTICALS **Code:** STC 111	**Total Credit Hours: 2 Hours/Week**
	Theoretical hours: 2Hours/Week
	Practical hours STC 113:

Pre-requisite:	(PRACTICAL FOR STC 111 & STC 112) CH :2 CU: 2

GOAL: the course is designed to provide students with knowledge of elements and their atomic structures in the periodic table.

General Objectives

1. **Understand the structure of atoms, molecules, and their composition**
2. **Understand the arrangement of elements in the periodic table**
3. **Understand chemical thermodynamic**
4. **Understand the properties and reactions of acids, bases and salts**
5. **Understand the fundamental concept of oxidation and reduction reactions**
6. **Understand surface phenomena and colloidal systems**
7. **Understand chemical equilibrium**

PROGRAMME: NATIONAL DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY		
COURSE TITLE: GENERAL PRINCIPLES OF CHEMISTRY & PRACTICALS	COURSE CODE: STC 111	CONTACT HOURS: 2-0-0 HRS/WEEK

COURSE SPECIFICATION: Theory 1 Practical				**Practical hours STC 113: (PRACTICAL FOR STC 111 & STC 112) CH :2 CU: 2**		
General Objective 1: Understand the structure of atoms, molecules, and their composition						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**

1	1.1Explain the experimental basis of atomic theory using the Bohr's theory of hydrogen atom and many electron atoms. 1.2 Describe atomic spectra particularly the atom emission spectrum 1.3 Discuss, qualitatively, the Energy States of the hydrogen atom in the Bohr model and relate these Energy States to the observed emission spectra	Explain atomic theory using the Bohr's theory of hydrogen atom and many electron atoms. Explain with illustration the qualitatively, the Energy States of the hydrogen atom in the Bohr model and relate these Energy States to the observed emission spectra	Textbooks direct vision spectroscope Bunsen burner, nichrome wire fixed to a cork handle, concHCl, solid ch chlorides of : barium, calcium, potassium, sodium and strontium beakers and watch glasses.	View the visible emission spectra of several metals in some of their compounds Interpret the mass spectrum of representati ve elements such as Oxygen, Carbon, and Chlorine etc.	Guide and supervise the technicians, technologists and students on Bohr"s theory of hydrogen and electron atoms	What is basis of atomic theory using the Bohr's theory of hydrogen atom and many electron atoms. Enumerate qualitatively, the Energy States of the hydrogen atom in the Bohr model and relate these Energy States the observed emission spectra
2	1.4 Explain limitations of the Bohr model 1.5 Describe the wave-particle duality of electrons and energy State the different main energy levels of an atom, namely K, L. M… Correlate the energies of the	explain the wave-particle duality of electrons and energy State the different main energy levels of an atom, namely K, L. M… Correlate the				What are Bohr model limitation

	electron in the K,L,M,N,…shells with the values of the principal quantum no n= 1,2,3,4,…… 1.6.Relate the lines of the hydrogen emission spectrum to electronic energy level. 1.7.State Hund's rule, Heisenberg uncertainty principle Pauli exclusion principle. 1.8. Outline 1.10 above in relation to the concept of orbitals including subsidiary energy levels (s,p,d,f orbitals). 1.9.Explain the significance e of the four quantum numbers 1.10 Describe the shapes of s and p orbitals. 1.8 Sketch the s and p orbitals. 1.19 Explain 1.10 above in relation to the concept of orbitals including subsidiary energy levels (s,p,d,f	energies of the electron in the K,L,M,N,…shells with the values of the principal quantum no n= 1,2,3,4,…… Explain the significant of the four quantum numbers Explain the shapes of s, p and concept of orbitals including sussidiary energy Explain the significance e of the four quantum numbers Describe the shapes of s and	Copper foil, tongs, Burner Workshop resources and representative mass spectra iron,	Separate a mixture of sand and salt and relate the results to the different types of bonding in each Prepare iron sulphide from iron and sulphur	provide spectra, and guide students through their interpretation	Enumerate different main energy levels of an atom, namely K, L. and Correlate the energies of the electron in the K,L,M,N,…shells with the values of the principal quantum no n= 1,2,3,4 .Relate the lines of the hydrogen emission spectrum to electronic energy level. Define Hund's rule, Heisenberg and uncertainty principle Pauli exclusion principle. What is the significance of four quantum numbers

3	orbitals). 1.10. Explain the significance e of the four quantum numbers 1.11 Describe the shapes of s and p orbitals. 1.10 Sketch the s and p orbitals. 1.12.Describe and explain in details determination; o relative atomic and molecular masses. 1.13 Explain isotopes and their use Describe the use of mass spectrometer as a means of proving the existence of isotopes.	p orbitals. 1.10 Sketch the s and p orbitals. .Describe and explain in details determination; o relative atomic and molecular masses. describe isotopes and their use explain the use of mass spectrometer as a means of proving the existence of isotopes.	Sulphur, Bunsen burner, glassware, magnets	Display chart on s, p orbitals		Diagrammatically show the s and p orbital's. What is atomic mass number ,etc
4	1.14.Define the following:: (i) Atomic number, (ii) Mass number, (iii) Atomic mass, Based on 12C 1.15.Explain valency	Describe the following:: (i) Atomic number, (ii) Mass number, (iii) Atomic mass, Based on 12C State different between ionic: covalent;				What is valency and chemical bonding that re-occur in between types bonding Define structurally covalent; metallic, co-ordination bond bonding and lattice energy what is the formation of covalent bonds, bond length and

	and chemical bonding. Explain the octet and duplet rules 1.16.Distinguish between the following types of bonds: ionic: covalent; metallic, co-ordination bond. 1.17.list out energy considerations in ionic bonding and lattice energy 1.18.Explain the formation of covalent bonds, bond length and bond energy,electro negativity and bond polarity, 1.19.Explain Van der Waal's forces.	metallic, co-ordination bond.	Lecture room Resources			bond energy, in electro negativity and in bond polarity
General Objective 2: 0 Understand the arrangement of elements in the periodic table						

5	2.1 Discuss the development of the periodic table Describe building up periods I and II Describe building up period III 2.2 Describe electron configurations within groups 2.3 Describe the first d-orbital transition series; building up 2.4 period IV Discuss the non-metallic elements 2.5 Discuss the noble gases	Explain the development of period table. Lecture and give note on transition metals and electoronic configuration explain non-metallic elements noble gases and electronic configuration for the first twenty elements of the periodic table	Mg, Ca, Sr, Ba, water, dilute hydrochloric acid test tubes etc Classroom resources Textbooks	Investigate the reactivity of group 2 metals (i) Mg. Ca, Sr, and Ba with water (ii) Mg and Ca with dilute HCl Reactivity of transition metals	Guide students Guide students on periodic table	What is periodic table Define period 1,11, 111 What is electronic configurations Define d-orbital and transition series What is non-metallic element, and give examples
6	2.6Write down electronic configuration for the first twenty elements of the periodic table. 2.7 Relate electron configuration to the position in the periodic table. 2.8. Describe trends in the Periodic Table					Differentiate between the following; Atomic size, ii)ionization energy, iii)electron affinity, reactivity and state their diagonal relationship

	i)Atomic size, ii) ionization energy, iii)electron affinity, reactivity. 2.81 Describe their diagonal relationships					
A						
General Objective 3: Understand chemical Thermodynamics						
7	3.1 Describe thermodynamic systems e.g. open system, closed system, isolated system. 3.2 Explain thermodynamic functions in; enthalpy, entropy, free energy. 3.3 Explain the first and second laws of thermodynamics and their significance. 3.4 Explain thermo chemistry as heat effects that accompany chemical reactions	Lectures with notes	Classroom resources Chemicals calorimeter silica tin	Measure heat of reaction by simple experiments e.g. heat of neutralization of NaOH, HCl i.e. strong acid and strong base	Teacher supervises and guides students in the laboratory Measure heat of reaction in an open, closed, and isolated system	What is first , second law of thermodynamics Define thermo function in entophy, entropy, free energy. State heat of Reaction that accompany th chemical reaction in thermo

General Objective 4.0: **Understand the properties and reactions of acid, bases and salts**.						
7	4.1Define an acid and a base according to Arrhenius, Bronsted – Lowry and Lewis concepts.	Define acid, bases and salts and teach to identify them in equations	Chemicals Conductance meters pH meters colour charts indicators burettes	Carry out acid base titration by using conducta	Guide students on how to carry out acid-base reaction in the laboratory	What is an acid , base according to Arrhenius, Bronsted – Lowry and Lewis concepts.

8	4.2Identify acids and bases in chemistry equations. 4.3Explain the meaning of the terms conjugates acid and conjugate base 4.4Distinguish between a strong and weak acid or base. 4.5Write the expression for the dissociation constant for an acid HA (aq) Give the equation for the degree of dissociation and concentration, M. (mole dm^3) for a dilute solution of a weak acid. 4.6 Explain Ostwald's Dilution law and dissociation constant, K.	Explain dissociation constant and derive expression for it Work out simple calculations on degree of dissociation of weak acid Succinately, calculate the degree of ostwalds dilution at	glassware	Identify indicators and use indicators in acid base titration	Guide students on how to Identify indicators and use indicators in acid base titration	Differentiate between strong and weak acid with example **State** Ostwald's Dilution law and i)calculate the dissociation constant, K. ii) the degree of dissociation of a weak acid given the molarity and dissociation k. iii) write the value of ionic product of water

	Calculate the degree of dissociation of a weak acid given the molarity and dissociation constant. 4.7State the value of the ionic product of water.	constant k				
9	4.8Explain the concept of hydrogen on concentration and pH 4.8.1Calculate the pH value of an acid or base given the hydrogen ion concentration 4.9 Identify various types of indicators and the use in the measurement of pH.	Lecture and give comprehensive notes		Measure the pH of solutions using colour charts, indicators and pH meter Determine experimentally the strengths of acids and bases in relation to structure e.g. in the series CH3COOH, HCL, NH4, OH, NaOH	Carry out laboratory analysis on pH	

10 11	4.10 Define the terms, pka and pkb 4.11State the Henderson 4.12Hasslebach equation 4.13 Use the Henderson Hassleback equation 4.14explain the incident that occur when a weak acid is in a solution where the pH = of the acid , the acid is 50% ionised. 4.15 Define the terms, buffer solution and buffer capacity Explain the effectiveness of a buffer solution. 4.16.Describe buffers in Biochemistry and Medicine (e.g. blood, and biochemical experiments)	Lecture and give notes Explain buffers in Biochemistry and Medicine (e.g. blood, and biochemical experiments)	test tubes chemicals burette for back titrations Buffer solution . glaswares Ph meter, Deionize water	Measure pKa of a weak acid via titration Titrate a weak acid by using a strong base. Plot the results and observe the region of buffering and the end point. Calculate the solubility product of silver acetate in water and solutions of varying concentrations of sodium nitrate. Biochemical and medicinal techniques on buffer	Teacher supervises students Guide students on how to carry out Biochemical and medicinal techniques on buffer	Describe pka using Henderson Hasslebach equation What is buffer solution and buffer capacity What are the effectiveness of a buffer solution. State the use of buffers biochemically and in medicine
General Objective 5.0 Understand the fundamental concept of oxidation and reduction reaction						

12	5.1Explain: a) Oxidation reaction b) Reduction reaction 5.2Explain the oxidation and reduction reactions in terms of electron transfer 5.3List some oxidizing and reducing agents. 5.4 State the periodicity of oxidation state of the elements. 5.5State half ionic equation involving in oxidation reaction. 5.6State half ionic equation to illustrate reduction. Balance simple redox equation's	Discuss redox reactions and interims of electron transfer State half ionic equation in oxidation and reduction reactions Conduct practical Titration Explain (5) State half ionic equation involving in oxidation reaction, and state the half ionic equation to illustrate reduction. Balance simple redox equation's	Titration apparatus and chemicals Radioactive equipment etc	Carry out redox titration's by using potassium permanganate Copper foil, tongs, Burner	Supervise students in the laboratory Guide student on laboratory practicals	What is a) Oxidation reaction b) Reduction reaction ii) and in terms of electron transfer and reduction state the State the periodicity of oxidation state of the elements. mention the half ionic equation involving in oxidation reaction , and its half life ionic equation to illustrate reduction. Balance simple redox equation's
	General Objective 6.0: Understand surface phenomena and colloidal systems					
13	6.1Explain surface	Lecture with notes	Finely cut		Guide	What is surface phenomena and

	phenomena and colloidal system 6.2 Explain the following; colloidal gels (b) surface tension © absorption, (d) emulsion (e) gels (f) flotation (g) chromatography 6.3 Differentiate between adsorption and absorption		leaves Chromatograph tank Paper chromatograph propanone, beaker, lid, glass rod or pencil		students to carry out surface phenomenal	colloidal system Compare the following; surface tension © absorption, (d) emulsion (e) gels (f) flotation (g) chromatography What is different between adsorption and absorption
	General Objective 7.0 Understand chemical equilibrium					
15	7.1Explain chemical equilibrium 7.2 State the factors affecting chemical equilibrium 7.3Explain reversible reaction in relation to	Lecture and give notes	test tubes, gloves, potassium chromate,	Procedures on chemical equilibrum	Guide students	Define chemical equilibrium List the factors that are affecting chemical equilibrium

	chemical equilibrium					
	7.4Explain Le Chatellier's principle 7.5Define equilibrium constant 7.6 Explain the law of mass action 7.6.1Calculate concentrations present in equilibrium mixture at given temperature starting from any given amounts of reactants and products.		sulphuric acid, NaOH, potassium or ammonium thiocyanate, iron III chloride ammonium chloride, glass rod, teat pipettes	Perfor experiment on chemical equilibria	Guide students	Enumerate Chatellier's principle State law of mass action Compute the concentrations present in equilibrium mixture at given temperature starting from any given amounts of reactants and products.

Recommended Textbooks & References:

Classic Chemistry Experiments published by The Royal Society of Chemistry (UK) and free on the internet at http://www.chemsoc.org/networks/learnnet/classic_exp.htm

Salters Advanced Chemistry Activities and Assessment Pack published by Heinemann Chemistry by M.J. Sienko and R.A. Plane (Mc Graw Hill

Course: Inorganic chemistry 1**: Semester: FIRST**	**Code:** STC 112 **Pre-requisite:**	**Total Hours: 2 Hours/Week**
		Theoretical hours: 2 Hours/Week
		Practical hours STC 113: **(PRACTICAL FOR STC 111 & STC 112) 2 :CH CU: 2**
Goal: the course is designed to provide students with basic knowledge of chemical reactions		
GENERAL OBJECTIVES 1: Understand use of stoichiometry in chemical reactions		

1. Understand the use of stoichiometry in chemical reactions

2. Understand the shapes of molecules of The Main Group Elements (VSEPR)

3. Understand the basic concepts of UV/Visible Spectroscopy

4. Understand the chemistry of some transition metals

5. Understand the chemistry of group VII elements

6. Understand the extraction and reactivity of the main group elements (Na, Zn, Ca)

	National Diploma		**Course Code: STC 112**		**Credit Hours: 2**	
	Inorganic **Chemistry I AND PRACTICALS**				**Theoretical: 2 hours/week**	
	Year: Semester:		**Pre-requisite:**		**Practical hours STC 113: (PRACTICAL FOR STC 111 &112) : 2 CH CU: 2**	
	Theoretical Content				**Practical Content**	
	General Objective 1.0: Understand the of use stoichiometry in chemical reaction					
Weeks	**Specific Learning Outcome**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**

1	1. Define the Mole 1.2Describe molar mass Interconversion of Moles, mass, and number of species 1.2.1calculation of mass percent from the chemical formula 1.3Define empirical formulas 1.4 Define molecular formulas 1.5 Define combustion analysis 1.6 Explain chemical formulas and the structures of molecules that enable to determine the formula of an unknown compound	Lecture with notes Explain chemical formula , empirical etc Explain chemical formula and molecular Classroom resources	copper strip (15 x 1 cm) emery paper filter paper balance iodine xtals (0.3 g) boiling tube Bunsen burner Determine the formula of a compound from experimental data prepare a standard solution of dilute NaOH or HCl or similar	Carry out experiment on mole , molar mass and calculate the empirical formular of each.	Guide students on the practical aspect on mole, molar mass.	What is; molar mass Moles, mass, and number of species molecular formula empirical formula and calculate and molecular formulate formula of an unknown compound

	1.7 write chemical	structure of unknown				

2	equations and balance the equations. calculate amounts of reactant and	compound				Write a chemical equation for amounts of reactant and product from the stoichiometrically and balanced the reaction equation

	product from the stoichiometrically balanced reaction equation. 1.8 Calculate; Theoretical, Actual and Percentage Yields. 1.9 Express concentration in terms of reactant and product when the reaction has a limiting reagent 1.10 calculate: Theoretical, Actual and Percentage Yields. 1.11express concentration in terms of Molarity 1.112 Be able to perform interconversions of Mole-mass- number for species in solution 1113use stoichiometry of chemical reactions in solution	Lecture and give notes	Solid NaOH Water volumetric glassware burettes reference solutions			
General Objective 2.0: Understand the shapes of molecules of The Main Group Elements (VSEPR)						
3-5	2.1 depict 2.2 Use the octet rule molecules and ions by using Lewis Dot structures to write Lewis structures 3	Explain molecules and ions by using Lewis Dot structures Describe	Molecular models (or modelling materials such as clay and wooden rods)	Build models of Main group compounds by using VSEPR	Guide students	What is the octet rule molecules and ions using Lewis Dot structures write Lewis structures

	2.3 .Appreciate Resonance and delocalized electron-pair bonding. 2.4 Apply Valence Bond Electron Pair Repulsion Theory (VSEPR) to molecular shape (a) two electron groups - Linear, (b) three electron groups - Trigonal Planar, (c) four electron groups - tetrahedral, (d) five electron groups - Trigonal Bipyramidal, (e) six elecrton groups – Octahedral 2.5.Descibe bond polarity, bond angle and dipole moment Explain the effect of molecular polarity on behavior 2.7. Relate molecular shape and polarity to biological and drug receptors including the sense of smell	Resonance and delocalised electron-pair bonding. Explain the bond polarity, bond angle and dipole moment . and effect of molecular polarity on behavior Illustrate the effect of molecular shape and polarity to		rules Fit tetrahedral models to a simulated receptor (2D but with size and polarity regions mapped out)	Supervise students on how to fit tetrahedral models on size polarity region	Resonance and delocalised electron-pair bonding. What is the effect of bond polarity on bond angle and on dipole molecule State the effect of molecular shape on biological and drug receptors including the sense of the smell.

		biological and drug receptors including the sense of smell				
General Objective 3: Understand basic concepts in UV/Visible Spectroscopy						
6 7	3.1Describe where the UV region occurs in the electromegnetic spectrum 3.2Descibe where the visible region occurs in the electromagnetic spectrum 3.3Appreciate that UV and Visible radiation may be absorbed by molecules and promote electronic transitions. 3.4Explain electronic transitions by using Energy diagram 3.5 Differentiate types of elecrnonic transitions n-pi*, pi-pi* charge transfer , etc 3.6 Use the equation relating energy to wavelength be able to draw a block diagram of a UV/Vis spectrophotometer 3.7Know and be able to use the Beer Lambert equation	Explain the UV region in the electromegnetic spectrum where the visible region occurs in the electromagnetic spectrum Define electronic transitions by using Energy diagrams Explain the use of relating to wavelength Explain Beer	UV spectrometer chemicals. Chart paper or computer printer	Obtain a UV spectrum of a colourless conjugated organic molecule and determine the wavelength of maximum absorbance and the extinction Coefficient.	Ensure that students are working within the limitations of the beer Lambert Law and Guide them in the Laboratory	Explain the application of UV/Visible, and the use experimentally Diagrammatically describe electronic transitions energy Write out beer lambert equation

		Lambert equation					
General Objective 4: Understand the chemistry of some transition metal							
8-9	4.1Explain the meaning of a transition metal. 4.2Write the electronic configuration of transition metal of a given atomic number. 4.3Explain the characteristic properties of the transition metals viz: metallic character (physical and chemical)	Lecture by Explain the transition metalsb and Relate their properties to electronic configuration, ionization energies, bond energies etc;	Teaching board Periodic table accurate balance nitric, sulphuric and phosphoric acid	Obtain a UV spectrum of a range of coloured conjugated transition metal complexes and determine the wavelength of maximum absorbance and	Guide Students to properly perform same experiments in the laboratory	What are transition metals Explain the electronic configuration of a trasition metal of a given atomic number	

10-11	(a) variable valency (b) formation of co-ordination complex d) formation of coloured ions e)paramagnetism 4.4Relate the characteristic properties of the transition elements in 5.3 above to: (a) electronic configuration. (b) Atomic and ionic radio (c) Ionization energies (d) Lattice energies and bond energies e)Availability of vacant orbital for complex formation 4.5Relate the shapes of transition metal complexes to d-orbital symmetry rather than VSEPR 4.6Describe the properties of the following transition elements: Ti, V, Cr, Mn, Fe and their compounds. 4.7Explain the formation of alloys of steel. 4.8List the different types of alloys 4.9.List the uses of different	Explain the following electronic configuration. a).Atomic and ionic radio b).Ionization energies c).Lattice energies and bond energies	potassium periodate Bunsen burner UV / vis spectrophotometer potassium manganate VII gloves safety glasses	extinction coefficient for each Add CoCl2 to water and obtain UV spectrum note wavelength of absorbance and calculate extinction coefficient. Note colour and relate colour to absorption. Acidify with conc HC and repeat. Explain the change in terms of molecular shape. Determination the amount of manganese in a steel paper clip.		Write characteristic and properties of a transition metal; physical and chemical) (c) variable valency (d) formation of co-ordination complex d) formation of colored ions e) paramagnetic what is ionization energy lattice energy and bond energies Write formula of steel and different types of steel State uses of alloy steel and special type of alloy steel .

	types of alloys 4.10Describe the different types of steel Describe the special					
General Objective 5: Understand the chemistry of group VII elements						
12-13	5.1.List the halogens and describe the occurrence of halogens in nature. 5.2.Write the electronic configuration of the halogens 5.3 Describe the elemental forms of group VII elements 5.4 Describe the physical and chemical properties of fluorine, Chlorine, Bromine and iodine. 5.5Compare the acid strengths of the four elements above. 5.6 Describe the preparation and properties of oxy compounds of halogens, oxyacids of chlorine	Explain halogens and its occurrence Explain group V11 element and their physical and chemical properties	Glass wares chemicals	Prepare chlorine in the laboratory	Ensure students carry experiment on physical, chemical properties of group V11 element	What are halogen Describe the occurrence of halogens in nature. State the physical and chemical properties of group V11 elements
General Objectives: 6.0 Understand the extraction and reactivity of the main group elements (Na, Zn, Ca)						

	6.1 Describe the occurrence and extraction of the following main group metals, Na, Sn, Ca. 6.2Describe the reactivity of Na, Ca, Sn 6.3Describe the occurrence and extraction of the following main group metals A1 and Zn. 6.4Describe the reaction of Al and Zn.	Lecture and give note on the of the following main group metals, Na, Sn, Ca. reactivity of Na, Ca, Sn and the occurrence and their extractions	Classroom Materials Textbooks	Investigate the reactivity of Al and Zn	Guide students to investigate reactivity on Al and Zn H2O and dilute HCl alkyl halides	Explain the occurrence and extraction of , Na, Sn,Al State the reaction group of Al and Zn metals .

Course: Mechanics **Semester:** First	**Code:** STP 111 **Pre-requisite:**	**Total Hours: 2 Hours/Week** **Theoretical hours: 2Hours/Week** **Practical hours STP 114:** **(PRACTICAL FOR STP 111, 112 &113)** **CH: 2 CU=2**
GOAL: This course is designed to develop the students' understanding and application of basic concepts in Mechanics.		
GENERAL OBJECTIVES		
On completion of this module students should be able to:		
1	Understand rotational motion of rigid bodies.	
2	Understand the phenomenon of surface tension.	
3	Understand periodic motion.	
4	Understand the behaviour of fluids in motion.	

PROGRAMME: NATIONAL DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY						
COURSE TITLE: Mechanics		**COURSE CODE:** STP 111			**CONTACT HOURS: 4HRS/WEEK**	
COURSE SPECIFICATION: Theory			Practical		Practical: STP 114 **(PRACTICAL FOR STP 111, 112 &113)** **CH: 2 , CU=2**	
General Objective 1: Understand rotational motion of rigid bodies.						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
1 – 3	**Rotational Motion** 1.1 Explain the concept of the moment	Solve numerical problems using the expressions stated in 1.2.	Flywheel of standard pattern with wall support. Mass attached to a length of	Determine experimentally the moment of inertia of a	Describe the theoretical basis and guide the students to	Verify students' understanding by asking questions on (i)

	of inertia about an axis 1.2 State and Explain the expression for moment of inertia of the following: i) a rod ii) rectangular plate iii) ring iv) circular disc v) solid and hollow cylinders vi) a sphere 1.3 Explain radius of gyration 1.4 Calculate the radius of gyration for each of the bodies 1.5 Define Torque of a body about an axis. 1.6 Define angular momentum of a body about an axis. 1.7 Establish the relationship between torque τ and angular momentum (L) i.e. $\tau = \frac{dL}{dt}$		cord. Vernier Caliper, Stop clock/watch, Metre rule. Two heavy stands and clamps, two threaded corks, metre rule, brass rod, stop clock/watch.	flywheel. Determine the moment of inertia of a uniform rod using bifilar suspension.	perform experiment to (i) determine the moment of inertia of a flywheel and (ii) determine the moment of inertia of a uniform rod using bifilar suspension.	moment of inertia about an axis (ii) the determination of moment of inertia of a flywheel and (iii)the determination of moment of inertia of a uniform rod using a bifilar suspension.

	where t is time. 1.8 State the law of conservation of angular momentum. 1.9 Explain the reduction in speed of a rotating body when struck by a small mass applying the law of conservation of angular momentum. 1.10 Write and explain the expression for the kinetic energy of rotation of a rigid body. 1.11 Calculate moments of inertia about some axes of interest of the following, using the appropriate formulae e.g. - Uniform rod - Ring - Circular disc - Solid cylinder - Hollow cylinder - Sphere Rectangular plate.	Lecture and apply the expression in the calculation of kinetic energy and acceleration of rolling and sliding rigid bodies e.g. cylinder sphere, disc, ring etc. Solve some numerical problems and give assignment.	Lecture notes Reference texts Inclined plane Cylinder, sphere, disc Ring, uniform rod rectangular plate.			

General Objective 2: Understand the phenomenon of surface tension						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
4 – 6	2.1 Explain the phenomenon of surface tension 2.2 Explain the origin of surface tension using the molecular theory. 2.3 Define the coefficient of surface tension (stating its units). 2.4 Explain adhesive and cohesive forces. 2.5 Define angle of contact 2.6 Explain capillary action giving examples of everyday situation. 2.7 Explain the variation of surface tension with temperature. 2.8 Explain surface tension in terms of surface energy. 2.9 Relate surface tension to specific latent heat. 2.10 Calculate the surface tension of	Lecture Use examples e.g. water and mercury etc to illustrate adhesive and cohesive forces. Lecture Solve numerical problems and give assignment.	Water, mercury etc., Glass dish, Needle Tissue paper Beaker Water Tap Travelling Microscope set of glass capillary, beaker dilute nitric acid caustic soda solution distilled- water stand with clamp Torsion balance. Beaker containing a liquid, large bottle filled with dropping funnel, an outlet tube bent twice at right angles/ To the end of the tube is forced a length of tubing which is immersed to given depth in the liquid. A manometer filled with xylol, a travelling microscope.	Demonstrate the existence of surface tension Determine experimentally the surface tension of a liquid by capillary rise method using travelling microscope. Determine experimentally the surface tension of a liquid using a torsion balance. Demonstrate the variation of surface tension with temperature using Jaeger's method.	Use examples such as water from tap, floating of needle on surface of water etc to demonstrate the existence of surface tension. Describe the theoretical basis and guide students to perform experiments to (i) determine the surface tension of a liquid by capillary rise method using travelling microscope and (ii) determine the surface tension of a liquid using a torsion balance. Demonstrate the variation of	Short verbal questions on surface tension, co-efficient of surface tension, angle of contact and capillary action. Quiz on surface tension ant its relation to surface energy and temperature.

	soap solution and soap bubble using the appropriate equations.				surface tension with temperature using Jaeger's method.	
	General Objective 3: Understand periodic motion.					
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
7 - 9	**Periodic Motion** 3.1 Explain the following:- (i) periodic motion (ii) simple harmonic motion 3.2 List examples of systems performing simple harmonic motion 3.3 Define the parameters associated with simple harmonic motion (amplitude "a"; period T; angular velocity ω etc) 3.4 Explain the expression for the period of oscillation of the following :- i) a simple pendulum ii) compound pendulum	Apply the formula for the period of oscillation in 3.4 to solve some simple numerical problems.	For 3.4 (i) Knitting needle, metre rule with holes drilled at equal intervals, Stop clock/watch. For 3.4 (ii) Spiral spring, slotted weights, stop	Determine 'g' (acceleration due to gravity) experimentally using: i) compound pendulum ii)loaded spiral spring iii)loaded cantilever	Describe the theoretical basis, demonstrate and guide students to perform experiments to determine acceleration due to gravity (g) using (i) compound pendulum, (ii) loaded spiral spring and (iii) loaded cantilever.	Ask students in turn to identify systems in simple harmonic motion and establish relation between period and length of oscillator.

	iii) loaded elastic spring etc 3.5 Draw the graphs of potential energy, kinetic energy and total energy against distance from equilibrium position. 3.6 Calculate velocities of bodies in periodic and simple harmonic motion when other parameters are known.		clock/watch and retort stand. For 3.4 (iii) Loaded metre rule, G-clamp, stop clock/watch.			
	General Objective 4: Understand the behaviour of fluids in motion.					
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
10 -12	**Fluids in Motion** 4.1 Explain viscosity applying molecular theory 4.2 Define velocity gradient in a fluid 4.3 Distinguish between streamline and turbulent flow. 4.4 Explain Newton's formula for viscosity:- $F = \eta A \frac{dv}{dx}$ where F = frictional force in a liquid	Lecture				Ask students to: (i) distinguish between streamline and turbulent flow; (ii) explain terminal velocity and state the importance of viscosity in lubrication; (iii) solve numerical problems using Poiseulle's and terminal velocity

	η = coefficient of viscosity A = the area of liquid surface $\frac{dv}{dx}$ = velocity gradient between successive layers of the liquid. 4.5 Define coefficient of viscosity S stating the units. 4.6 State the expression for the steady flow of liquid through a pipe i.e. Poiseulle's formula: $Vol\ per\ \text{sec} = \frac{\pi p a^4}{8\eta L}$ where: π = a constant (3.14) P = pressure difference a = radius of tube L = length of tube η = coefficient of viscosity 4.7 Explain the motion of a small spherical body falling through a viscous fluid. 4.8 Explain terminal velocity 4.9 Explain stoke's law		Measuring cylinder with marks for distance, stop clock/watch. Steel sphere of different diameters, micrometer screw gauge, etc..	Determine experimentally the coefficient of viscosity of a low density liquid using porseuille's formula.	Describe the theoretical basis and guide students to perform experiments to (i) determine the coefficient of viscosity of a low density liquid using porseuille's formula; (ii) determine the terminal velocity of small ball bearings; (iii) investigate the variation of viscosity with temperature; (iv) determine the value of coefficient of viscosity of a liquid based on	formulae; and (iv) derive Bernoulli's equation and solve numerical problems using the equation.

	– $F = 6\pi\eta av$ where: F = frictional force in liquid v = terminal velocity a = radius of spherical ball π = a constant (3.14) η = coefficient of viscosity 4.10 Write the expression for the terminal velocity of a small spherical ball i.e. falling through a liquid column: $v_0 = \frac{2ga^2(\rho_s - \rho_l)}{9\eta}$ where: ρ_s = density of the ball bearing's material ρ_l = density of the liquid a = radius of the ball bearing g = acceleration due to gravitation η = coefficient of viscosity 4.11 Explain the importance of viscosity in		Set of long tubes of different diameters, short inlet tubes, outer jackets for tubes, number of small steel ball bearings of different diameters, stop watch/clock. Set of long tubes of different diameters, short inlet tubes, outer jackets for tube and stir, thermometer, number of small still ball bearings of different diameters, vernier callipers, stop clock/watch.	Determine experimentally the terminal velocity of small ball bearings. Demonstrate experimentally the variation of viscosity with temperature. Determine experimentally the value of the coefficient of viscosity of a	Poiseulle's formula; and (v) determine the viscosity of a high density liquid.	

13 - 15	lubrication. 4.12 Explain the effect of temperature on the viscosity of a liquid. 4.13 Derive Bernoulli's equation. $P + \frac{1}{2}\rho v^2 + \rho gh = constant$ where: p = pressure ρ = density h = elevation g = acceleration due to gravity 4.14 List some applications of Bernouli's principles e.g. action of filter pumps and carburetors etc. 4.15 State the dimensions of coefficient of viscosity. 4.16 Calculate the terminal velocity of steel balls or other bodies falling under gravity in liquids.		Cylindrical cylinder marked at different intervals, ball bearing, stop clock/watch, micrometer screw gauge.	liquid based on Poiseulle's formula. Use stoke's theorem to measure the viscosity of a liquid of high density.		

Assessment: Give details of assignments to be used:
Coursework/Assignments 10 %; Course test 20%; Practical 30 %; Examination 40 %

Recommended Textbooks & References:

(1) Advanced Level Physics by Nelkon and Parker
(2) Laboratory Manual of Physics by Tyler

Course: Heat Energy **Semester:** First	**Code:** STP 112 **Pre-requisite:**	**Total Hours: 1 Hours/Week** **Theoretical hours: 1Hours/Week** **Practical hours STP113:** **(PRACTICAL FOR STP 111, 112 &113)** **CH:2 CU: 2**
GOAL: This course is designed to develop the students' understanding and application of basic concepts in Heat Energy.		
GENERAL OBJECTIVES		
On completion of this module students should be able to :		
1	Construct and use different types of thermometers.	
2	Understand different methods of determining specific heat capacity and apply Newton's cooling correction.	
3	Understand the behaviour of gases in terms of atomic and molecular motions	
4	Understand the application of different modes of heat transfer.	

PROGRAMME: NATIONAL DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY						
COURSE TITLE: Heat Energy		**COURSE CODE:** STP 112			**CONTACT HOURS: 4HRS/WEEK**	
COURSE SPECIFICATION: Theory Practical					Practical: STP 114 **(PRACTICAL FOR STP 111, 112& 113)** **CH:2 CU=2**	
General Objective 1: Construct and use different types thermometers**.**						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
1 – 2	**Temperature** 1.1 Define temperature using concept of thermal equilibrium. 1.2 Define temperature in terms of thermometric properties, length of liquid column, pressure of a gas under constant pressure, resistance of a wire, e.m.f. of thermocouple, radiation from a hot body. 1.3 Define temperature scale: Celsius	Lecture with examples	Liquid in glass thermometers (choice of appropriate liquid). Resistance thermometer. Thermocouple Pyrometers Gas thermometer Clinical thermometers Minimum and maximum thermometers	Identify the different types of thermometers:- Liquid in glass thermometers (choice of appropriate liquid). Resistance thermometer. Thermocouple Pyrometers Gas thermometer Clinical thermometers Minimum and maximum	Provide different types of thermometers and first allow students to identify them using their previous knowledge of thermometry. Divide students into project groups for the work	Direct students to identify and explain the different types of thermometers and state their temperature ranges and practical applications for each.

3 - 6	scale; Kelvin scale; and ideal gas scale. 1.4 Convert Celsius to Kelvin scale. 1.5 Compare the ideal gas scales and other scales. 1.6 List the basic fixed points on the international temperature scales. 1.7 Describe the appropriate uses of thermometers in 1.2 above.		Glass blowing laboratory .Mercury, Capillary tube, mercury, copper and platinum wire. Hot and cold sources.	thermometers Construct and calibrate a liquid in glass thermometer resistance thermometer, Thermocouple and Gas Thermometers. Conduct experiment to ascertain the sensitivity of thermometers constructed by comparing with standard ones.	Divide students into groups for the work	
General Objective 2: Understand different methods of determining specific heat capacity and apply Newton's cooling correction.						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**- Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
7 – 9	2.1 State Newton's laws of cooling $\frac{d\theta}{dt} = Ks\ (\theta - \theta_0)$ where: θ = the body's temperature s = the area of the body's surface θ_0 = temperature of its surrounding K = cooling constant	Lecture	- Calorimeter - Heater - Thermometer - Stop Clock/Watch -Ammeter -Voltmeter - Source of EMF Calendar and Barnes apparatus. Stop Clock/Watch.	Determine specific heat capacity of solid and liquid using electrical methods. Determine specific capacity	Students should determine specific heat capacity of solid and liquid using electrical methods. Student should determine specific capacity	Direct students to state the factors which affect heat losses. Direct students to explain with the aid of an example how cooling correction is effected in measurements of quantity of heat.

10	2.2 Explain cooling corrections in measurements of quantity of heat.		Source of EMF. -Ammeter -Voltmeter - Resistance Thermometer. Thermometer Stirrer made of copper wire. Stop watch/clock Paraffin Beaker. Copper calorimeter provided with a lid and supported on corks inside a double walled vessel containing cold water between the walls.	of liquid by continuous flow method. Verify Newton's law of cooling experimentally	of liquid by continuous flow method. Students should verify Newton's law of cooling experimentally Apply cooling corrections in heat experiment. Note: (i) Supervise the practicals. (ii) Group the students for the purpose of the practicals. (iii) Demonstrate the experiment for the students before allowing them to work in groups	
General Objective 3: Understand the behaviour of gases in terms of atomic and molecular motions						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
11 - 12	**Kinetic Theory of**	Lecture		Demonstrate	Demonstrate	Ask students to state

	Gas 3.1 Define atom, molecule, Avogadro constant, relative molecular mass, mole, molar mass, molar volume and S.T.P 3.2 Differentiate between: (i) Number of moles; number of molecules and Avogadro's constant. (ii) Number of moles, mass of the gas and molar volume 3.3 State the assumptions of the kinetic theory of gases. 3.4 Explain Brownian motion 3.5 Explain Maxwellian distribution of velocities (quantitatively) 3.6 Explain the terms most probable		Boyles and Charles laws apparatus	Brownian Motion. Verify the gas laws experimentally.	Brownian motion by asking the students to watch the movement of dust or smoke particles. Demonstrate the use of Boyles and Charles laws apparatus before asking students to verify the laws using the apparatus.	the assumptions of the kinetic theory of gases and hence explain Brownian motion. Direct students to derive the formula for the pressure exerted by an ideal gas and use it to solve problems.

	speed, the mean speed and the mean square speed. 3.7 Derive the expression for the pressure exerted by an ideal gas as: $P = \frac{1}{3}\rho c^2$ where: P = Pressure ρ = density c^2 = mean square velocity 3.8 Relate the kinetic energy of a gas to its temperature. 3.9 Derive the equation of state of an ideal gas using the kinetic theory. 3.10 State Boyles and Charles laws. 3.11 Distinguish between real and ideal gas.					
General Objective 4: To understand the application of different modes of heat transfer.						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
13 - 15	4.1 Explain heat current. 4.2 Explain Thermal conductivity of a material.	Lecture	Standard form of Searle's apparatus with steam heater. Beaker, stop	Determine Thermal conductivity of copper using Searle's	The students Should determine Thermal conductivity of	Direct students to explain the difference between perfect absorber and perfect radiator.

	4.3 Explain Stefan's law of radiation. 4.4 Explain green house effect and its every day applications. 4.5 Explain black body radiation.		clock/watch callipers. Standard laboratory form of Lees' Disc apparatus, stop clock/watch and screw gauge.	method. Determine Thermal conductivity of ebonite by Lees' Disc method.	copper using Searle's method. Supervise conduction of the practical. Students should determine Thermal conductivity of ebonite by Lees' Disc method. Supervise conduction of the practical.	Ask students to give a brief description of a practical source of black body radiation.

Assessment:

Coursework/ Assignments 10 %; Course test 20 %; Practical 30 %; Examination 40 %

Recommended Textbooks & References:

(1) Advanced Level Physics by Nelkon and Parker
(2) Laboratory Manual of Physics by Tyler

Course: Electronic Logic for Science **Semester:** First	**Code:** STP 113 **Pre-requisite:**	**Total Hours: 4Hours/Week** **Theoretical hours: 2Hours/Week** **Practical hours STP 114:** **(PRACTICAL FOR STP 111, 112 & 113)** **CH:2 CU=2**
GOAL: This course is designed to introduce the students to the basics of Electronic Logic.		
GENERAL OBJECTIVES		
On completion of this module students should be able to :		
1	Understand binary, hexadecimal arithmetic and the coding scheme	
2	Know the fundamentals of Boolean algebra	
3	Know the basic logic gates and understand their operation and applications	

PROGRAMME: NATIONAL DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY						
COURSE TITLE: Electronic Logic for Science		**COURSE CODE:** STP 113/STP 114			**CONTACT HOURS: 4HRS/WEEK**	
COURSE SPECIFICATION: Theory			Practical		Practical: STP 114 **(PRACTICAL FOR STP 111, 112 & 113) 2 Hours/Week, CU=2**	
General Objective 1: Understand binary, hexadecimal arithmetic and the coding scheme						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
1 - 2	1.1 Convert binary to decimal and decimal to binary 1.2 Explain coding scheme	Explain the conversion from binary to decimal and decimal to binary numbers. Solve many examples and give assignments Explain binary bits,bytes,nibbles,	Classroom Resources			Ask students to solve problems involving conversion from binary to decimal to binary.

		word,Binary coded decimal(BCD)				Give assignment to distinguish between the coding scheme.
General Objective 2: Know the fundamentals of Boolean algebra						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
3 – 4 5 – 6 7 – 8 9	2.1 Explain the basic Boolean postulates 2.2Define truth table. 2.3 Construct truth table for up to four (4) variables. 2.4 Define karnaugh map (K-map). Construct a k-map for 2,3,4 variable. 2.5 Minimise a logic expression using a K-map	State an explain the commutative law, associative law, distributive law, identity law, negative law, De Morgan's theorem etc. Define truth table and construct truth table for up to four variables. Give assignments. Explain K-map and construct K-map for 2,3,4 variable. Give assignments. Minimize logic expression using a K-map	Classroom Resources			Ask students to state and explain some basic Boolean postulates. Give class assignment on the construction of truth table. Give home work to students to construct K-map for 2,3,4 variables Give assignment on maximization of logic expressions using a K-map.
General Objective 3: Know the basic logic gates and understand their operation and applications						
WEEK	**Specific Learning**	**Teachers Activities**	**Learning Resources**	**Specific**	**Teachers**	**Evaluation**

	Objective			**Learning Objective**	**Activities**	
10 – 11	3.1 List the basic logic function 3.2 Explain with the aid of symbols and truth tables the functions of the logic gates	List the basic logic functions OR, AND, NOT, NOR NAND, EXOR etc and explain with the aid of symbols and truth tables the functions of the gates.	Electrical switches, source of e.m.f, wire connectors, electric bulbs.	Construct circuits using electrical switches to illustrate OR and AND gates	Guide students on how to construct circuit using electrical switches to illustrate how the OR and AND gates operate	Ask students to explain the functions of the basic logic gates with the aid of symbols and truth table.
12	3.3 Describe the construction of the AND and OR gates using diodes.	Explain with the aid of circuit diagrams how the AND and OR gates can be constructed using diodes	Diodes, resistors, sources of e.m f	Demonstrate how diodes can be used implement the functions Y=AB,Y=A+B	Guide students on how to use AND,OR making use of diodes to implement the functions Y=AB,Y=A +B	Direct students to explain with the aid of circuit diagrams, diodes, resistors and sources of emf how AND and OR gates are constructed.
13	3.4 Convert Boolean expression to logic diagram.	Explain the conversion of Boolean expressions to logic diagrams.	Logic modules	Demonstrate the conversion of Boolean expression to logic diagram.	Use the logic modules to illustrate the conversion.	Give assignments on the conversion of Boolean expression to Logic diagrams.
14	3.5 Convert truth table to Boolean	Explain the conversion of a truth table to a Boolean	Logic modules	Demonstrate the conversion of a truth table	Demonstrate using logic modules	Give class assignment of conversion of

	expression	expression.		to a Boolean expression.		Boolean expression to truth table. Give
15	3.6 Convert logic diagram to a truth table.	Explain conversion of a logic diagram to a truth table.	Logic modules	Demonstrate the conversion of a logic diagram to a truth table	Demonstrate using logic modules	assignment on conversion of Logic diagrams to a truth table

Assessment: Give details of assignments to be used: Coursework/Assignments 10 %; Course tests 20 %; Practical 30 %; Examination 40 %

Recommended Textbooks & References: Principles of Electronics by T. Duncan

PROGRAMME: NATIONAL DIPLOMA					
COURSE: General Laboratory Techniques I		**COURSE CODE:** GLT 111		**Credit HOURS: 1 Theoretical: 1 hours/week Practical: hours /week 1**	
GOAL: this course is designed to provide students with knowledge and skill of maintenances of laboratory equipment					
COURSE SPECIFICATION: THEORETICAL CONTENT			**COURSE SPECIFICATION:** PRACTICAL CONTENT		
SEMEATER:	**Pre-requisite**				
	GENERAL OBJECTIVE : On completion of this course, the students should be able to: 1.0 Know the common laboratory hazards 2.0 Understand the basic safety rules in the laboratory 3.0 Understand Radiation 4.0 Know the use of laboratory ware and simple laboratory equipment 5.0 Understand the calibration of glass ware 6.0 Know the various uses of glass ware in the laboratory equipment 7.0 Know maintenance of laboratory balances				

	8.0 Understand the principles of application and maintenance of microscope 9.0 Know the maintenance of heating apparatus in the laboratory 10.0 Know the maintenance of cooling equipment in the laboratory 11.0 Know the maintenance of temperature measurement equipment 12.0 Understand microtomy and the maintenance of microtomy tools 13.0 Know basic electrical appliances 14.0 Understand the care and maintenance of audio-visual equipment 15.0

PROGRAMME: NATIONAL DIPLOMA				
COURSE: General Laboratory Techniques I		**COURSE CODE:** GLT 111	**Credit HOURS: 1** **Theoretical: 1 hours/week** **Practical: hours /week1**	
GOAL: This course is designed to introduce the students to the basic knowledge safety in laboratories and maintenance				
COURSE SPECIFICATION: THEORETICAL CONTENT:1 hr				
SEMEATER:	**Pre-requisite**			
	GENERAL OBJECTIVE : On completion of this course, the students should be able to: 16.0 Know the common laboratory hazards 17.0 Understand the basic safety rules in the laboratory 18.0 Understand Radiation 19.0 Know the use of laboratory ware and simple laboratory equipment 20.0 Understand the calibration of glass ware 21.0 Know the various uses of glass ware in the laboratory equipment 22.0 Know maintenance of laboratory balances 23.0 Understand the principles of application and maintenance of microscope 24.0 Know the maintenance of heating apparatus in the laboratory 25.0 Know the maintenance of cooling equipment in the laboratory 26.0 Know the maintenance of temperature measurement equipment 27.0 Understand microtomy and the maintenance of microtomy tools 28.0 Know basic electrical appliances			

	29.0 Understand the care and maintenance of audio-visual equipmen

PROGRAMME: HIGHER NATIONAL DIPLOMA						
COURSE: Insurance Module (i) Safety in the laboratory, and Module (ii) Care and maintenance of laboratory ware and equipment			**COURSE CODE:** GLT 111	**CONTACT HOUR: 1**		
GOAL: This course is designed to introduce the students to the basic knowledge safety in laboratories and maintenance of laboratory wares						
COURSE SPECIFICATION: THEORETICAL CONTENT				**COURSE SPECIFICATION: PRACTICAL CONTENT**		
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVE 1.0: Know the common laboratory hazards					
1	1.1 List different types of laboratory hazards: Electrical, chemical, fire, biological, mechanical etc. 1.2 Describe the nature and causes of the hazards in 1.1 above. 1.3 List examples of each of the types of hazards in 1.1 above. 1.4 Introduction to potential health and safety hazards 1.5 General Safety Laboratory Practice and specific remedies to 1.1 above. 1.6 Legislation related	Use question and answer techniques. Illustrate with examples. Use question and answer techniques. Series of Lectures and Presentation	Class room resources Hand gloves, Nose mask, and some other safety equipments Classroom Resources and some Safety gadget	The course will provide students with the basic knowledge required to work safely in a variety of science and technology-based workplace such as Laboratories or chemical manufacturing plants.	Teachers guide and supervise students	Explain types of hazards in laboratory. Give examples of the types of hazards Outline the legistlation related to chemical and biological works

	to chemical and biological work such as MHMIS system					
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 2.0: Understand the basic safety rules in the laboratory					
	2.1 List basic laboratory safety rules. 2.2 Display charts showing safety symbols and rules. 2.3 Interpret the symbols in 2.2 above. 2.4 Know the procedure for treating acid burns in the laboratory. 2.5 Examine the procedure of treating cases of inhalation or swallowing of toxic gases and liquids in the laboratory. 2.6 Classify fires. **2.7** Extinguish various types of fires using extinguishers. **2.8** Practice the procedure of treating burns from naked fire in the laboratory.	Demonstrate application Fix permanently in the laboratories. Use practical illustrations. Demonstrate how to flush water on the area affected. To illustrate how to use first aid in severe cases. Use colour coding on fire extinguishers to show different areas of	Laboratory safety wears and gears. Fire extinguishers. Tap water. First Aid Box Fire extinguisher Fire blanket Extinguishers sources of fire controlled. First Aid Box Hand gloves specimen preparation kit. Pieces of dry wood or plastic first aid box	Demonstrate how to use first aid in severe cases Demonstrate how to extinghish fire using different ways of quenching fires	Guide students to demonstrate how to treat sere cases of accidents in the laboratory Guide students to to demonstrate how to extinguish fire	Outline the safety rules and interprete symbols used in laboratories Demonstrate procedures for treating accidents in a laboratory Explain how to extinguish fire Explain microbial contamination in laboratories

	2.9 List possible sources of microbial contamination of laboratory workers. **2.10** Describe procedures to be adopted in the prevention of microbial contamination in the laboratory. **2.11** Describe first aid measures to be taken in case of microbial contamination in the laboratory. **2.12** Describe the procedure for treating electric shock in the laboratory. **2.13** Describe the precaution against electric shock in the laboratory. **2.14** List the content of the first aid box in the laboratory. **2.15** Describe and practice how to treat cuts and other minor injuries in the laboratory. **2.16** Describe and apply various methods of artificial respiration for the	application. Demonstrate how to extinguish different types of fires using sand, water, blanket and different types of extinguishers. Use the facilities in first aid box to demonstrate treatment. Use question and answer. Illustrate by use of hand gloves. Lecture with examples of actions to be taken Illustrate use of an insulator to remove victim from the electric source and use of first aid Refer to safety regulation first aid. Use question and answer format Use the facilities in the first aid box to demonstrate the treatment of injuries. Use students to		Demonstrate how to apply various methods	Expalin how to apply various methods of artificial respirations	Explain what is artificial

	injured in the laboratory e.g. mouth to mouths cardiac compression. **2.17** Describe the procedure for treating Acid/chemical spill in the laboratory importance of water tray/showers in chemistry laboratory.	demonstrate among themselves. illustrate the use of shower/water trays in the laboratory		of artificial respirations		respirations and the procedure for treating acid spill in laboratory
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	Refer to safety	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 3.0: Understand Radiation					
	3.1 Define Radiation 3.2 List and describe types of radiation e.g. x- ray, gamma ray etc. 3.3 Draw the electromagnetic wave length to show non-ionizing and ionizing	Define radiation Explain types of radiation Explain the	Sealed Radioactive source Unsealed radioactive sources			Explain ration List the sources of radiation Explain what is meant by sealed and unsealed radioactive sources

	radiation 3.4 List the sources of ionizing and non-ionising radiation. 3.5 Enumerate various types of radioactive sources e.g. uranium, thorium. 3.6 Explain and identify sealed and unsealed radioactive sources. 3.7 Define basic radiation terms such as radiation absorbed dose maximum permissible level etc	sources of ionizing and non ionizing raditions Illustrate with examples using charts etc				Define and give examples of radiation terms
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**		**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 4.0: Know the use of laboratory wares and simple lab. equipment					
	4.1 Identify the different types of laboratory glass wares e.g. beakers test tube, funnels, flask etc. 4.2 State the uses of different laboratory	Identify different laboratory wares. identification and sketch/illustration in the laboratory Laboratory	Beakers, burette, pipette, test tube etc. Water fittings, gas fittings, light fittings			Give uses of different laboratory wares

	wares in 4.1 4.3 Identify different types of fittings in the laboratory e.g. water, gas, light etc. 4.4 Identify the different types of grease and their application on joints. 4.5 Prepare cleaning reagents for laboratory wares. 4.6 Clean laboratory wares using cleansing agents. 4.7 Explain the uses of parcel on sintered glass, nickel and platinum. 4.8 Store laboratory wares. 4.9 Maintain laboratory wares. 4.10 Identify types of glass wares suitable for storage in the laboratory 4.11 Identify types of glass wares suitable as containers e.g. for storage of photo-sensitive reagents and some acids. 4.12 Identify other laboratory storage	identification Gets students involved in the preparation and use of cleansing agents. Explain cleaning of sintered glass ware using chromic water and organic advents. . Explain how to identify types of grease and their application on joints Explain how to identity types of glass wares suitable as containers for the storage of photosensitive reagents and acids	Grease, kipps apparatus condensers Containers, H_2SO_4, alcohol etc. Used or dirty sintered glass wares; cleansing agents, running tap water, washing bowls and detergents. Reagent bottle, amber, glass containers, plastics, ceramics	Prepare cleaning reagents for laboratory wares Store laboratory wares	Ghide studemts to prepare cleaning reagents Demonstrate how to store laboratory wares	Explain how to prepare cleaning agents in laboratories Explain the procedures of storing laboratory wares

	containers e.g. plastics and ceramics. 4.13 State the precautions necessary in the storage of chemicals e.g. Hydrofluoric acid in plastic containers, sodium metal in paraffin and silver nitrate in amber containers	Explain precautions measures adopted in storing some chemicals in plastic containers				
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**		**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 5.0: Understand the calibration of glass wares					
	5.1 Define calibration 5.2 Distinguish between calibration and graduation. 5.3 Explain the effect of heat on calibration of laboratory glass wares. **5.4** Record fluid levels of calibrated glass wares e.g. water level, mercury level. **5.5** Graduate simple laboratory glass wares using standards volumes.	Explain how to calibrate using burettes, pipette and standard flask. Explain effect of heat on calibration of glass wares Graduate simple glass wares using standards volumes	Sensitive balance, chromic acid still water weighing containers, thermometers etc. Water and mercury returned steels, burettes. Test tubes, clamps making pencils water etc.	Calibrate burettes, pipettes and standard flask Gruaduate simple laboratory glass ware	Guide students to calibrate burettes and standard flasks Show students how to graduate simple laboratory glass ware e.g. using the test tube	Explain how to calibirate burrets and standard flasks Outline the process of graduating simple laboratory glass waress
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 6.0: Know the maintenance of laboratory balances					
	6.1 Explain the working principles of the	Outline types of laboratory	Balances	use different balance to take weight of different	Guide students to use different	Explain how to weigh different

	laboratory balance. 6.2 Identify the various types of balance in use in the laboratory. 6.3 Distinguish between accuracy and prevision of a balance. 6.4 Determine the sensitivity of a balance. 6.5 Differentiate between analytical and top loading balances. 6.6 Explain how to use operation manuals of balances. 6.7 Explain the effect of shock, temperature, chemicals on the operation of balances. 6.8 Explain how to Re-calibration of balance using any Recalibration weight. 6.9 Identify the weight of substances using various balances. 6.10 Check balances to know when they require servicing	balances. Explain cleaning of balances. Explain sensitivity of a balance	Analytical balance Top loading balance, operation manuals. Top loading balance, Analytical balance, Standard masses	objects calibrate balances operates manuals of balances Re-calibration of balance using any Recalibration weight Install and test-run a balance. Troubleshoot a faulty balance, effect repairs or replacement of parts on a balance	balance to take weight of different objects Observe students to calibrate balances Supevise students operating manual balances Supervise the process Supervise how to install and test run a balance and troubleshoot a faulty balance	objects. Explain differences between accuracy and precision of a balance Explain the effect of shock and temperature on operation of balances Explain re-calibration of balances Explain the process of troubleshooting a faulty balance

	e.g. using standard masses.					
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 8.0: Understand the principles application and maintenance of microscope					
9	7.1 Identify a simple microscope and its parts 7.2 List the various types of microscope use in the laboratory. 7.3 Explain the use of various microscopes 7.4 State the ranges of magnification of microscope. 7.5 Outline the principles of operation of various types of microscope. 7.6 Explain the various procedures in the routine maintenance of microscopes.	Explain the functions of parts of a binocular microscope. Explain the function of the different parts of the microscope.	Simple microscope compound microscopes Dark-field microscope etc. Different types of microscope. Dirty microscope lens tissue Chamois leather Xy lens Lubricating oil.	Assemble various types of microscope e.g. Daylight, light, stereo, projector Clean optical lens with lens tissue Use XY paper sparingly where necessary Clean body with chamois cloth paper lubricate moving parts. Apply the various procedures in the routine maintenance of microscopes.	Guide students to assemble microscopes Guide students to perfome the activity in column 5 Guide students to perform routine maintenance of microscopes	Explain the uses of various microscopes State the ranges of magnification of microscopes Out line the steps carried out in routine maintenance of microscopes
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 8.0: Know the maintenance of heating apparatus in the laboratory					
	8.1 Identify the various heating apparatus like burners, hot plates, autoclave	Identify burners, heating mantles, water oil and sand baths heating oils	Burners, hot plate, autoclave, oven etc. Water bath			Identify various heating apparatus in a laboratory

	etc. 8.2 Describe the application of each type in 8.1 Above. 8.3 Explain how to heat water and other liquids, powder etc. using Bunsen burner, hot plates etc. 8.4 Explain how to sterilize various objects using autoclave. Heat and dry various objects using oven. 8.5 Describe the various procedures in the routine maintenance and minor repairs of autoclave, oven and other	etc. Explain principle and uses of the each above. Use portable autoclave and oven to sterilize some used glass wares. Student to note and submit a description of the demonstration exercise. Calibrate an autoclave	heating mantle gas supply etc Portable autoclave oven	Heat water and other liquids, powder etc. using Bunsen burner, hot plates etc Sterilize various objects using autoclave. Heat and dry various objects using oven Apply the various procedures in the routine maintenance and minor repairs of autoclave, oven and others	Supervise the activity in column 5 Guide students to sterilize objects Supervise students to carry out routine maintenance of autoclaves, oven etc	Enumerate the uses of the heating apparatus Explain how to sterilize objects using oven and autoclave
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 9.0: Know the maintenance of cooling equipment in the laboratory					
	9.1 Identify apparatus for cooling e.g. refrigerator, freeze drier, water circulators, ice making machine etc. 9.2 Explain the principle of	Explain how to identify apparatus for cooling Explain the principle of	Refrigerator Freeze drier ice making machine etc.			Explain the principles of freezing Explain the different

	freezing. 9.3 Explain the different application of cooling system in 9.1 above 9.4 Identify the various parts of the apparatus in 9.1 above. 9.5 Describe the procedure for the routine maintenance and minor repair of the apparatus in 9.1 above.	freezing Explain the process of routine maintenance of the apparatus in 9.1		Apply the procedures for the routine maintenance and minor repair of the apparatus in 10.1 above.	Guide students to carry out the maintenace	application of cooling system i
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 10.0: Know the maintenance of temperature measurement equipment					
	10.1 Identify apparatus for temperature measurement e.g. thermometer, pyrometers, thermocouples. 10.2 Explain the operating principles of temperature measuring devices listed in 10.1 above. 10.3 Distinguish between the various temperature scales e.g. Fahrenheit, Kelvin, Celsius etc	Explain how to identify measuring equipment Outline the operating principles of temperature measuring devices Explain temperature scales Explain how to	Thermometer Thermocouples pyrometers etc Water basin burner thermometer etc	Measure temperature stating result in various units	Guide students to measure temperatures	Convert temperature measurement into various scales Distinquish between the different types of temperature scales

	10.4 Measure temperature stating result in various units listed in 10.3 above 10.5 Describe the procedure for the routine maintenance and minor repair of the apparatus identified in 10.1 above	Measure memperature stating result in various units listed in 10.3 above				
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 11.0: Understand microtomy and the maintenance of microtomy tools					
	11.1 Identify different types of microtomes. 11.2 Identify the different parts of microtomes and explain their functions. 11.3 Explain the working principles of microtomes. 11.4 Identify types of knives used in microtomes. 11.5 Explain how to sharpen microtone knives. 11.6 Describe wax	Identify different types of microtomes e.g. rocking Rotatory sledge sliding etc. Show how to identify the parts of microtomes Explain the working principles of microtomes Explain how to Sharpen microtome knife Lecture describe	Rocking, microtome Rotatory sledge microtome etc. Microtome knives. Sharpening some wax tissue. Honing and stropping tools.	sharpen microtone knives prepare an embedment of	Guide students to sharpen microtome knives	Describe parts of a microtome Describe wax embedded tissue

	embedded tissue. 11.7 Cut sections 11.8 Identify faults in section cutting and explain how to remedy the faults. 11.9 Explain the care of microtomes and knives.	how to prepare an embedment of plant or animal tissue.		plant or animal tissue and section the embedded tissue using one of the microtomes above	Guide students to prpare plant and animal tissues and section them using microtome knives	
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 12.0: Know basic electrical appliances					
	12.1 Explain the following terms. Alternative current and direct current supplies. Low tension and high tension. 12.2 List one example of the sources or supply listed in 12.1 above. 12.3 Identify various types of distribution and connection. 12.4 Identify the standard colour code. 12.5 Explain the result of wrong wiring. 12.6 Identify the different types of wiring.	Explain the terms explain colour coded wires and resistors Explain how to construct with S.P.D.T., D.P.S.T. wirings. Explain the methods and importance of	Dry cell Generating set NEPA Colour code Charts Fuses Relays Cut out etc. S.P.D.T. and D.P.S.T. switches relays etc. Switches, relays, wires, bulbs, sockets etc. Symbols chart Display charts of electrical components	Construct with S.P.D.T., D.P.S.T. wirings and test (i) with fuse on (ii) without fuse	Illustrate how to construct with S.P.D.T., D.P.S.T. wirings	Explain the following terms. Alternative current and direct current supplies. Low tension and high tensio Explain types of distribution and connections Explain method of proper earthing

	12.7 Explain the methods and importance of proper earthing. 12.8 Explain how to identify different types of switches single pull double throw (SPDT), Double pull single throw (DPST) control gear, relays, cut outs etc. 12.9 Identify different types of protective devices e.g. relays cut outs fuses etc. 12.10 Draw symbols of electrical component. **12.11** Identify such symbols in 12.10 above in circuit diagram.	proper earthing identify different types of switches Identify different types of protective devices Explain electrical component symbol representation				
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 13.0: Understand the care and maintenance of audio-visual equipment					
	13.1 Describe the methods of routine maintenance of (i) overhead projectors (ii) lenses, recording and playback heads of tape recorders and compact disc. 13.2 Undertake proper	Describe the methods of routine maintenance of (i) overhead projectors (ii) lenses, recording and playback heads of tape recorders and	Tape recorders Overhead projectors, lenses compact disks	Clean lens Screen, body etc.	Guide students to carry out the cleaning	Explain the process of cleaning of audio visual equipment

	care and routine maintenance of th items listed in 13.1 above mend tapes and films.	compact disc.				

Assessment:
Coursework/ Assignments 1 0 %; Practical 40 %; Examination 50 %
Recommended Textbooks & References:-
General Laboratory Techniques for beginner Professional by Ibe, Colman Chikwem 20

Course: Cell Biology	**Code:** STB 121	**Total Hours: 2 Hours/Week**
		Theoretical hours: 2 Hours/Week
Semester: FIRST	**Pre-requisite:**	**Practical hours STB 123: (PRACTICAL FOR STP 121, 122 &) CH: 2 CU=3**

Goal: This course is intended to provide students with in depth knowledge of cells structures and their functions.	
GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Know cell as the basic unit of life
2	Know the composition of the nucleus and cytoplasm of the cell
3	Know the different types of cell division and their significance
4	Understand Chemical reactions in a cell
5	Know the different types of specialized cells and their functions
6	Understand the process of photosynthesis
7	Understand the process of respiration
8	Understand the process of Transpiration
9	Understand the process of translocation in plant
10	Know the process of ion and water absorption in plants
11	Appreciate the process of growth

12	Understand movement in plants

	Course: Insurance National Diploma	**Course Code:**			**Credit Hours:**	
	Cell Biology	STB 121			**Theoretical: 2 hours/week**	
	Year: Semester: SECOND	**Pre-requisite:**			**Practical STB 123: (Practical for STP 121&122) CH: 2 CU=3**	
	Theoretical Content			**Practical Content**		
	General Objective 1 Understand the cell as the basic unit of life					
Week /s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1	1.1 .Explain the cell as a unit of Life. 1.2 Describe the cell theory 1.3. Describe cell inclusions and organelles. 1.3 Explain the functions of cell organelles in 1.3 above. 1.4 Differentiate between prokaryotic and eukaryotic cells. 1.5 Differentiate between animal and plant cells.	Explain the structure and types of the cell	White board and marker, Video films, monographs Microscope	Draw single celled animal and plants under the microscope; Amoeba, paramecium, plasmodium, chlamydomonas, chlorella, Spirogyra. Observe and draw samples of plant and animal cells from appropriate sources, under the microscope viz, cheek cells, blood cells, epidermis of *Allium cepa*,	Supervise microscopic examinations Guide students to identify the different types of cell	State the cell theory Explain the differences between the prokaryotic and eukaryotic cells Draw the plant and animal cells as seen under the electron microscope
2	1.6 Describe the effects of hypertonic, hypotonic and isotonic solutions on the cell plasma	Explain hypertonic, hypotonic and isotonic solutions	White board and marker, Video films,	Examine different cells and cell inclusions	Guide students to observe the effect of hypertonic	Explain the difference between hypertonic and

			monographs Microscope	Observation of the effect of hypertonic isotonic and hypertonic solution on cell plasma	isotonic and hypertonic solution on cell plasma	hypotonic solutions
General Objectives 2 Know the composition of the nucleus and cytoplasm of the cell						
3	2.1. Describe the structure and functions of the components of cell nucleus. 2.2 Describe the structure and functions of DNA and RNA and differences and significance of DNA and RNA in protein synthesis 2.2 Explain the building blocks of nucleic acid (nucleotides), sugar, phosphoric acid. 2.3 Describe the biochemical components of the cytoplasm and the nucleus. 2.4 Describe the replication of the DNA molecules and significance of the replication. 2.5 Explain the role of the RNA in protein synthesis.	Lecture with demonstration. Describe the component of cell nucleus, structures of DNA, RNA. Explain the building blocks of sugar and protein	Prepared slides of DNA and RNA Electron Micrograph	Draw the cytoplasm and its components as revealed by an electron micrograph. Draw Deoxyribonucleic acid(DNA) and Ribonucleic acid(RNA)	Guide students to draw the cytoplasm and organelles as seen on the micrograph Deoxyribonucleic acid(DNA) and Ribonucleic acid(RNA) from the prepared slides under the microscope	Draw the components of the cytoplasm. State the functions of cell organelles, DNA and RNA
	General Objective 3: Know the different types of cell division and their significance					
4	3.1. Define cell division 3.2. Describe various types of cell divisions 3.3. Define mitosis 3.4. Describe the stages of mitotic divisions.	explain the significance of mitotic divisions	Motion pictures charts Prepared slides Microscopes	Draw different stages of mitosis shown by root tips of onion (*Allium cepa*) under the microscope.	Guide students to observe and draw different stages of mitosis shown by root tips of onion (*Allium cepa*) under the microscope	Draw and label the stages of mitosis

					Demonstrations	
5	3.5.Define meiosis 3.5.Describe the stages of meiotic divisions 3.6.Compare and contrast mitotic and meiotic divisions 3.7.Explain the significance of mitotic and meiotic divisions to plant and animals	Explain the significance of meiotic division	Motion pictures charts Prepared slides Microscopes	Draw different stages of meiosis under the microscopes	Supervise microscopic examinations	Draw and label the stages of meiosis
	General Objective 4: Understand Chemical reactions in a Cell					
6	4.1.Mention the different chemical Reactions in the cell 4.2.Explain the importance of hydrogen ions concentration (pH), buffers, crystalloids, colloids suspension to cell. 4.3. Explain the importance of water to normal life functioning 4.4.List the chemical substances (organic and inorganic in the cell e.g. enzymes of biological importance. 4.5.Explain the role of the following components in the cell: (a) carbohydrates (b) lipids (c) Proteins (d) Ribonucleic acid.	Discuss the various components of the cells as listed in 4.2 their chemical structure, Explain the Importance of water to normal life functioning Explain the units of protein	Charts and standard texts. White board and marker Enzymes Buffers	Investigate effects of different pH values on solubility of proteins Measure enzyme activity at different pH values Prepare simple buffer	Guide students to carry out the different experiments	Draw the structure simple sugars
7	4.6. Describe the chemical structure of carbohydrates: simple sugar, monosaccharides, disaccharides, polysaccharides. 4.7. Describe the basic unit of proteins its structures and function.	Explain the differences between the phospholipids, RNA and DNA	Alcohol, peas, meat, tendrils, blender	Extract DNA from split peas or any other plant or animal source	Guide students to carry out the different experiments	Draw the structure of RNA DNA glycerides and fatty acid

	4.8. Explain glycerides and fatty acid groups as the two major building blocks of fat 4.9. Explain phospholipids.					
	General Objective 5: Know the different types of specialized cells and their functions					
8	5.1. List various types of cells e.g. meristematic cells, parenchyma, sclerenchyma, collenchyma, bone marrows, blood and bone cells, etc. 5.2.Define tissue. 5.3.Describe the structure and composition of the following tissue:- brain, bone, blood, e.t.c and vascular bundles in plants. 5.4.List the functions of the various tissues describes above.	Explain tissues, structure and functions of various tissues Describe meristematic cells, parenchyma, sclerenchyma, collenchyma, bone marrows, blood and bone cells	White board and marker	Examine slides of plants and animals tissue under the microscope Identify the location of the above cells in the body.	Guide students to carry out the different experiments	Draw and label different types of tissues List their functions
	7.1. Explain the process of respiration with relevant equation. 7.2. List the differences between aerobic and anaerobic respiration. 7.3. Describe the process of Glycolysis. 7.4. Explain the net ATP produced during glycolysis. 7.5. Explain the process of Krebs and citric acid cycle 7.6. List the net ATP produced during Krebs CYCLE 7.7. Compare the ATP produced in Glycolysis with the produced in Kreb's cycle.	Explain the process of respiration with relevant equation. The differences between aerobic and anaerobic respiration. And the process of Glycolysis.	White board and marker, charts, Lime water respirometer seeds and green plants	illustration on the ATP generation during glycolysis and Kreb and citric acid cycles Show experimentally that germinating seeds producing heat Show experimentally that carbon	Guide students to carry out experiments Germination of seeds showing production of heat and carbon dioxide	Describe the process of respiration and the factors affecting respiration. Compare ATP generation during glycolysis and Kreb cycle

	7.8. Explain the role of the mitochondrion in respiration. 7.9. Compare tissue respiration with fermentation. 7.10. List and explain the factors affecting respiration			dioxide is produced by green plants during respiration		
General Objective 6: Understand the process of photosynthesis						
9	6.1 Explain with relevant equations, the process of photosynthesis 6.2. Describe the structure of the chloroplast. 6.3. Explain the importance of the stoma and gramma in chloroplast.	Discuss photosynthesis, its importance and factors affecting photosynthesis	White board and marker, charts, Green leave, iodine solution, Bell jar plants, lights candle	Separate pigments using chromatographic Methods. Carry out experiment to show the presence of starch in leaf Demonstrate that plant will grow in an atmosphere that has been depleted of oxygen	Supervise students to carry out the experiments	Preserve selected samples of Gymnosperms (e.g. *Cycas revolute*), monocotyledons (e.g. Guinea grass, maize, palms etc) and Dicotyledons (e.g. *Hibiscus, Crotolaria, citrus, tridax,* mangoes, Cashews etc).
	General Objectives 7: Understand the process of Transpiration					
11	7.1. Define transpiration in plants. 7.2. List types of transpiration in plants. 7.3. Differentiate between transpiration and guttation 7.4. Explain the mechanism of stomata movement in plants 7.5. Explain the importance of transpiration to plants. 7.6. Explain the factors affecting transpiration	Explain transpiration in plants and its importance. Explain mechanism of stomata movement	White board and marker, charts, Green plant, photometer	Measure the rate of transpiration in plants by using a photometer	Supervise students to measure the rate of transpiration in plants	Explain transpiration and its importance in the plants Describe the factors affecting transpiration in the environment

	in plants					
General Objectives 8 Understand the process of translocation in plants						
12	8.1 Explain the process of translocation in plants. 8.2. List evidences to support translocation through the phloem. 8.3. Draw the structure of the phloem in relation to translocation. 8.4. Explain the mechanism of translocation in relation to the cytoplasmic streaming, pressure mass flow theory and active transport. 8.5. Explain factors affecting translocation.	Discuss the mechanism of translocation in plants and outline the substances translocated in plants Viz nutrients, hormones and alkaloids	Healthy growing young plants e.g. mango Hcl, Fehlings solution A and B	Investigate translocation by using dyes, Carry out experiments to show that translocation takes place through the phloem	Guide the students to carry out experiment on translocation in plants	Enumerate the importance of translocation in plants
General Objectives 9.0: Know the process of ion and water absorption in plants						
13	9.1. List ions that are important to plant. 9.2. Explain the mechanism of ion absorption in plants 9.3. List factors affecting ion absorption plants. 9.4. Explain diagrammatically the path of water movement from the root hairs to the endodermis. 9.5.Explain various theories to support water movement up to the leaf e.g. root pressure and transpirational pull	Explain the process of ion absorption in plants and mention the ions that are essential to plants	White board and marker	Grow plants in the presence and absence of essential ions Investigate the movement of water from the root hairs to the endodermis in plants	Supervises students to carry out the experiments on ion absorption	Describe the process of ion absorption in plants State the various theories that support the water movement from the root hairs up to the leaf
General Objectives 10: Understand the process of growth						
14	10.1. Define growth. 10.2. Explain the growth regions and	Explain growth, the growth	White board and marker,	Measure the height increase of a whole	students to carry out the	Describe growth and phases of

	phases of growth 10.3. List the parameters used to assess growth e.g. dry weight, fresh weight, leaf area etc. 10.4. Enumerate factors affecting growth.	regions and phases of growth Describe parameters used to assess growth and the factors affecting growth.	leaf samples auxanometer	stem using auxanometer Determine the weight of organisms by dry-weight method	experiments on growth	growth. Mention the parameters used to measure growth. Explain the factors affecting growth
General Objectives 11 Understand movement in plants						
15	11, 1.Define movement. 11.2. List the two main types of movements in plants, locomotion and that of curvature. 11.3. Explain the various kinds of movements e.g. Tropism, Taxism etc. 11.4. Explain conditions necessary for movements in plants. 11.5 Explain experimentally, phototropism, geotropism, hydrotropism, chemo tropism, and thermo tropism in plants. 12.6. Explain auxins and the role in plant movement.	Explain movement, the various kinds of movements and the conditions necessary for movements in plants. Discuss the role of auxins in plant movement	White board and marker, Potted plants, Cellophane, small block wood, an evenly lit room	Determine the response of plant to light and to gravity	Supervise the students to carry out experiments on phototropism, geotropism, hydrotropism, chemo tropism, and thermo tropism in plants	Describe movement and types of movement Explain the conditions necessary for movement. Explain the role of auxins in plant movement

ORGANIC CHEMISTRY I

GOAL: The course is designed to provide students with knowledge of chemical properties, preparations and uses of mono substituted aliphatic hydrocarbons

General Objectives

1. Understand the classification of organic compounds
2. Understand bonding reactions and application of aliphatic hydrocarbons
3. Know the chemical properties, preparations and uses of mono substituted aliphatic hydrocarbons

4. Understand the general methods of petroleum refining

	National Diploma	**Course Code: STC 121**		**Credit Hours: 2**	
	Organic Chemistry I &PRACTICALS			**Theoretical: 2 hours/week**	
	Year: Semester:	**Pre-requisite:**		**Practical hours STC 121: (PRACTICAL FOR STC 121,122 &123) CH: 2 CU=2**	
	Theoretical Content		**Practical Content**		
	General Objective 1.0 Understand the classification of organic compounds				
Weeks	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1	1.1 Classify organic compounds by functional groups. 1.2 Explain homologous series with examples 1.3 State the members of a homologous series and their physical properties. 1.4 Define the functional group. 1.5 Identify functional groups in alkanols, alkanals, alkanones, armines, alkanoic, acids, phenols, nitriles ethers, esters, amides etc. 1.6 Draw structures for the functional groups in 1.5 above. 1.7 Understand that Infra Red spectroscopy used to	Classify organic compounds by functional groups. 1.10 Explain homologous series with examples 1.11 State the members of a homologous series and their physical properties. 1.12 Define the functional group. 1.13 Identify	Instrumentation resources Chemicals test tubes IR instrument	Determine qualitatively the elements present in an organic compound. Identify functional groups in organic compounds via qualitative chemical tests (reactions) Give the students tables of	Guide and supervise students	Mention major classification of organic compounds by functional groups. What are homologous series with examples States functional groups of the following compounds; alkanols, alkanals, alkanones, armines, alkanoic, acids, phenols, nitriles ethers, esters, amides,and raw their structures

	i) identify functional groups in an organic compound to the end: 1.7 Explain the properties of light, including frequency, wavelength and energy 1.8 Discuss the electromagnetic spectrum 1.9 Relate the energy associated with the IR region of the electromagnetic spectrum to molecular stretching, vibrations and rotation. 1.10. Relate the energy of absorption to the different functional groups.	functional groups in alkanols, alkanals, alkanones, armines, alkanoic, acids, phenols, nitriles ethers, esters, amides etc. 1.14 Draw structures for the functional groups in 1.5 above. 1.7 Understand that Infra Red spectroscopy used to	.	characteristic stretching frequencies	Guide students on the of IR in identifying functional group compound ,	Mention the principles of IR in identifying functional group What is electromagnetism in relation to molecular stretching, vibrations and rotation. Outline the energy associated with the IR region of the electromagnetic spectrum to molecular stretching, vibrations and rotation.

		Describe functional group etc. Describe properties of light, including frequency, wavelength Explain the electromagnetic spectrum to molecular stretching, vibrations and rotation.				

General Objective 2.0 Understand bonding: reactions and application of aliphatic hydrocarbon						
2 **3**	2.1Explain the bonding in carbon atom as 2.2Name alkanes by using the IUPAC nomenclature 2.3List the industrial uses of alkanes. 2.4 List natural sources of alkanes 2.5State the general formula, CnH2n to represent alkenes 2.6Explain the bonding in carbon atom as Sp^2 hybridized in alkene 2.7Explain the existence of cis-trans isomerism in alkenes. 2.8Draw cis-trans isomeric structures as in butene. 2.9 Use IUPAC nomenclature to name alkenes represent the addition reactions of simple alkenes by means of chemical equation e.g. with Br_2 HBr and H_2. 2.10.Undrestand the use of curly arrows to represent reaction mechanisms 2.11Use curly arrows to show the mechanism of the above addition reactions of alkenes	Lectures with comprehensive notes	Classroom resources Glassware Chemicals (bromine or bromine water, cyclohexene, or similar Solvents styrene dodecanoyl peroide toluene, balance, source of hot water Acetanilide may be made impur by adding small amounts of	Use IR specroscopy to identify functional groups in unknown organic compounds and to identify organic compounds from a list of possibilities Laboratory Procedures on	Teacher guides and supervises students in the laboratory Teacher guides and supervises students in the laboratory	Describe bonding in carbon as Sp^3 hybridized in alkane, and state the general formula, CnH2n+2 to represent alkanes What are natural sources of alkene Structurally show the cis-trans isomeric structures of butane and the use of curly arrows to represent reaction mechanisms

4	2.11Explain the use of alkenes in the production of polymers e.g. PVC, polyethene polystyrene etc 2.12Explain that the carbon in alkynes is Sp hybridized. Represent the addition reaction of alkynes by means of simple equation e.g. reaction with H_2. Br_2 and HBr.. 2.13.Describe chemical tests for the unsaturation in alkenes and alkynes. 2.14 Describe the industrial uses of alkynes e.g. production of oxyacetylene flame, production of vinyl chloride in the production of polymers	Explain the use of alkenes in the production of polymers e.g. PVC, polyethene polystyrene Explain the chemical tests for the unsaturation in alkenes and alkynes and the industrial uses of alkynes e.g. production of oxyacetylene flame, production of vinyl chloride in the production of polymers	Bismark brown and it recrystallises well from water	production of polymers Carry out chemical test on unsaturated alkene and alkyenes	Guide student on chemical test on alkene and alkynes and related compound	Mention the use of alkenes and enumerate the preparation of alkene in laboratory Write structure and reaction of alkynes by means of simple equation e.g. reaction with H_2. Br_2 and HBr.. Write chemical tests for the unsaturation alkenes and alkynes. Enumerate the industrial uses of alkynes e.g. production of oxyacetylene flame, production of vinyl chloride in the production of polymers
General Objective 3.0 Know the: Chemical properties, preparations and uses of monosubstituted aliphatic hydrocarbons						

5	3.1State the functional group of alkanol as – OH 3.2 State the general formula of alkanols as ROH. 3.3Apply the IUPAC system in naming monohydric alkanols. Illustrat 3.4 Outline the methods of preparation of monohydric alkanols. 3.5Describe the physical properties of alkanols 3.6 Describe each of the following reactions of monohydric alkanol: esterification; dehydration; oxidation; and alkoxide formation 3.7Use curly arrows to show the mechanism of dehydration and reaction of an alcohol with an acyl chloride. Specify the conditions for the reactions in 3.7 above.	Explain the functional group of alkanol as – OH 3.2 State the general formula of alkanols as ROH and Apply the IUPAC system in naming monohydric alkanols. Illustrate isomerism Explain the following reactions; monohydric alkanol: esterification; dehydration; oxidation; and alkoxide formation	Cyclohexan ol, or alcohol, sulphuric acid, source of heating, Textbooks and classroom resources	Either :Carry out the experimental dehydration of cyclohexanol (or similar) by using concentrated sulphuric acid and heat. Or: Carry out hydration of cyclohexene or similar by using dilute sulphuric acid Purify isopropanol by distillation (use a heating mantle) and identify the product by its boiling point	Supervise, guide students and explain reactions	Write functional group of alkanol as – OH 3.2 and state the general formula of alkanols as ROH. Write out laboratory preparation of monohydric alkanols, and physical properties of alkanols Write equation on the formation of the following compounds; monohydric alkanol: esterification; dehydration; oxidation; and alkoxide formation
6	3.8Explain that alkanol could be mono or polyhydric. 3.8.1Classify alkanols as 1^o, 2^o and 3^o alkanols.	Describe that alkanol could be mono or polyhydric. 3.8.1Classify alkanols as 1^o,		Prepare n-octane from 1-bromooctane via the Grignard reaction.	identify the	Write the general formula of alkanols as ROH and state the IUPAC system in naming monohydric alkanols. Illustrate isomerism

General Objective 4.0 Understand the general methods of petroleum refining						
14-15	4.1Outline the origin of petroleum 4.2State the types of crude oil in terms of specific gravity or nature of hydrocarbon present. 4.3Outline the constituents of crude oil. 4.4Describe following refining processes:- Seperation processes: (i) Fractional distillation (iii) Vaccum distillation (iv) (v) Solvent extraction (vi) Absorption b) Conversion processes: (i) hydrotreating (ii) catalytic refining (iii) catalytic cracking 4.5 List the products obtained from primary distillation of crude oil. I}Gas fraction, ii)naphtha fraction, iii)kerosene fraction, light gas, iv) oil heavy gas v)oil residue.	Explain the origin of petroleum, types of crude oil in terms of specific gravity or nature of hydrocarbon present and constituents of crude oil. (ii) Explain the the following separation techniques Fractional distillation (vii) Vaccum distillation (viii) (ix) Solvent extraction (x) Absorption c) Conversion processes: (i) hydrotreating (ii) catalytic refining (iii) catalytic cracking 4.6 and the product	Blackboard Chalk duster Catalyst (Al2O3, or broken unglazed porcelain or pumice or zeolite) higher alkanes (Vaseline etc) test tubes, rubber bungs, Bunsen Burner	Cracking Alkanes	Supervise and guide students in the laboratory and explain safety requirements during the the experiment	Enumerate origin of crude oil and mention type of crude oil in terms of specific gravity or nature of the hydrocarbon present and their constituent Write short note on the following techniques; (iii) Fractional distillation (xi) Vaccum distillation (xii) (xiii) Solvent extraction (xiv) Absorption d) Conversion processes: (i) hydrotreating (ii) catalytic refining (iii) catalytic cracking state the product of distillation process of ;i)Gas fraction, ii)naphtha fraction, iii)kerosene fraction, light gas, iv) oil heavy gas v)oil residue.

		obtained from primary distillation of crude oil. I}Gas fraction, ii)naphtha fraction, iii)kerosene fraction, light gas, iv) oil heavy gas v)oil residue.				

Assessment: Coursework/ Assignments 10 %; Practical 40% Examination 50%

Recommended Textbooks & References: Organic Chemistry by McMurray. 6th edition. Thompson/Brooks-Cole.

Classic Chemistry Experiments published by The Royal Society of Chemistry (UK) and free on the internet at http://www.chemsoc.org/networks/learnnet/classic_exp.htm

Salters Advanced Chemistry Activities and Assessment Pack published by Heinemann Chemistry by M.J. Sienko and R.A. Plane (Mc Graw Hill) Chemistry (The Molecular Nature of Matter and Change) by M.S. Silberberg published by Mc Graw Hill Small scale synthesis by M.Zanger and J.R.McKee published by Wm.C.Brown

	Department/ Programme: National Diploma	**Course Code:122 & 123**		**Credit Hours**:2
	Subject/Course: **Physical Chemistry**	 STC 122 &STC123		**Theoretical: hours/week**
	Year: ND I Semester: 2	**Pre-requisite:**		**Practical hours STC 121:** **(PRACTICAL FOR STC 121,122 &123) CH: 2 CU=2**

General Objectives

The course is designed to provide students with basic knowledge the relationship between energy distribution within a reacting system and the factors that affect rate ofreaction

1. **Understand the relationship between energy distribution within a reacting system and the factors that affect rate ofreaction**
2. **Understand basic concepts in electrochemistry.**
3. **Understand the effect of solutes on the properties of solvents.**
4. **Understand colligative properties of solutions**

	National Diploma	**Course Code: STC**			**Credit Hours: 2**	
	Physical Chemistry	STC 122			**Theoretical: 2 hours/week**	
	Year: Semester:	**Pre-requisite:**			**Practical hours STC 121:** **(PRACTICAL FOR STC 121,122 &123) CH: 2 CU=3**	
	Theoretical Content			**Practical Content**		
	General Objective 1.0 Understand the relationship between energy distribution within a reacting system and the factors which affect rate of reaction					
Weeks	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning**	**Teacher's activities**	**Resources**

				Outcomes		
1-2 **3**	1Define reaction rate Average, Instantaneous, and Initial Rate 2. Explain the effect of the following factors on the rate of reaction: (a) temperature, (b) concentration (or pressure of gas), (d) catalysis 3.Express rate in terms of reactant and product concentrations 4.Explain order of reaction viz: first order reactions; second order reactions 5.Explain why the order of reaction is commonly a whole number such as 0,1 or 2. 6.Explain the rate law and its components 7.Give the rate law for zero, first and second order reactions 7.1 use the zero, first and second order rate equations Interpret rate data to obtain order with respect to one of the reactants. 7.2.Interpret rate data to obtain rate constants for	Explain reaction rate Average, Instantaneous, and Initial Rate Discuss the effect of temperature, (b) concentration (or pressure of gas), (d) catalysis Express rate in terms of reactant and product concentrations Explain order of reaction viz: first order reactions; second order reactions	Laboratory resources; flasks stop-clock thermometer Bunsen measuring cylinders chemicals As above but use different concentration of sodium thiosulphate Potassium peronxodisulphate VI. Sodium thiosulphate, Potassiumiodide, test tubes, burrettes-Thermometers etc.	measure and plot the effect of temperature on the reaction between sodium thiosulphate and dilute hydrochloric acid. Use the iodine Clock methods to fin the order of reactions	Guide and supervise students (rate is measured by placing an x on paper beneath the reaction)	What is reaction rate Average, Instantaneous, and Initial Rate State the effects of the following on rate of reaction)a)temperature, (b) concentration of pressure of gas), (d) catalysis State 0,1,2, order reaction and deduce the equation state a graphical representation of the order.

	reactions 7.3 Interpret rate data to obtain half life for first order reactions. 8.Explain integrated rate law 9.Discuss reaction mechanisms and molecularity 10.Discuss the rate determining step of a reaction mechanism 11.Correlate reaction mechanisms with the rate law 12.Explain energy of activation 13.Describe transition states and the molecular nature of the activated state 14.Explain the characteristics of a catalyst 15. Explain the theories of heterogeneous catalyst and that of continuous formation and decomposition of unstable intermediate compounds.					
General Objective 2: Understand basic concepts in electrochemistry						

4-5	1. Explain Faraday's laws of electrolysis. 2. Explain Arrhenius theory of electrolytic dissociation. Distinguish between electrolytic and metallic conduction. 3. Explain specific and molar conductivity. 4. Describe the measurement of specific conductance and equivalent conductance. 5. Explain conductance. Distinguish between electrolysis and electrophoresis 6. Describe electrodes and electrosystem with special reference to standard hydrogen electrode. 7. Discuss two and three electrode systems 8. Define electrode potential as the driving force with which metals lose electrons from solution containing their ions. 9. Explain Redox potential 10. Explain Nernst	Lectures and give comprehensive note Discus electrodes and electrosystem with special reference to standard hydrogen electrode. State two and three electrode systems Define electrode Discuss Redox	Classroom resources Nitrophenyl acetate, buffer solutions, UV spectrometer glassware etc Catalase (yeast suspension made from 2g dried yeast in 160 ml water aerated for several hours) Burette test tubes etc	Use UV/Vis spectrophotomete r to measure initial rates for the hydrolysis of a range of concentrations of nitrophenyl acetate at pH 8 and determine pseudo first order rate constant and true rate constant. Investigate a catalysed reaction (enzyme catalyst) and determine the effect of enzyme and substrate concentrations on the rate of the reaction. Part 1 =	Guide and supervise students Guide and supervise students (rate is measured by using an inverted burette to measure the volume of oxygen produced.	State Faraday's laws of electrolysis and principles of Arrhenius theory of electrolytic dissociation. Differentiate between electrolytic and metallic conduction. What is electrodes List two and three electrode systems What is redox pontential. Deduce equation related

6	Equation: 13. $E=E^{o} + \frac{0.0591}{N} \log k.$ Where E=Cell Emf, E^{o} = Standard Emf , N = number of electrons transferred, K = equilibrium constan 11.Discuss galvanic systems - theory and applications 12 Discuss modes of mass transport - diffusion, migration, convection 13 .Discuss the electrical double layer and its limitations 14. Discuss half-cell reactions. 15. Discuss redox reactions 16. Explain the difference between chemical and electrochemical reversibility.	potential and formulate Nernst Equation:		varying enzyme concentration Part 2 = varying substrate concentration to obtain the saturation kinetics curve		to redox pontential theory
	General Objective 3: Understand the effect of solutes on the Properties of solvents.					
7	3.1Define vapour pressure of liquids. 3.2 Explain the relative lowering of vapour pressure of the solvent by the present of a non-volatile solute. 3.3 State Raoult's law with the appropriate equation. 3.4 Express Raoult's law	Discuss vapour pressure of liquids, and relative lowering of vapour pressure of the solvent by the present of a	voltmeter crocodile clips sodium chloride solution strips of: zinc, copper, lead, iron, magnesium	Construction of an electrochemical cells, measurement of resulting emf and arrangement of metals in	Guide and supervise students Demonstrate and Guide the	,

	with the appropriate equation. 3.5 Relate the relative lowering of vapour pressure of dilute solution to the molecular concentration of the solute. 3.6 Determine from Raoult's law the molecular weight of solute given the pressures of the solvent and solution. 3.7 Define an ideal solution as one that obeys Raoult's law over the whole range of concentration. 3.8 Define boiling point at which the temperature of a liquid substance will be equal to vapour pressure at the atmospheric pressure (atp) 3.9 Draw the diagram of vapour pressure against temperature for pure solvent and solution. 3.10 Define the ebullioscopy constant, K, as the boiling point elevation produced if one gram molecule of any solute were dissolved in	non-volatile solute. Explain Raoult's law of molecular weight of solute given the pressures of the solvent and solution. Discuss the boiling point of a liquif substance be equal to atomospheric pressure.	Power supply, ammeter beaker copper cathode copper anode copperII sulphate high resistance voltmeter metals and solutions, beakers filter papers soaked in potassium nitrate V solution Calorimeters Bunsen burner Glassware	order of reactivity. Quantitative Electrolysis: relating the amount of metal removed from an electrode to electric current and time. Construction of copper/copper sulphate half cell, zinc/zinc sulphate half cell and iron/iron sulphate half cell. Connect via salt bridge and measure emf Determine the relative molecular mass of a solute dissolved in a	students	What is relative vapour pressure What is Raoults law of molecular weight of a solute at ATP. What is ideal solution in raoults law Outlinethe point at which liquid substance will be equal to atmospheric pressure. Skech the diagram vapour pressure against temperature on a pure solvent and solution.
8						

	1,000 Grams of solvent. 3.11 Write an equation relating K to boiling point elevation □T and the molarity of solution. □T = KW where □T = boiling point elevation W = mass of solute in 1,000g of solvent and M = molecular mass of solute	Discuss the boiling point elevation in one gram molecule of any solute dissolved in 1,000 gram of solvent	thermometer	given weight of solvent using equation 3.11 above. Measure the elevation of boiling point by Rasts method		What is ebullioscopy Write in details the ebullioscopy equation
9	3.12 Explain the problems involved in the measurement of boiling point elevation, viz super heating, dependence of boiling point on pressure. 3.13Describe the following methods of measuring elevation of boiling point. i) Landsbergers ii)Cottrell's and ii)Beckmann's 3.14. Explain depression of freezing point. 3.15. Define the cryoscopic constant K as the freezing point depression produced if one grammes – molecule of any solute dissolved in 1,000 grams of solvent. Use the formula □T = KW	Discuss problems associates with measurement point elevation.		Measure the elevation of boiling point by the Landsberger's method.		Mention methods use in measuring elevation boiling point.

10	where □T = depression of freezing point K = Cryoscopic constant W = Mass of solute in 1,000 grams solvent M= Molecular mass of solute 3.16. Calculate relative molecular mass of solute using the formula above. 3.17. Explain the problems involved in the measurement of freezing point depression especially that of super cooling. 3.18. . Describe the following methods of measuring depression of freezing point e.g. Rasts method and Beckmann's method. 3.19. Define osmosis 3.20. Define osmotic pressure State and explain the Laws of Osmosis 3.21. Derive the formula v = RT where = Osmotic pressure, V = Volume of Solution containing one gram of solute, R = Universal gas constant T = absolute temperature. 3.21.1Calculate molecular	Discuss the methods of measuring depression of freezing point e.g. Rasts method and Beckmann's method. Define				What are method use in measuring depression of freezing point What is osmosis, osmotic pressure and state the law of osmosis .derived formulae for it

	mass using the equation in above. 3.22. Describe methods for the measurement of Osmotic pressure. 23. 3. Define colligative properties. 24. List natural examples of Osmosis. Describe the relationship between osmotic pressure and vapour pressure. 25. Explain the	osmosis, osmotic pressure and State the Laws osmosis Derive molecular mass using the equation in above. Discuss methods for the measurement of Osmotic pressure. Define colligative properties. Explain the natural examples of Osmosis. Describe the relationship between osmotic pressure and vapour pressure. Discuss the interrelationshi				Ouline methods use in measuring a n osmotic pressure. What is the relationship between osmotic pressure and vapour pressure.

	interrelationship of the Colligative properties of a solution. 26.Explain phase, phase rule and various degrees of freedom) 2.7.Exlain phase equilibria exemplified by 1 and 2 component system.	p of the Colligative properties of a solution. Explain methods for the measurement of Osmotic pressure. colligative properties. explain the relationship between osmotic pressure and vapour pressure. Discuss				

		phase, phase rule and various degrees of freedom) phase equilibria exemplified by 1 and 2 component system.				
	General Objective 4: Understand Colligative Properties of Solutions					
13 **14-15**	4. 1.Define colligative properties 4. 2. List natural examples of Osmosis 4.3. Describe the relationship between osmotic pressure and vapour pressure. 4.4. Explain the interrelationship of the Colligative properties of a solution. 4.5.Explain colligative properties namely:-	Lectures with notes	Classroom Resources. Textbooks Calorimeter Glassware Thermometer	Measure the following in the laboratory: • Lowing of vapour pressure • Elevation of boiling point depression of freezing point. Determine relative molecular mass of substance	Guide **students to** Measure the various osmotic pressures	Differentiate between colligative properties namely:- lowering of vapour pressure elevation of boiling point depression of freezing point osmotic pressure and various methods of measuring (i) vapour density:- ii)vapour pressure iii)effect of solute on vapour pressure

	lowering of vapour pressure elevation of boiling point depression of freezing point osmotic pressure 4. 6.0Describe various methods of measuring (i) vapour density:- ii)vapour pressure iii)effect of solute on vapour pressure iv)effect of solute on boiling point v)effect of solute on freezing point osmotic pressure 4.7. Calculate molecular weight of solutes from expressions derived from Roults' law on lowering of vapour pressure. 4.8. Calculate the molecular weight of solutes from expression derived from elevation of boiling point and depression of freezing point.	Explain the molecular weight of solutes from expressions derived from Roults' law on lowering of vapour pressure. Derived the molecular weight of solutes from expression derived from elevation of boiling point and depression of freezing point.				iv)effect of solute on boiling point What is the molecular weight of solutes from expressions derived from Roults' law on lowering of vapour pressure. Calculate the boiling point and depression of a freezing point of osmotic pressure.

Assessment:

Coursework/ Assignments 10 %; Practical 40 %; Examination 50 %

Recommended Textbooks & References:

Chemistry by M.J. Sienko and R.A. Plane (Mc Graw Hill)
Chemistry (The Molecular Nature of Matter and Change) by M.S. Silberberg published by Mc Graw Hill Classic Chemistry Experiments published by The Royal Society of Chemistry (UK) and free on the internet at http://www.chemsoc.org/networks/learnnet/classic_exp.htm
Salters Advanced Chemistry Activities and Assessment Pack published by Heinemann

	Programme: ND Science Lab. Technology	**Course Code:**		**Credit Hours: 2**
	Course: Analytical Chemistry	**STC 123**		**Theoretical: hours/week 2**
	Year: Semester:	**Pre-requisite:**		**Practical hours STC 121: (PRACTICAL FOR STC 121,122 &123) CH: 2 CU=3**

General Objectives

Goal: The course is designed to provide students with knowledge of the physical and chemical principles involved in separation techniqu

1. **Understand the Analytical Process**
2. **Understand the physical and chemical principles involved in separation techniques**
3. **Understand the Statistical Analysis of Experimental Data**
4. **Further understanding of Titrimetric Analysis, including the use of non-aqueous solvents**
5. **Understand the principles and applications of Gravimetric Analysis**

	National Diploma	**Course Code: STC 123**		**Credit Hours: 2**	
	Analytical Chemistry	STC		**Theoretical: 2 hours/week**	
	Year: Semester:	**Pre-requisite:**		**Practical hours STC 121: (PRACTICAL FOR STC 121,122 &123) CH: 2 CU=3**	
	Theoretical Content		**Practical Content**		
	General Objective 1: Understand the Analytical Processes				
Weeks	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1	1.1List process involved with sample collection and storage. 1.2 Explain how to obtain a representative sample. 1.3.Describe the techniques used in sample preparation. 1.4.Descrbe'Fitness for purpose' and relevant technique characteristics: limit of detection, limit of quantization, sensitivity, and selectivity. 1.5.Understand the three methods of calibration: i)external standards, ii)internal standards iii) standard additions.	Discuss the issues involved with sample collection and storage. Explain how to obtain a representative sample and the techniques used in sample preparation. Explain, 'Fitness for purpose' and relevant technique characteristics: limit of detection, limit of quantization, sensitivity, and	Classroom resources Balance, 50 or 25 ml pipettes, fillers, weighing containers, table of density vs. temperature for water, thermometer s Rulers, calculators	Calibration of a pipette– use of lab glassware and analytical balance Practical use of linear regression	Quide students on Lab safety talk; introduction to general apparatus, demonstration of correct method of operation	What are the problems involved with collection and storage of samples. Write of the following issues; i)Fitness for purpose' and relevant technique characteristics: limit of detection, limit of quantization, sensitivity, and selectivity.
2						

	1.6 use the method of least squares to calculate a straight line through data points	selectivity.	Statistical equipment			
General Objective 2: Understand the physical and chemical principles involved in separation technques						
3	2.1 Define chromatography as a means of separating mixtures by the distribution of its components between a stationary and a mobile phase in adsorption and partition chromatography. 2.2 Describe paper and silica gel thin layer chromatography 2.3 Describe column chromatography over silica gel 2.4 Describe gas chromatography 2.5 Distinguish between adsorption chromatography and partition chromatography 2.6 Define partition coefficient and	Explain with relevant examples and give assignments Explain and illustrate with relevant examples	chromatographic column, thin layer plate, mixture of components Solvents extraction apparatus Paper and thin layer chromatographic equipment Ion exchange column	Separate mixture into its various components using silica gel TLC and column chromatography Determine the extent of extraction of a material from one phase into a second phase applying the principle of	Demonstrate and let the student practice the separation of a mixtures Demonstrate and allow students to apply some principles Demonstrate and let the students practice the identification of colorless materials	Use practical manual to carry out the required laboratory experiment. State techniques use in separating mixtures in both stationary and mobile stage. Differentiate between adsorption chromatography and partition chromatograph.

4	retention time 2.7 Define the terms Rf and Rv (retention volumes) 2.8 Describe the technique of solvent extraction 2.9 Explain why it is more efficient to extract a solute from a solution by using two or more portions of an immiscible solvent than to use the same total volume in one bulk. 2.10. Describe the functioning of soxhlet extraction. 2.11. Differentiate between batch and continuous extraction. 2.12. Describe the use of acidic and basic solvents to extract basic and acidic materials respectively. 2.13. Describe the use of chelation to extract an ionic substance into a non-polar solvent.	Explain with relevant examples and give assignments Explain why it is more efficient to extract a solute from a solution by using two or more portions of an immiscible solvent than to use the same total volume in one bulk. Explain and illustrate with relevant examples	solvents Agar or agarose gel, citrate and ammonium acetate, HPLC, soft drinks, ammonium acetate, glacial acetic acid, solvent saccharin, benzoic acid, caffeine, aspartame Magnetic board, Chemicals and Test tubes	partition law Set up an ion exchange column and use it to separate a chlorophyll Analysis of additives in soft drinks by HPLC	Demonstrate and allow the students to carry out the separation Demonstrate and allow students to repeat Demonstrate and allow students to test own samples Guide and supervise students on methods on the detection	State why important to extract a solute from solution using more immisible solvent. State the Different between batch and continuous extraction. What is ion exchange resin
5	2.14. Describe methods for the detection of colourless material in paper and thin layer chromatography and solvents in GC.	Explain and illustrate with relevant examples the method use in		Identify colourless material in paper and thin layer chromatograp Investigation of pH dependance	colourless material paper and thin layer chromatograph	state methods used in laboratory to detect colouless materials.

6	2.15 Describe the chemical form of an acidic or basic ion exchange resin. 2.16. Explain that an ion exchange resin exchanges ionic units with ions in the surrounding solution. 2.17 Explain the terms selectivity coefficient and distribution coefficient for an ion exchange material. 2.18. State the abilities of a resin to exchange ions with those in dilute solution increases as the change on the solvated ions increases. 2.19. Define the terms bed volume and exchange capacity. 2.20. Describe the process of re-generating an ion exchange resin.	decting colourlless materials paper and thin layer chromatograph Explain the terms selectivity coefficient and distribution coefficient for an ion exchange material Explain the terms bed volume and exchange capacity. Discuss the process of re-generating an ion exchange resin and its applications		of electrophoresis of natural anthocyanine dyes (or similar experiment)	Ensure students use electrophoresis machine for lab analysis.	
7	2.21. Describe laboratory and industrial applications of ion exchange resins. 2.22. Explain electrophoresis, discussing electrophoretic mobility and Stokes equation	Define electrophoresis, discussing electrophoretic				

8	2.23.Discuss Electroosmosis, apparent mobility and theoretical plates 2.18 Describe the experimental set-up for capillary electrophoresis 2.25 Discuss applications of capillary electrophoresis, e.g. separating milk proteins, gunshot residues, detecting chemical weapon products, drugs 2.26 Describe HPLC chromatography 2.27 Discuss normal phase HPLC and reverse phase HPLC 2.28 Discuss retention time, peak shape, peak broadening and peak integration 2.29.Conversion of ppm to other units of measurement, i.e mg/litre to % (g/100) etc. 2.30.Conversion of Molarity to g/dm3 or g/litre 2.31Conversion of Molarity to	mobility and Stokes equation .				

	Normality Conversion of Molarity to %					
General Objectives: 3 Understand the Statistical Analysis of Experimental Data						
9 **10**	3.1.Explain the limitations of analytical methods. 3.2 Define accuracy. 3.3.Explain the two methods of measuring accuracy- absolute and relative error. 3.4.Define precision. 3.5.Express absolute precision statistically, namely: the two methods of measuring accuracy- absolute and relative error. 3.4.Define precision. 3.5.Express absolute 3.6.Explain the two main classes of error viz:- (a) systematic or determinate errors (b) random or indeterminate errors. 3.7.Discuss gross errors. 3.8.List and explain the different forms of systematic errors, namely operational and personal errors, instrumental and reagent errors, method errors, additive and proportional errors.	Explain and illustrate with appropriate examples explain the two methods of measuring accuracy- absolute and relative error. Expain precision. absolute the two methods of measuring accuracy- absolute and relative error.	Classroom resources, calculators Classroom materials Classroom resources, statistical tables, calculators	Treat various experimental data to bring out the meaning of mean deviation, standard deviation absolute error, relative error Calculate propagated errors for a typical experiment including glassware, balances etc. Apply statistical tests to specific analytical problems	Demonstrate and allow students to repeat Demonstrate and allow students to repeat with another experiment Demonstrate and allow students to repeat with another experiment	

11	3.9Explain ways by which errors can be minimized, such as calibration of apparatus, and application of corrections, running a control determination, and use of independent methods. 3.10. Calculate propagated errors over an analysis 3.11 .Explain the meaning of significant figures. 3.12 .List examples of significant figures. 3.14. Explain normal distribution (Gaussian) 3.15 . Explain the three methods of testing results, namely:- student's t test and the F test; and the chi-square distribution 3.16. Apply statistical test to specific analytical problems. 3.17.Define outlier tests: Dixon's Q and Grubb's tests 3.18.Explain the number of parallel determinations (repetitive determination) needed in results for analysis.					
General Objective 4: Understand the principles of Titrimetic Analysis						

12 **13**	4.1 Explain meaning of titrimetic analysis 4.2. Describe the basic principle of titrimetic analysis 4.3 Determine the end points. 4.4. List out the use of indicators 4.5. Use pH and conduct metric screened methyl orange in methods 4.6. Discuss different types of titrations such as acid/ base, oxidation/reduction, complexiometric, and non aqueous solvents 4.7. Relate the strength of acids and bases to the solvent medium (levelling effect). 4.8. Classify solvents as amphiprotic (amphoteric, protophilic, protogenic and approtic. 4.9. List solvents used in non-aqueous titration 4.10. Explain autoprotolysis 4.11. List basic and acidic titrants used for particular non-aqueous media 4.12. Explain why non-aqueous titration is applicable to acids and	Explain and give relevant examples of titrimetic analysis Discuss the use of pH and conduct metric screened methyl orange in methods	Classroom resources sulphuric acid, screened methyl orange indicator, aspirin tablets, sodium hydroxide, bunsens, phenol red indicator Burettes, glassware, HCl sodium carbonate, screened methyl orange indicator Burettes, glassware, acetylsalicyli c acid, sodium carbonate, screened methyl orange indicator, aspirin tablets, sodium hydroxide, bunsens,	Standardisation of HCl with sodium carbonate standard solution Analysis of aspirin by back titration Analysis of aspirin by back titration	Demonstrate and allow students to repeat Guide students	What is titrimetic analysis Discuss basic principle of titrimetic analysis and the end points. Mention use of indicators Explain the use of pH and conduct metric screened methyl orange in methods etc.

	bases weaker than water 4.13. List applications o titrations in non-aqueous media		phenol red indicator			
General Objective 5: Understand the principles and applications of gravimetric analysis						
14-15	5.1.Explain the meaning of gravimetric analysis. 5.2 .Describe precipitation as gravimetric method for separation of elements or compounds. 5.3. Explain co-precipitation, pot-precipitation and digestion. 5.4Relate the effects of 4.3 above to the purity of the precipitate. 5.5. Outline the conditions necessary for precipitation	Explain with relevant examples and give notes Explain and give notes	Classroom resources Glass wares chemicals	Determine chloride ion, calcium as calcium oxalate in natural samples in the laboratory. - Determine nickel as nickel dimethyl-glyoximate to show the use of organic substances in precipitation. Determine the percentage of water of crystallization in Barium chloride, magnesium sulphate hepthahydrate etc	Guide the students to carry out Practicals as listed	What is gravimetric analysis. Differentiate between this phenomena; i)co-precipitation, ii) pot-precipitation and iii) digestion list conditions for necessary precipitation.

Assessment: Give details of assignments to be used:
Coursework/ Assignments C o u r s e test 10%; Practical 40%; Examination 50%

Recommended Textbooks & References:

J.N. Miller and J.C. Miller. Statistics and Chemometrics for Analytical Chemistry. Fourth Edition. Prentice Hall. 2000.
D.C. Harris. "Quantitative Chemical Analysis", 6th Edition, Freeman, New York. 2002.

D.A. Skoog, D.M. West & F.J. Holler. "Fundamentals of Analytical Chemistry", 7th edition. Saunders and Holt, New York. 1996

R. Kellner, J.-M. Mermet, M. Otto & H.M. Widmer (eds.). "Analytical Chemistry" Wiley-VCH, Chichester. 1998

Course: Electricity and Magnetism **Semester:** Second	**Code:** STP 121 **Pre-requisite:**	**Total Hours: 2 Hours/Week** **Theoretical hours: 2Hours/Week** **Practical hours STP 123:** **(PRACTICAL FOR STP 121,122 &123)** **CH: 2 CU=3**
GOAL: This course is designed to provide the students with an understanding of Electricity and Magnetism.		
GENERAL OBJECTIVES		
On completion of this module students should be able to :		
1	Understand the concept of static electricity.	
2	Understand capacitance and the use of capacitors in d.c. circuits.	
3	Understand the behaviour of moving charges in conductors	
4	Understand the chemical effects of electric current.	
5	Understand the concepts of magnetic field.	

PROGRAMME: NATIONAL DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY						
COURSE TITLE: Electricity and Magnetism		**COURSE CODE:** STP 121		**CONTACT HOURS: 2 HRS/WEEK**		
COURSE SPECIFICATION: Theory Practical				**Practical hours STP 123:** **(PRACTICAL FOR STP 121,122 &123)** **CH: 2 CU=3**123		
General Objective 1: Understand the concept of static electricity.						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
	1.1 Describe the	Solve numerical problems	Van de Graff	Demonstrate	Students should	Assign

1 - 2	principles of electrostatics shielding. 1.2 State Coulomb's law. 1.3 Explain the principles of operation of the Van de Graff generator. 1.4 State the expression for Coulomb's force in a medium of permitivity ε $F = \frac{q_1 q_2}{4\pi\varepsilon r^2}$ 1.5 Calculate the resultant force between two or more charges using coulomb's law. 1.6 Draw lines of force due to:- i) an isolated point charge ii) two similar charges iii) two unlike charges. 1.7 Define Electric field intensity. 1.8 Calculate field intensity due to a point charge and a dipole.	and give assignment. Lecture.	generator.	the action of the Van de Graff generator.	be involved in the demonstration of the Van de Graff generator.	students to explore behavior of electric charges using combs, glass rods etc and draw conclusions. Give assignment involving the calculation of; electrostatic potential at a point,

	1.9 Explain the terms electrostatic potential, potential difference and electron volt. 1.10 Explain the meaning of potential gradient. 1.11 State the relation between electric potential gradient and electric field. 1.12 Calculate the force and acceleration of an electron placed in electric fields of know intensities. 1.13 Calculate the work done in bringing closer two positively or negatively point charges placed at a distance apart. 1.14 Calculate the potential and electric field between any two of three charges placed respectively at the corners of an equilateral triangle of known dimension.					potential at different points and stating the relation between electric potential gradient and electric field.

General Objective 2: Understand capacitance and the use of capacitors in d.c. circuits.						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
3	**Capacitors** 2.1 Explain the meaning of capacitor. 2.2 Define capacitance. 2.3 Describe the different types of capacitors. 2.4 List the uses of the capacitor 2.5 Explain the factors affecting the capacitance of the parallel plate capacitor (Area, distance and dielectric material). 2.6 Define permitivity and relative permitivity (or dielectric constant) 2.7 Explain Dielectric strength of a medium	Lecture	Mica, paraffin, waxed, electrolytic, variable, air capacitors, etc	Identification of different types of capacitors.	Students should be shown different types of capacitors.	Give assignment for determining capacitances of capacitors with varying area, plate separations and dielectric constants.
4 - 5	2.8 Write the expression for the capacitance of a parallel plate capacitor ($C = \frac{\varepsilon A}{d}$ where d is the distance between the plates, A is the	Lecture Solve some simple numerical problems using the expressions.	Large capacitor, Large resistor, Micro ammeter, two-way key, source of EMF and wire connectors. Ballistic	Charge and discharge a capacitor using a resistor. Demonstrate the ballistic galvanometer	Demonstrate the charging of a capacitor using a resistor. Demonstrate the discharge of a capacitor	Assign numerical problems involving computation of total capacitance of parallel and

	surface area of the plate and ε is the permittivity of the medium between the plates). 2.8 Write the expressions for the equivalent capacitance of series and parallel arrangements of capacitors: $\frac{1}{C} = \frac{1}{c_1} + \frac{1}{c_2}$ (for serials arrangement) $C = c_1 + c_2$ (for parallel arrangement) 2.9 Write an expression for the energy stored in a capacitor 2.10 Calculate the equivalent values of capacitors placed in (i) series (ii) parallel. 2.11 Calculate the energy stored in a capacitor.		galvanometer, two electrical switches, source of EMF, two capacitors (one standard capacitor) wire connectors.	method of comparing two capacitances of two capacitors.	through a resistor. The student should perform the experiment to compare two capacitances of two capacitors using ballistic galvanometer method.	series combinations.
General Objective 3: Understand the behaviour of moving charges in conductors						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
6 - 7	**Direct Current**	Lecture	Standard resistors such	Identify	Students should	Students are

	3.1 Explain why metals are good conductors of electricity using a free electron model. 3.2 Define potential difference and electromotive force (e.m.f.) 3.3 State the relationship between current and charge. 3.4 Write an expression for drift velocity in metals and explain the symbols used.		as carbon black and wire wound resistors, and variable resistors such as rheostat and resistance boxes.	different types of resistors	be shown different types of resistors	asked to rank various metals in order of conductivity and identify all factors determining electric current.
8 - 11	3.5 Explain how two resistances in series are used to provide a known fraction of a given potential difference (potential divider arrangement). 3.6 Define resistivity and conductivity. 3.7 Explain the effect of temperature on the resistance of a wire. 3.8 Explain temperature coefficient of	Lecture	Wheatstone bridge, accumulator or dry cell, switch, sensitive centre reading galvanometer, standard resistor (5 ohm), Thermometer, boiling tube containing paraffin in which is immersed the copper coil. Constructed meter bridge, the meter bridge in the laboratory, dry cell, key set of standard	Determine the temperature coefficient of resistance of a coil. Construct a meter bridge. Determination of unknown resistances. Carry out the following experiments using the potentiometer arrangement. (i).Calibrate	Students should perform an experiment to determine a temperature coefficient of resistance of a copper coil. Group students and give out the construction of meter bridge as assignment. Students should use the constructed bridge to	Assign problems on voltage divider principle and Kirchoff's laws. Assign problems using meter bridge to determine unknown resistances.

	resistance. 3.9 Define internal resistance of a cell. 3.10 Write the expression E = 1 (R+r) for a complete circuit. 3.11 Describe the effect of internal resistance on the current drawn from the cells. 3.12 State Kirchoff's first and second laws. 3.13 Calculate current and emf in complete circuits applying Kirchoff's laws. 3.14 Write the formula for electric power developed in a resistor. 3.15 Explain the principle of operation of the wheatstone bridge. 3.16 Explain the principle of the potentiometer.		resistances, unknown resistance, galvanometer. Potentiometer ammeter, standard cell, galvanometer, keys, accumulator, standard cell, rheostat, dry cell Potentiometer volt metre standard cell, galvanometer, keys, accumulator, standard cell, rheostat, dry cell Two accumulators, two keys, potentiometer, rheostat, galvanometer, two resistances (can be unknown and standard resistance respectively). Potentiometer, two resistance boxes (2000 OHM) accumulator, key, galvanometer, cadmium standard cell, sand bath, thermometer reading up to 350 degrees centigrade, copper and iron wire	an ammeter (ii) Calibrate a voltmeter (iii)Compare two resistors v) Calibrate a thermocouple. Calibrate a thermocouple.	determine the values of unknown resistances and compare with that obtained using the meter bridge in the laboratory. Student should use the potentiometer to calibrate an ammeter. Student should use the potentiometer to calibrate a voltmeter. Students should use the potentiometer to compare the resistances of two resistors. Group students and give out as assignment. The students are expected to construct the thermocouple first.	Assign problems on construction of thermocouples using different pairs of metal wires.

			thermocouple.			
General Objective 4: Understand the chemical effects of electric current.						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
12 - 14	**Chemical Effects of Electric Current** 4.1 Explain electrolysis and voltammeter 4.2 Define electrodes (Anodes and Cathode) 4.3 Explain with examples the term electrolyte. 4.4 Explain ionization process in an electrolyte 4.5 Explain the mechanism of electrolytic conduction. 4.6 Define electrochemical equivalent and equivalent weight. 4.7 State faraday's laws of electrolysis 4.8 Describe electrolysis of water using Hoffman voltameter 4.9 List the applications of	Lecture Solve some simple numerical problems and give assignment.	Hoffman apparatus and copper voltammeter. Daniel cell, Laclanche cell (dry and wet) lead Accumulator, Nife cell and western cell, Charger.	Demonstrate electrolysis with Hoffman and copper voltammeter. Identify Daniel cell, Leclanche cell (dry and wet) lead Accumulator, Nife cell and western cell.	Students should be made to watch the demonstration of electrolysis using Hoffman apparatus and copper voltammeter. Identify the following cells for the students: Daniel cell, Laclanche cell (dry and wet) lead Accumulator, Nife cell and western cell. Group students and give out the construction of simple cells using locally available	Direct students to solve various electrolysis problem, especially identifying Daniel cell, Leclanche cell (dry and wet) Lead Accumulator, Nife cell and Western cell.

	electrolysis e.g. electroplating 4.10 Describe the construction of these cells in 4.2 above. 4.11 Explain charging, discharging and care of the accumulators. 4.12 Calculate the e.m.f's of cells from energy consideration given the necessary data. 4.13 Calculate the mass of a substance liberated during electrolysis using M=ZIt where m = mass. Z is electrochemical equivalent of the substance; I is current and t is time. 4.14 Calculate the back e.m.f. produced in a water voltammeter connected to an accumulator given other necessary data. 4.15 Solve problems			Charge accumulators in the laboratory. Construct simple cells using locally available materials	materials as assignment. The charging process of accumulators should be witnessed by the students.	

	involving the concept of electrolysis.					
General Objective 5: Understand the concepts of magnetic field.						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
15	**Magnetism** 5.1 Explain the concept of magnetic field. 5.2 Explain the nature of the magnetic field:- ii) around a bar magnet iii) around a straight current carrying conductor iv) a solenoid v) circular coil vi) toroid 5.3 Explain the principle of operation of the magnetometer.	Lecture	Bar magnet, Solenoid, straight current carrying conductor, Circular coil, iron fillings, Magnetometer.	Plot magnetic lines of force. Demonstrate the use of magnetometer.	Students should plot magnetic lines of force for the following: Bar magnet, straight current carrying conductor, solenoid. Students should observe the demonstration of the use of the magnetometer by the teacher.	

Assessment: Give details of assignments to be used:
Coursework/ Assignments 10%; Course test 20 %; Practical 30%; Examination 40 %
Recommended Textbooks & References:

Advanced level Physics by Nelkon and Parker.
Physics Practical manual by Tyler.

Course: Optics and Waves **Semester:** Second	**Code:** STP122 **Pre-requisite:**	**Total Hours: 2 Hours/Week** **Theoretical hours: 2Hours/Week** **Practical hours STP 123:** **(PRACTICAL FOR STP 121,122 &123)** **CH: 2 CU=3**
GOAL: This course is designed to provide the students with an understanding of Optics and Waves.		
GENERAL OBJECTIVES		
On completion of this module students should be able to :		
1	understand the principles and applications of reflection and refraction at plane and curved surfaces.	
2	understand the working principles of optical instruments.	
3	understand the basic concepts of photometry.	
4	understand the phenomenon of wave, optics and sound waves.	

PROGRAMME: NATIONAL DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY						
COURSE TITLE: Optics and Waves		**COURSE CODE:** STP 122			**CONTACT HOURS: 4HRS/WEEK**	
COURSE SPECIFICATION: Theory Practical					**Practical hours STP 123:** **(PRACTICAL FOR STP 121,122 &123) CH: 2 CU=3**	
General Objective 1: understand the principles and applications of reflection and refraction at plane and curved surfaces.						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
1 - 6	**Reflection and Refraction at Plane Surfaces** 1.1 Revise previous work on reflection and refraction at curved surfaces. 1.2 Define refractive index in terms of	Lecture	Spherometer, piece of plane glass, convex mirror. Concave mirror, liquid, retort stand. Clamp. Pin, meter rule.	Determine the radius of curvature of a convex mirror using a spherometer.	Students should perform an experiment to determine the radius of curvature of a convex mirror using a spherometer.	Ask students to: a) Explain the use of Spherometer; b) construct: i) Submarine Periscope and Kaleidoscope ii) Explain the application of

	velocities of light in vacuum and in a medium. 1.3 Explain the use of spherometer. 1.4 Explain the application of total internal reflection in the construction of the following: Submarine periscope, binoculars, optical fibre and kaleidoscope. 1.5 Determine the focal length of two thin lenses in contact using the formula: $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ 1.4 Explain defects of lenses (spherical and chromatic aberration) and their corrections.		Illuminated object, meter rule, convex lens, stands and screen. Light box, screen, cardboard tube with lens inside and having window on both ends. Travelling microscope with vernier scale, glass block, tank with glass sides, lycopodium powder, fine sand.	Determination of the refractive index of liquid using a concave mirror. Determination of the focal length of a convex lens by the displacement method. Determination of the focal length and position of a lens mounted in an inaccessible position inside a tube. Determination of refractive index of (i) glass, liquid using a travelling microscope.	Student should perform an experiment to determine refractive index of liquid using a concave mirror. Student should carry out experiment to determine the focal length of a convex lens by the displacement method. Student should perform an experiment to determine the focal length and position of a lens mounted in an inaccessible position inside a tube. Perform experiment to determine refractive index of	total internal reflection with respect to submarine periscope, binoculars, optical fibre and kaleidoscope. c) Explain defects of lenses and their remedy. d) Use lenses formula to solve problem.

					i) glass, (ii) liquid using a travelling microscope.	
General Objective 2: understand the working principles of optical instruments.						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
7 - 8	**Optical Instruments and Human Eye** 2.1 Explain the magnifying action of lens. 2.2 Write expression for angular magnification of a lens. 2.3 Explain the working of: ii) Simple microscope iii) Compound microscope iv) Astronomical telescope v) Galilean telescope vi) Terrestrial telescope	Lecture	Microscope	Demonstrate the use of microscope	Students should be made to use the microscope to view minute particles.	Ask students to explain the magnification of a lens and with the aid of a diagram explain the working principles of: i) compound microscope ii) astronomical telescope iii) terrestrial telescope
9 - 11	2.4 Explain the magnifying power of optical instruments in 2.3 above. 2.5 Calculate the magnifying power of the optical	Solve simple numerical problems.	Compound microscope, unsilvered glass plate, two millimetre scales (mounted white paper scales are	Determine the magnifying power of a microscope.	Student should determine the magnifying power of a microscope.	Ask students to: i) Determine the magnifying of some optical instruments and then determine their magnifying power by calculation.

	instruments in 2.3 above. 2.6 Describe the working of a spectrometer. 2.7 Explain the defects of the eye and their correction. 2.8 Calculate the magnifying power, angular magnification of optical instruments. 2.9 Calculate the focal lengths of the objective and eye lenses of compound microscope given the magnification and other necessary parameters.		suitable). Spectrometer.	Demonstrate the use of the spectrometer Measure angle of deviation, minimum deviation angle of a prism using spectrometer.	Teacher should demonstrate the use of spectrometer Students should measure angle of deviation, minimum deviation angle of a prism using spectrometer	ii) Identify some common eye defects and their correction. iii) Determine by calculation the focal length of the objective and eye lens of compound microscope for a magnification and other necessary parameters.
General Objective 3: understand the basic concepts of photometry.						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
12 - 13	**Photometry** 3.1 Define radiant power, radiant flux, luminous flux. 3.2 Define luminance and luminous intensity. 3.3 Describe the international standard source of light. 3.4 Define solid angle.	Lecture Solve some numerical problems.	Light sources of different intensities, meter rule, photometer.	Compare light intensities	Student should compare light intensities using photometer.	Students should be give assignments to: i) Distinguish between radiant power, radiant flux and luminous flux. ii) State the relationship between luminance and luminous flux; luminous intensity and luminous flux. iii) Determine luminous intensity (I) and

	3.5 Define luminous efficiency. 3.6 State the relationship between illuminance and luminous flux; luminous intensity and luminous flux. 3.7 State cosine law and inverse square law. 3.8 Describe lummer – Brodhun photometer and the flicker photometer. 3.9 Compare intensities of light sources. 3.10 Calculate the luminous intensity I, and luminous flux F, of a source. 3.11Calculate the luminance of a surface.					luminous flux (F) of a source by calculation.
	General Objective 4: understand the phenomenon of wave, optics and sound waves.					
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
14 - 15	4.1 Explain sound waves in air columns and waves in strings. 4.2 Define resonance. 4.3 List examples of resonance in other physical events. 4.4 Identify the factors that affect the velocity of sound	Lecture	Glass resonance tube about 100 cm long and 3cm in diameter, clamp, rubber bung, set of tuning forks of frequency range 256 to 512 hertz, metre rule.	Determine experimentally the velocity of sound in air using a resonance tube. Determine the	Student should perform the experiment to determine experimentally the velocity of sound in air using a resonance tube.	Ask students to outline some examples of resonance in physical events. Derive the relationship between frequency of waves in a straight string, length and tension.

	waves in pipes. 4.5 Establish the relationship between the frequency of waves in a straight string and the length and tension: $f = \frac{\sqrt{\frac{T}{m/L}}}{2L}$ Where: f = Frequency T = Tension in string L = Length of string M = Mass of string 4.6 Explain what is meant by Doppler effect. 4.7 List examples of Doppler effect in sound and light. 4.8 Explain the terms:- i) Reflection ii) Refraction iii) Super position iv) Interference and diffraction as they relate to waves. 4.9 State the conditions necessary for interference and diffraction to occur in waves. 4.10 Explain the term beat. 4.11 Determine beat frequency.		Sonometer, length of steel of diameter about half millimetre, supporting hook and set of slotted five Newton weights, tuning folk, and micrometer screw gauge, Ripple tank.	frequency of a tuning fork using a sonometer. Demonstrate reflection, refraction, super position, interference and diffraction using a ripple tank.	Student should determine by experiment the frequency of a tuning fork using a sonometer. The teacher should demonstrate reflection, refraction, super position, interference and diffraction using a ripple tank.	Give examples of Doppler Effect in sound and light. The student should state the conditions necessary for interference and diffraction to occur in waves. Explain the electromagnetic spectrum in relation to wavelength and frequency.

	4.12 Explain the electromagnetic spectrum in relation to wave lengths and frequency. 4.13 Distinguish between emission and absorption of waves.					

Assessment:
Coursework/ Assignments 10 %; Course test 20 %; Practical 30 %; Examination 40 %

Recommended Textbooks & References:
(1) Advanced Level Physics by Nelkon and Parker
(2) Physics Practical Manual by Tyler

PROGRAMME: NATIONAL DIPLOMA						
COURSE: General Laboratory technique II Module (iii) Preparation of Laboratory Side Shelf Reagents, and Sample Management Module (iv) Separation Techniques			**COURSE CODE:** GLT 121		**CONTACT HOURS: 1**	
GOAL: The course is designed to provide students with knowledge and skill of preparations of laboratory reagents, its storage, dispensing, use and disposals.						
COURSE SPECIFICATION: THEORETICAL CONTENT				**COURSE SPECIFICATION:** PRACTICAL: 2 hour/week		
Week						
	GENERAL OBJECTIVE : On completion of this course, the students should be able to: **1.0 Know the preparation of solutions and reagents in the laboratory** **2.0 Know the different types of solvents and their applications** **3.0 Understand the: storage, extraction, dispensing, recovery and disposal and of chemicals in the laboratory** **4.0 Understand the basic techniques of sampling** **5.0 Understand the physical and chemical principles involved in some separation methods used in the laboratory**					

	6.0 Understand the collection, handling and preservation of biological laboratory specimens **7.0 Understand the setting up and management of tropical aquarium and animal house** **8.0 Know how to prepare a herbarium**

PROGRAMME: NATIONAL DIPLOMA						
COURSE: General Laboratory Techques II Module (iii) Preparation of Laboratory Side Shelf Reagents, and Sample Management Module (iv) Separation Techniques		**COURSE CODE:** GLT 121		**CONTACT HOUR: 1**		
GOAL: The course is designed to provide students with knowledge and skill of preparations of laboratory reagents, its storage, dispensing, use and disposals.						
COURSE SPECIFICATION: THEORETICAL CONTENT				**COURSE SPECIFICATION: PRACTICAL CONTENT**		
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVE 1.0: Know the preparation of solutions and reagents in the laboratory					
1-2	1.1 Define standard solution e.g. Normal, molar, saturated and supersaturated solution. 1.2 Calculate the concentration of solution from a given assay. 1.3 Describe the methods of preparation and standardization of solutions	Define standard solution Explain how to calculate the concentration of solution from a given assay.	Burettes, Pipettes, beakers, retort, Stand, volumetric flasks, H_2 SO_4, NaOH Indicator	Prepare and standardise various solutions Label all prepared solutions and reagents	Demonstarat how to Prepare 0.1M H_2 SO_4,0.1M NaOH and titrate	Explain how to prepare stadard solutions
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 2.0: Know the different types of solvents and their applications					
3	2.1 Define a solvent 2.2 List some known solvents.	Define a solvents, list some and	Soxhlets apparatus/ petroleum ether,			Define what solvents and are

	2.3 Classify solvents in 2.2 above e.g. organic in organic, and universal. **2.4** State the application of solvents e.g. solid/liquid extraction	classify them	ethanol and methylene chloride			Explain how to classify solvents
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 3.0: Understand the: storage, extraction, dispensing, recovery and disposal and of chemicals in the laboratory					
4-5	3.1 Describe methods of carrying out the following processes in the laboratory i. Storage ii. Extraction iii. Dispensing iv. Recovery and Disposal 3.2 Explain how to apply each of the processes in 3.1 above to the various chemicals in the laboratory. 3.3 List and describe the safety regulations involved in the process in 3.1 above. 3.4 Separate various solvents in the laboratory. **3.5** Explain the methods of handling and storage of various	Explain the methods listed in column 2 Describe the safety regulations involved in the process in 3.1 Explain the methods of handling and storage of various gaseous and corrosive substances in the	Silver halide residue Distillation apparatus Separating funnel; organic solvent e.g. petroleum ether.	Use batch solvent extraction Recover acetone from its residues. Recover silver (Ag) from silver halide residue. Recover Mercury from its contaminated residues.	Guide students to use batch solvent extraction Guide students to carry out the practicals in column 5	Explain the methods of carrying out storage, extraction, dispensation etc List safety regulation involved in the process in column 2 Explain the methods of handling and storage of various gaseous and corrosive substances in

	gaseous and corrosive substances in the laboratory	laboratory				the laboratory
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 4.0: Understand the basic techniques of sampling					
6	4.1 List and explain types of sampling techniques e.g. riffle, coning, quartering etc. 4.2 Explain the application of sampling techniques in 4.1 above. 4.3 Explain the importance of paper sampling	Explain the types of sampling techniques Describe the application of sampling techniques	white sheets of paper. Sets of series Cellophane /nylon bags. balance oven			List types of sampling techniques and state the importance of paper sampling
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GLT Module IV: Separation Techniques GENERAL OBJECTIVES 5.0: Understand the physical and chemical principles involved in some separation methods used in the laboratory					
7	5.1 Describe the technique of solvent extraction. 5.2 Explain the principle of the partition law. 5.3 Explain why it is more efficient to extract a solute from a solution by using two or more	Describe the technique of solvent extraction Explain the principle of the partition law	Separating funnel Soxhlet extractor Distillation apparatus Condenser (leibere) round bottomed flask (about 25ml)	Perform batch extraction using a separate funnel. Mount the soxhlet apparatus and use it to separate a given	Guide student to carry out batch extraction using sepeating funnel Supevise student to mount soxhlet apparatus and use it to	Describe the technique of solvent extraction Explain the principle of the partition law

8-9	portions of an immiscible solvent than to use the same total volume in one bulk. 5.4 Describe the principle of soxhlet extraction. 5.5 Differentiate between batch and continuous extraction. 5.6 Describe how acidic and basic solvent can be used to extract basic and acidic materials respectively. 5.7 List different techniques of distillation. 5.8 Explain how to draw the apparatus assembly for simple distillation under reduced pressure. 5.9 Explain how to set up the distillation apparatus above for the purification of a flammable liquid. 5.10 Describe the principle and process of fractional distillation.	Describe the principle of soxhlet extraction Describe how acidic and basic solvent can be used to extract basic and acidic materials List different techniques of distillation Explain how to set up the distillation apparatus Describe the principle and process of fractional distillation	Heating mantle Receiver Sublimation apparatus	material e.g. soya- beans powder for oil content Set up and use a simple distillation apparatus. Use it to explain the differences between it and steam distillation fractional reflux etc	separate a given material Guide students to Set up and use a simple distillation apparatus	Describe how acidic and basic solvent can be used to extract basic and acidic materials Describe the principle and process of fractional distillation Describe the

	5.11 Describe the principle and process of steam distillation. 5.12 Define an azeotrope as a constant boiling mixture. 5.13 List applications of the various distillation procedures in industry. 5.14 Define sublimation 5.15 Describe the principle and process of sublimation as used in the purification of organic compound. 5.16 List compounds that can be purified by sublimation. 5.17 Explain how to set apparatus to be used for sublimation procedure. 5.18 Describe the principles and process of crystallization as used in the isolation and purification of compounds. 5.19 Explain filtration as a process of	Define sublimation Explain the principle and process of sublimation as used in the purification of organic compound. Describe how to set apparatus to be used for sublimation procedure Explain filtration as a process of separation and purification Explain dialysis as a process of				principle and process of steam distillation Explain filtration as a process of separation and purification Explain dialysis as a process of separation and purification

	separation and purification. 5.20 Explain dialysis as a process of separation and purification.	separation and purification				
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 6.0: Understand the collection, handling and preservation of biological laboratory specimens					
10-11	6.1 Describe the various types of traps for collecting plants and animal specimens for the laboratory. 6.2 Describe various ways of preserving and transporting plant and animal specimens to the laboratory. 6.3 List and describe different methods of preserving plants and animal specimens	Demonstrate the various methods of preserving specimen. Display collection tools Explain the various ways of preserving and transporting plant and animal specimens to the laboratory.	Various biological specimen – plants and animals. Formalin Stuffing materials	Collect specimens of various types using traps. Transport specimens to the laboratory in good conditions Prepare and preserve animal/specim in formalin by drying and by stuffing. Display preserved specimen. Preserve and display plant specimens	Supervise students for a filed trip for the collection. Demonstrate how to preserves – plant material e.g. sida acuta and animal material) by (a) war method (b) pinning	Explain the process of collecting plants and animal specimens and preservation
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 7.0: Understand the setting up and management of tropical aquarium and animal house					
12-13	7.1 List various types of aquarium tanks. 7.2 Explain the functions of the different	List various types of aquarium tanks Explain the functions of the different	A functional animal house with various species bred. Animal house	Collect selected species of fish. Organise accessories	Teacher sets up a class aquarium with the students Fill it with selected species keep it on	List various types of aquarium tanks and explain the functions of its

	accessories of an aquarium. 7.3 Describe the process of reconditioning tap water for aquarium use. 7.4 Explain how to select species of fish and plants suitable for any tropical aquarium using appropriate tables. 7.5 State provision of the cruelty Animal Act.. 7.6 Identify common laboratory animals and handle each of these animals such that it does not experience any discomfort. 7.7 Explain how to feed the animals regularly and adequately bearing in mind the need for a balanced diet. 7.8 Enumerate the different signs of ill health exhibited by animals and how to identify a sick animal.	accessories of an aquarium Explain how to select species of fish and plants suitable for any tropical aquarium State provision of the cruelty Animal Act. Demonstrate feeding and mating. Explain how to identify healthy and (sick) animals	containing animals An aquarium. Fish plant and species Animal cage	and plants correctly within the tank. Design a means of feeding organism manually bearing in mind the need for a balanced diet per day Clean the aquarium without disturbing the fish carry out in the lab the humane killing methods esp. chloroforming	for at least a month. Explain how to feed the organism manually Demonstrate how to carry out in the lab the humane killings	accessories. Describe the process of reconditioning tap water for aquarium use. State provision of the cruelty Animal Act

	7.9 Explain how to clean animal cage and ventilate it. 7.10 Distinguish between male and female species of each animal by observation. Observe animals carefully to determine when to mate them use breeding table. 7.11 Explain methods used in the laboratory for mating animals. 7.12 State the advantages and disadvantages of mating animals artificially. 7.13 State the various methods of humane killings of animals e.g. physical killings, like electrocution, stoning et and chemical killings like chloroforming	Explain methods used in the laboratory for mating animals				
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 8.0 : How to prepare a herbarium					
15	8.1 Define a herbarium 8.2 State the essential requirement of a herbarium	Define herbarium Explain the essential requirement of a	A functional herbarium	Prepare a herbarium	Send students out to collect plant materials. Demonstrat e mounting plants	List the essential requiremen t of a herbarium

		herbarium			materials for herbarium.	

Assessment:
Coursework/ Assignments 10%; Practical 40%; Examination 50%

Recommended Textbooks & References: General Laboratory Techniques for beginner professionals by Ibe, Colman C. 2008

Course: Introductory Microbiology **Semester: THIRD**	**Code:** STM 211 **Pre-requisite:**	**Total Hours: 2 Hours/Week** **Theoretical hours: 2 Hours/Week** **Practical hours STB 213: (PRACTICAL FOR STM 211,211 &212) CH: 2 CU=2**

Goal: This course is intended to introduce students' Microbiological concepts.	
GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Know the history and scope of microbiology
2	Know the microscopic examination of micro-organisms
3	Understand systematic microbiology
4	Understand growth of micro-organisms
5	Know the isolation, cultivation and preservation of different micro-organisms
6	Know the various methods of control of micro-organisms

	National Diploma	**Course Code: STM 211**		**Credit Hours: 2**

	Introductory Microbiology			**Theoretical: 2 hours/week**		
	Year: Semester:	**Pre-requisite:**		**Practical hours STB 213: (PRACTICAL FOR STM 211,211 &212) CH: 2 CU=2**		
	Theoretical Content			**Practical Content**		
	General Objective 1.0: Understand the History and Scope of Microbiology.					
Week /s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1 2	1.1 Outline the scope of microbiology 1.2 List the early scientists involved in the development of the microscope and microbiology. 1.3 Describe the role of the scientists in 1.2 above. 1.4 Explain the role of microbiology in medicine, agricultural, industry etc.	Refer students to relevant texts and asses their work up. Introduce the various aspects of microbiology. Give assignment.	Classroom and library Microscopes : Light and compound Microscopes	Examine a drop of pond water under the light and compound microscope and identify micro-organisms Continue with the experiment above	Assist students to make:- smears hanging drops, whole mounts, staining etc	Give brief description of the role of the early scientist in development microscope and microbiology
	General Objective 2.0: Know the microscopic examination of micro-organisms.					
3	2.1.Explain the principle of microscopy. 2.2.Describe all types of microscope e.g. light microscope, compound microscope, dark field, microscope, phase contrast microscope, and electron microscope. 2.3.Explain the application of each type of microscope in 2.2 above in the study of microbiology. 2.4. Describe the various microbial staining techniques e.g., spore stain, flagella stain	Describe how microscopes work, types of microscope and application Give assignment	Microscopes Microscopes Chemicals and stains microscopic slides, culture loops and laboratories reagents	Distinguish micro- organism By using staining techniques	Assist students to make:- whole mounts, staining etc Illustrate the various diagnostic method to identify the micro-organisms	Explain the functions of different types of microscope. Briefly explain staining techniques

	General Objective 3.0: Understand Systematic Microbiology					
4	3.1. Describe the characteristics of microorganisms 3.2. Describe the morphological characteristics of the following groups of micro-organism: Virus, Bacteria, Rikettsiases, Mycoplasma, Protozoa, Fungi-Algae	Explain characteristics of different forms of microorganisms	Microscopes Chemicals and stains microscopic slides, culture loops and laboratories reagents, culture media	Carry out serological tests, oxidase test, catalase test etc.	Assist students to prepare slides and observe the different microorganism under the microscope	Explain the morphological differences between the various microorganisms in 3.2
5	3.3.Explain the morphological and biochemical basis for classifying micro- organisms e.g. (a) Morphological shape, possession of flagella, capsule, vacuoles, chloroplasts etc. (b) Biochemical-Classify the different groups of microorganisms applying above	Describe the morphology of microorganisms	Classroom resources Autoclave Refrigerators	Identify by culturing, observation and measurement of growth of micro-organisms (e.g. *Rhizopus Penicillium*, *E.coli*, etc)	Supervise students to carry out the experiments	Classify microorganisms using biochemical methods

	General Objective 4.0: Understand the growth of microorganisms					
6	4.1.Explain the nutritional requirements of micro-organisms 4.2.Explain the sources of nutrient for various groups of micro-organisms.	Explain nutritional need of microorganisms	Classroom resources Autoclave Refrigerators Growth media	Prepare, sterilise and preserve microbial growth cultures.	Supervise students to carry out the experiment	Classify different organisms base on nutritional requirements And explain the sources
7	4.3.Describe the break down of food molecules by micro-organisms. 4.4. Describe the microbial growth curve. 4.5.Explain the microbial activities on each growth curve		Raw source of carbohydrate	Preserve growth on petri dishes and on agar slants.		
	General Objective 5.0: Know the isolation, cultivation and preservation of different micro-organisms					
8	5.1. List types of culture media used for different groups of micro-organisms. 5.2. Describe the composition of each of the media in 5.1 above.	Describe various culture media and their composition	Classroom resources Amino Acid vitamins etc. Autoclave Incubators Anaerobic jars	Prepare pure culture from a mixed culture.	Involve students in the preparation of culture media and sub-culturing of micro-	
9-11	5.5.Explain how microbial growth media are enhanced. 5.6.Describe various culture characteristic on agar 5.7.Describe the terms pure culture and mixed culture.			Inoculate bacteria aerobically and anaerobically using incubator and jars		

	5.8.Describe methods of maintaining pure cultures in the laboratory.					
General Objective 6.0: Know the various methods of control of Micro-organisms.						
12-14	6.1. List reasons why microorganisms should be controlled. 6.2. Explain the terms sterilization; disinfecting. 6.3. Describe various methods of (a) physical disinfecting and sterilization (b) chemical disinfecting and sterilization. 6.4. Describe modes of action of various chemical anti-microbial agents. 6.5. Explain the term inhibiting agents	Lecture Assignments	Blackboard Chalk Charts Monographs Dusters	Apply of safety precautions involved in Microbiological works Sterilize various laboratory objects using the autoclave. Grow micro-organisms (e.g. *Mucor, Aspergillus*) under aseptic	Conduct practicals to know the mode of actions of inhibitors.	Autoclave Petri dishes Culture apparatus Microscopes stains
15	Describe the procedure for transporting culture samples from one laboratory to the other	Lecture Assignments			Demonstration of aseptic techniques	

Course: PEST AND PESTS CONTROL **Semester: THIRD**	**Code:** STB 211 **Pre-requisite:**	**Total Hours: 2 Hours/Week** **Theoretical hours: 2 Hours/Week** **Practical hours STB 213:** **(PRACTICAL FOR STM 211,211 &212)** **CH: 2 CU=2**

Goal: This course is designed to provide students with knowledge of different pest, identification and control.

GENERAL OBJECTIVES

On completion of this module students should be able to :

1	Know animal phyla containing pests
2	Know plant parasitic nematodes
3	Know the characteristics of the Importance orders of Insects of agricultural importance
4	Understand the Importance of Vertebrate Pests in our Agricultural Systems
5	Understand various crop Protection Techniques
6	Understand the formulation, types, protection and modes of action of pesticides

	Course: Science Laboratory Technology	**Course Code:**			**Credit Hours: 2**	
	Subject/Course: **Pests and Pest Control**	**STB 211**			**Theoretical: 2hours/week**	
	Year: Semester:	**Pre-requisite:**			**Practical hours STB 213:** **(PRACTICAL FOR STM 211,STB211 & STB 212)** **CH:2 CU= 2**	
	Theoretical Content			**Practical Content**		
	General Objective 1: Know animal phyla containing pests					
Week /s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1	1.1 List animal pests belonging to the phyla: Nematoda, Mollusca, Arthropoda and Chordata. 1.2 Classify Arthropoda pests into the Insecta, Symphyla, (symphilids), Arachnids (mites) the Diplopoda (Millipedes) and the Crustacea (woodlice). 1.3 Describe Molluscan pests i.e. slugs and snails which are incompletely adapted to land life	Explain animal pests belonging to the phyla: Nematoda, Mollusca, Arthropoda and Chordata. Classify Arthropoda pests into the Insecta, Symphyla, (symphilids), Arachnids (mites) the Diplopoda (Millipedes) and the Crustacea (woodlice). Exemplify Molluscan pests i.e. slugs and snails which are incompletely adapted to land life.	Chalkboard	Identify the animals in the lab. Show the locomotion of molluscans	Lead students to give examples Take students to Snairy in the Biological garden.	Name pests belonging to the phylum: Nematoda, Mollusca, Arthropoda and Chordata.
	General Objective 2: Know plant parasitic nematodes					

2-4	1.4 Describe the life history of *Globafera rostochiensis* 1.5 Explain the life history of Meloidogyne incognita 1.6 List the major crops that are susceptible to nematode attack. 1.7 Describe the various control measures of reducing nematode in the soil. 1.8 Explain the economic importance of nematode infections.	Explain the life-cycle of *Globafera rostochiensis* List crops that are susceptible to nematode attack. List the various control measures of reducing nematode in the soil.	Video tapes, Charts showing destructive activities of nematodes	Identify the animals in situ Continue above practical	Fields	Describe the life history of Globafera rostochiensis How can nematode in the soil be reduced.
	General Objective 3: Know the characteristics of the Importance orders of Insects of agricultural importance					
5	3.1. Describe the diagnostic features of the following orders: (a) Hemiptera, (b) Lepidoptera, (c) Coleoptera(d) Diptera (e)Hymenoptera 3.2. Explain the life history, mouthparts and special adaptive features of members of the orders Hemiptera and Lepidopteron i.e. plant bugs and butterflies and moths.	Explain the diagnostic features of the orders: Hemiptera, Lepidoptera, Coleoptera, Diptera, Hymenoptera		Examine dry mount of mouthparts of insects in 3.2 and draw	Assist students to make dry mount of mouth part and examine	Elucidate the diagnostic features of the orders: Hemiptera, Lepidoptera, Coleoptera, Diptera, Hymenoptera
	General Objective 4: Understand the Importance of Vertebrate Pests in our Agricultural Systems					
6-7	4.1. Describe the diagnostic features of birds and mammals. 4.2. Describe the menace of rodents, squirrels, monkeys, elephants warthogs constitute on the farms. 4.3. Appreciate the role of birds in ravaging on cereals farms. E.g. partridge, quelea birds.	Explain the diagnostic features of birds and mammals. Explain the menace of rodents, squirrels, monkeys, elephants warthogs constitute on the farms.	Films, Video, Charts and other teaching aids			Explain the diagnostic features of birds to flight and mammals toenvironment. What are the

	4.4. List the measures adopted in the control of rats, mice and roaches.	Explain the role of birds in ravaging on cereals farms. E.g. partridge, quelea birds. Explain the measures adopted in the control of rats, mice and roaches.				menace of rodents, squirrels, monkeys, elephants warthogs constitute on the farms. How do you control birds? List the measures adopted in the control of rats, mice and roaches.
	General Objective 5: Understand various crop Protection Techniques					
8-9	5.1. Describe the use of resistant varieties of crops to overcome pests. 5.2. Explain the elimination of alternative host plants. 5.3. Describe biological techniques applied in the control of pests. 5.4. Enumerate factors considered in biological control of pests	Enumerate the use of resistant varieties of crops to overcome pests. Explain the elimination of alternative host plants and biological techniques applied in the control of pests. Explain factors considered in biological control of pests	Variety of sample crops.	Apply a Biological technique to control pest in the greenhouse	Take students on a field-trip to see the application of a biological technique to control of pest in a greenhouse	Name resistant varieties of crops used to overcome pests.
10-11	5.5. Enumerate cultural methods adopted in the control of various pests.	Explain the cultural methods adopted in the		Demonstrate the use of	Guide students in the	What are cultural

	5.6. Differentiate advantages and disadvantages of cultural pest control methods. 5.7. Describe chemical methods adopted in the control of pests. 5.9.Explain the integrated pest management as a technique of pest control involving more than one method of pest control.	control of various pests such as the uses of neem leaves, ashes and dry chili pepper in control of weevils in beans preservation. Explain the advantages and disadvantages of cultural pest control methods and the integrated pest management technique of pest control		pheromones in the control of pests.	use of pheromones in the control of pests.	methods adopted in the control of various pests?
	General Objective 6: Understand the formulation, types, protection and modes of action of pesticides					
12-14	6.1 Define pesticides. 6.2 Describe types of pesticides formulation liquids, formulation – emulsified concentrates e.g. inflammables, aerosols and liquefied gases; 6.3Explain the factors affecting pesticide activity. 6,4 Exemplify pesticides into insecticides, agaricides, nematicides, fungicides, herbicides, rodenticides, molluscicides, repellents, attractants, and plant growth regulators. 6.5 Group pesticides into inorganic, plant derived, organic and synthetic pesticides. 6.6 Describe pesticides as protectants, sterilants, contacts, stomach poisons, systemics, translocated herbicides and fumigants. 6.7 Describe the various methods of application	Define pesticide List out types of pesticides; formulations liquid formulation emulsified concentrates e.g. flowables, aerosols and liquefied gases. Explain the grouping of pesticides into inorganic, plant derived, organic and synthetic pesticides. Explain the functioning of pesticides as protectants, sterilants, contacts, stomach poisons, systemics, translocated herbicides and fumigants.	Pesticides, sprayers, containers, farm/garden	Prepare pesticides Apply pesticides Observe the mode of action of the pesticides Control insect pests and rodents.	Define pesticide Take students for a trip to see the preparation and application of pesticides. Pesticides, appliances used in the application of pesticide Glasshouse	Explain types of pesticides, its application

	of pesticides.	Explain the various methods of application of pesticides.				
	General Objective 7 : Understand the hazards that may result from the use of pesticides					
15	7.1. Enumerate the precautions necessary for safe use of pesticides. 7.2. List the hazards of pesticide use, to man and environment. 7.3. Describe the first aid procedures to be adopted in case of pesticide poisoning of humans. 7.4. Describe the precautions to be taken in pesticide transportation and storage. 7.5. Describe the maintenance of pesticide equipment.	List the precautions necessary for safe use of pesticides. List the hazards of pesticide use, to man and environment. Explain the first aid procedures to be adopted in case of pesticide poisoning of humans. Explain the precautions to be taken in pesticide transportation and storage. Explain the maintenance of pesticide equipment.	Sprayers, hand pumps	Demonstrate equipment maintenance	Show students ways to maintain pesticide equipment.	Describe the maintenance of pesticide equipment.

Course: PATHOLOGY	**Code:** STB 212 **Pre-requisite:**	**Total Hours: 1 Hours/Week** **Theoretical hours: 1 Hours/Week**

Semester: 1 YEAR 2		**Practical hours STB 213: (PRACTICAL FOR STM 211,STB211 & STB 212) CH:2 CU= 2**
Goal: This course is designed to acquaint students with knowledge of plants and animals pathogens, effects and control.		
GENERAL OBJECTIVES		
On completion of this module students should be able to :		
1	Know common terminologies in parasitology	
2	Know diseases caused by protozoan	
3	Know parasitic platy helminthes of medicinal and veterinary importance	
4	Know diseases caused by nematodes	
5	Understand the nature of gland diseases and their transmission and control	

PROGRAMME: NATIONAL DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY						
COURSE TITLE: PATHOLOGY		**COURSE CODE: STB 212**		**CONTACT HOURS: 1 HRS/WEEK**		
COURSE SPECIFICATION: **Theory 1**				**Practical hours STB 213: (PRACTICAL FOR STM 211,STB211 & STB 212) CH:2 CU= 2**		
General Objectives:1 Know common terminologies in parasitology						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
1- 4	1.1 Define the following terms in parasitism with examples in:- symbiosis, parasitism, commensalisms, definitive host, intermediate host and vector.	Explain parasitism examples:-symbiosis, parasitism, commensalisms, definitive host, intermediate host and vector.	Charts, Films, Video, Charts and other teaching aids	Identify the mode of Symbiosis, parasitism, and commensalisms on definitive host, intermediate host and vector.	Show with aids of illustration the mode of Symbiosis, parasitism, and commensalisms on definitive host, intermediate host and vector	Define parasitism in relation to symbiosis, commensalism, definitive host intermediate host and vector.

	1.2 Describe adaptations to parasitism	Explain adaptations to parasitism.				
General Objective: 2 Know diseases caused by protozoan						
5-7	2.1 Describe the life-cycle, mode of infection and economic importance of the following protozoan class: *Rhizopoda-Entamoeba histolytica, Mastigophora-Trypanosomagambienze T. rhodisence of T.brucei, Sporozoa e.g. Plasmodium.* 2.2 Explain the methods of control of infection by the protozoa listed in 2.1 above.	Explain the life-cycle, mode of infection and economic importance of the following protozoan class: *Rhizopoda-Entamoeba histolytica, Mastigophora-Trypanosomagambienze T. rhodisence of T.brucei, Sporozoa e.g. Plasmodium.* Describe the methods of control of infection by the protozoa listed in 2.1 above.	Charts Films, Video, Charts and other teaching aids	Examine blood, stool for living specimens of protozoa in 2.1 above. Draw from prepared slides of specimens in 2.1 above.	Guide students in the practical works. Guide students in the drawing.	Describe the life-cycle and mode of infection of protozoan.
General Objective: 3 Know parasitic platy helminthes of medicinal and veterinary importance						
8-11	3.1 Explain the life history, location of parasites within the host and economic importance of *Trematodes e.g. Fasciola hepatica or T. gigantica, Schistosoma mansoni and S. haematobium, Taenia saginata and T. solium*	Explain the life history, location of parasites within the host and economic importance of *Trematodes e.g. Fasciola hepatica or T. gigantica, Schistosoma mansoni and S. haematobium, Taenia saginata and T. solium*	Prepared slide Microscope Urine contaminated with the parasites Microscopes, slides, spirit.	Collect urine and stool specimens to detect presence of parasites listed in 3.1.	Guide students in the practical work.	Describe the life history, location of *Fasciola hepatica, Schistosoma mansoni T. saginata*

	3.2 Describe mode of transmission of Trematodes and cestodes listed in 3.1. 3.3 Describe preventive/control measures against trematodes and cestodes.	Explain the mode of transmission of each type of Trematodes and cestodes listed in 3.1 above Explain preventive/control measures against trematodes and cestodes.		Draw specimens of adult parasites and eggs from prepared slides	Guide students in the experiment.	Describe mode of transmission of Trematodes and cestodes.
General Objective: 4 Know diseases caused by nematodes						
12-15	4.1 Explain the life-history of Ascaris lumbricoides, the hookworms of man Ancylostoma and Necator, the filarial worms – Wuchereria bancrafti, Onchocera volvolus and /or Loa loa and Guinea worm; Dracunculus medinensis. 4.2 Enumerate the economic importance of the listed organisms listed 4.1 4.3 Describe the mode of transmission and agent of disease in 4.1 above. 4.4 Describe the control of parasites in 4.1 above	Explain the life-history and economic importance of Ascaris lumbricoides, the hookworms of man Ancylostoma and Necator, the filarial worms – Wuchereria bancrafti, Onchocera volvolus and /or Loa loa and Guinea worm; Dracunculus medinensis. Explain the mode of transmission and agent of disease in 4.1 above. Explain the methods of control of parasites in 4.1 above	Chart Prepared slide Microscopes magnifying glass.	Examine infected stool for eggs of parasite, blood or tissue fluid for larvae of parasites.		
General Objective: 5 Understand the nature of gland diseases transmission and control in plants.						
	5.1 Outline the scope of	Outline the scope of plant	prepared slides	Identify infected plant	Guide students to prepare slide	

	plant pathology. 5.2 Recognize the following basic terms in plant pathology; pathogen, parasites, pathogenesis. 5.3 Describe the general nature of fungal diseases of plants. 5.4 Describe the general nature of bacterial diseases of plants. 5.5 Describe the general nature of viral diseases of plants. 5.6 Describe the generalized structure and life cycle of a viral particle. 5.7 Describe the epidemiology, causative agents, lifecycle and control of the following fungal diseases: black pod of cocoa, damping off of seedling, leaf spot of groundnut; rusts and smuts of maize, rice blast. 5.8 Describe the epidemiology of the following bacterial diseases, blights of Soya beans, rut off disease; citrus canker;	pathology. Explain the following basic terms in plant pathology; pathogen, parasites, pathogenesis Explain the general nature of fungal, bacterial and viral diseases of plants. Explain the generalized structure and life cycle of a viral particle. Explain the epidemiology, causative agents, lifecycle and control of fungal diseases: black pod of cocoa, damping off of seedling, leaf spot of groundnut; rusts and smuts of maize, rice blast. Explain the epidemiology of bacterial diseases; blights of Soya beans, rut off disease; citrus canker; bacterial spot of tomato.	Microscopes	parts e.g. fruits, seeds, leaves, stem, and seedlings. culture media	from infected plant. Collect and examine macroscopically and microscopically infected plant specimens and identified the pathogens causing diseases in them.	List the general nature of fungal diseases of plants. Describe the life cycle of a viral particle. Outline the epidemiology, causative agents, lifecycle and control of fungal diseases: black pod of cocoa, damping off of seedling, leaf spot of groundnut;

	bacterial spot of tomato. 5.9 Describe the epidemiology of the following viral diseases, cocoa swollen shoot, and cassava mosaic. 5.10 Describe the life history of vectors of plant diseases of aphids. 5.11 Explain the Koch's postulates of establishing pathogen city of disease. 5.12 Describe the general principles of plant disease control-exclusion, eradication, protection and resistance or immunization principles. 5.13 Explain the application of the control principles to a sspecific plant disease.	Explain the epidemiology of viral diseases; cocoa swollen shoot and cassava mosaic. Explain the life history of vectors of plant diseases of aphids. Discuss the Koch's postulates of establishing pathogen city of disease. Enumerate the general principles of plant disease control-exclusion, eradication, protection and resistance or immunization principles. Discuss the application control principles to specific plant disease.				rusts and smuts of maize, rice blast. Explain the life history of aphids What is Koch's postulate?

	Programme: ND Science Lab.	**Course Code:**		**Credit Hours:1**

	Technology			
	Course: Inorganic Chemistry 11 & PRACTICALS	**STC 211 & 223**		**Theoretical: 1 hours/week**
	Year: Semester:	**Pre-requisite:**		**Practical hours STC 213: (PRACTICAL FOR STC 211, & STC 212) CH:1 CU= 1**

General Objectives

1. Understand the relation of alkali and alkaline metals to atoms

2 .Understand the electronic configuration of group 1 elements

3. Understand the electronic configuration of group 2 elements

4. Understand the gradation in properties of elements

5. Understand the effects of the presence of group II metal ions in water

6. Understand the relationships in properties of elements of group III and group IV

7. Understand the occurrences, properties and reactions of the halogens

	National Diploma	**Course Code: STC 211**		**Credit Hours: 2**		
	Inorganic Chemistry 11			**Theoretical: 2 hours/week**		
	Year: Semester:	**Pre-requisite:**		**Practical hours STC 213: (PRACTICAL FOR STC 211, & STC 212) CH:1 CU= 1**		
	Theoretical Content			**Practical Content**		
	General Objective 1.0: Understand the relation of alkali and alkaline metals to atoms					
Weeks	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
1-2	1.1.Explain that the alkali metals are all group 1 elements and have one electron in their outer most orbital. 1.2. List the elements in	Lecture and give notes on group 1 element.	Classroom resources models (or model making materials such	students handle models of s, p and d orbitals	guide students to read the electronic configuration charts/ models	What are Alkaline metals List the elements in group 1 as in 1.1 above

	group 1 as in 1.1 above 1.3.Write the electronic configuration of the atoms of these elements in group 1 in terms of s,p,d orbital. 1.4.Explain the following properties of some metals based on their atomic sizes:- a) Softness b) Low density c) Low melting point.	Explain the electronic configuration of atom	as modelling baloons)			.Write out the electronic configuration of elements in group 1 in terms of s,p,d orbital. State the following properties of some metals based on their atomic sizes:- a) Softness b) Low density c) Low melting point.
General Objectives:2.0. : Understand the electronic configuration of group 1 elements						
3	2.1Explain why the electronic configuration of these elements in 1.4 above confers many similarities in chemical behaviour on them e.g. a) reactivity b) univalence c) formation of ionic compounds d) strong reducing agents low ionization energy	Discuss configuration of these elements in 1.4 above confers many similarities in chemical behaviour on them e.g.reactitivity etc.	Classroom resources chemicals safety screen test tubes etc www.chemsoc.org/pdf/learnnet/classicdemos/Alkalimetals.pdf	lecturer (NOT student) performs demonstration of the reactivity of Li, Na and K in water	Do the demonstratn do not allow students to do it.	Mention reasons behind the electronic configuration of these elements group 1 element confers many similarities in chemical behaviour on them e.g. Reactivity univalence

						formation of ionic compounds strong reducing agents and low ionization energy
4	2.2. Describe changes in the general properties of the atom and the corresponding ions of these elements in group 1 on descending the group viz: atomic size, ionic size, ionization energy, electroegativity. 2.3.Explain the differences between lithium and the other group 1 elements	Lecture and give comprehensive notes	Transition chart	demonstration of the reactivity of Li, Na and K in concentrated HCl	Guide students appropriately	Explain group 1 element in terms of the following; atomic size, ionic size, ionization energy, electronegativity.
	General Objective: 3 Understand the electronic configuration of group 2 elements					
5	3.1 Describe the electronic	Discuss the electronic	Classroom	Demonstrate	do the	

	configuration of alkaline earth metals-group II. 3.2.List the elements in group II. 3.3.Describe changes in the general properties of the atom and the corresponding ions of these elements in group II on descending the group viz: atomic size, ionic size, ionization energy, electroegativity.	configuration of alkaline earth metals-group II and List the elements in group II. Discuss changes in the general properties of the atom and the corresponding ions of these elements in group II on descending the group viz: atomic size, ionic size, ionization energy, electroegativity.	resources textbooks	the reactivity of Mg and Ca in water and in some acidic solvents	demonstratio n do not allow students to do so	
	General objective 4.0: Understand the gradation in properties of elements					
6.	4.1 Describe the gradation in the properties of the elements in group II in terms of metallic characteristics and chemical behaviour. 4.2.Relate the properties shown by elements in	Lecture and give notes	Periodic table eye protection see www.chemsoc.org/networks/learnnet/classic_exp.	React Mg with dilute HCl and measure the volume of H2 gas produced by using an inverted burette.	Guide and supervise students	Discuss generally group 11 elemnt

	groups I and II with respect to:- a)electronic configuration; b)atomic and ionic radii c)ionization energies d)lattice and bond energies		htm			
7-8	4.3.Explain the similarities between alkali metals and alkaline earth metals. 4.4.Explain the differences between alkali and alkaline earth metals. 4.5.Explain the anomalous behaviour of beryllium 4.6.Explain reasons why lithium resembled group II metals.	Outline the similarities between alkali metals and alkaline earth metals and differences between alkali and alkaline earth metals. Discuss the anomalous behavior of beryllium and reasons why lithium resembled group II metals.		Investigate the ease of decomposition of Na, K, Pb and Cu carbonates	Ensure students carry out experiment on alkaline and non alkaline metals	List similarities between alkaline and earth metal alkaline. Enumerate why lithium resembles group 11 metal
General Objective 5.0: Understand the effects of the presence of group II metal ions in water						
9-11	5.1 Differentiate between temporary and permanent hardness. 5.2. State the disadvantages of hard water 5.3.Describe methods of removal of hardness.	Discuss temporary and permanent hardness.	Laboratory resources	Remove water hardness by distillation, addition of Mg_2CO_3 Determine hardness of water	Ensure students carry out experiment on water hardness using EDTA	What is water hardness What are substance responsible for water hardness Mention methods of removal of hardness.

	5.5. Explain how the complexity agent EDTA may be used to estimate the amount of Ca++ and Mg++ present in water.			using EDTA titration.		
General Objective 6: Understand relationships in properties of elements of group III and group IV						
12-14	6.1.List the elements in groups III and iV respectively. 6.2.Write the electronic configuration of the elements in group III and IV 6.3.Describe the gradation in the properties of the elements of groups III and IV with respect to:- a) metallic characteristics b) nature of bonding in their chlorides c) relative stability of their oxidation state. d) Acidic/basic nature of their oxides. 6.4 Explain the diagonal relationship between Boron and Silicon 6.5.Explain why properties of the first element in the group differ from those of the other members. 6.6.Relate properties of the elements in groups III and IV to their uses.	Discuss the elements in groups III and iV respectively and write the electronic configuration of the elements in group III and IV Lecture and give comprehensive notes Discuss the	Consumables such as; chlorine, bromine, and iodine water indicator paper KCl, KBr, and KI etc. see www.chemsoc.org/networks/learnnet/classic_exp.htm	Investigate the properties of carbon (lead from a pencil) and aluminium (aluminium foil) by testing conductivity and reaction with acid	Ensure students properly perform experiments on Acidic/basic nature of their oxides.	Mention elemet in group 111 and IV .then, state their properties and their uses. What is the diagonal relationship between boron and silicon

		properties of the first element in the group differ from those of the other members and relate properties of the elements in groups III and IV to their uses.				
General Objective 7 Understand the occurrences, properties and reactions of the halogens						
15	7.1.List the halogens and describe the occurrences of halogens in nature. 7.2.Write the electronic configuration of the halogens. Describe the elemental forms of group VII elements.	Define halogens and discuss the occurrences of halogens in nature. Write the electronic configuration of the halogens.	Consumables(on halogens test tubes, alcohol, iodine, thermometer test tubes filter paper etc	Ask students to Identify fluorine, chloride, bromide and Iodine ions in the laboratory	Ensure students properly perform practicals on group V11 element	What are halogens State physical and chemical properties of group V11 element as; i) Down group ii) Across goup
	7.3.Describe the physical and chemical properties of fluorine, chlorine, Bromide and Iodine. 7.4.Compare the acid strengths of fluorine, chlorine, bromine and iodine	Outline the physical and chemical properties of fluorine, chlorine, Bromide and Iodine. Discuss the		Reaction of Iodine with zinc to give a salt		Explain the preparation of group V11 elements.

	7.5 Describe the preparation and properties of oxycompounds of halogens, oxyacids of chlorine.	preparation and properties of halogens and oxyacids of chlorine.				

Assessment:
Course test 10 %; Practical 40 % Examination 50%

Recommended Textbooks & References:

Chemistry by M.J. Sienko and R.A. Plane (Mc Graw Hill)
Chemistry (The Molecular Nature of Matter and Change) by M.S. Silberberg published by Mc Graw Hill Classic Chemistry Experiments published by The Royal Society of Chemistry (UK) and free on the internet at http://www.chemsoc.org/networks/learnnet/classic_exp.htm
Salters Advanced Chemistry Activities and Assessment Pack published by Heinemann

	Programme: ND Science Lab. Technology	**Course Code:**		**Credit Hours:2**
	Course: **Analytical Chemistry and quality control &223**	**STC 212**		**Theoretical: 2 hours/week**
	Year: Semester:	**Pre-requisite:**		**Practical hours STC 213: (PRACTICAL FOR STC 211, & STC 212) CH:2 CU= 2**

General Objectives

1 **Understand the principles of spectrophotometry**

2 **Understand the principles of atomic spectroscopy**

3 **Understand the principles of ion selective electrodes**

4 **Understand the principles of mass spectrometry**

5 **Understand the principles of NMR**

6 **Further understand the techniques of HPLC and GC**

7 **Understand the principles of Quality Control**

	National Diploma	**Course Code: STC 212**		**Credit Hours: 4**	
	Analytical Chemistry and Quality Control	STC 212		**Theoretical: 1 hours/week**	
	Year: Semester:	**Pre-requisite:**		**Practical hours STC 213: (PRACTICAL FOR STC 211, & STC 212) CH:2 CU= 2**	
	Theoretical Content		**Practical Content**		
	General Objective 1.0: Understand the principles of spectrophotometry				
Weeks	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
1	1.0.Revise the properties of light, including frequency, wavelength and energy 1.2. Discuss the electromagnetic spectrum 1.3. Relate the energy associated with different regions of the electromagnetic spectrum to interactions with matter.	Illustrate with examples the properties of light, including frequency, wavelength energy and Relate the energy associated with	Prisms, diffraction gratings, light source	Use of prisms and diffraction gratings to explore the properties of light	Demonstrate and allow students to explore	What is electromagnetic spectrum Mention properties of light

	E.g. electronic and molecular absorption, molecular vibrations and rotation and proton orientation in magnetic field.	different regions of the electromagnetic spectrum to interactions with matter. E.g. electronic and molecular absorption, molecular vibrations and rotation and proton orientation in magnetic field.				List regions at which electromagnetic spectrum interact with matter.
2	1.4 Understand the basic principles of light absorption 1.5. Understand the Beer-Lambert law and its limitations 1.6. Discuss emission spectra Describe the instrumental set-up of single and double beam spectrophotometers 1.7.Understand the characteristics of UV-Visible absorption spectroscopy	Lecture	Classroom resources	Determination of phosphate in cola by UV-visible spectrometry	Demonstrate and guide students	Spectromete r, cola samples, phosphate standards
3	1.8.Understand the characteristics of Infrared spectroscopy, including fourier transform and interferometry	explain the characteristics of Infrared spectroscopy, including fourier	Classroom resources	Determination of Cr(VI) in water by UV-Visible spectrometry	Guide students on practical aspect using Infrared spectroscopy,	State the application and uses of UV-Visible spectrometry, Infrared spectroscopy,

	1.9.Understand the principles of flow injection Analysis, and its application to spectroscopy 1.20. Discuss the principles and applications of immunoassays	transform and interferometry			fourier transform and interferometry and UV-Visible spectrometry	fourier transform and interferometer What is mmunoassays
	General Objective 2: Understand the principles of atomic spectroscopy					
4	1.1.Discuss the principles of atomic spectroscopy 1.2.Discuss different methods to atomise samples – flames, furnaces and plasmas 1.3. Discuss the effect of temperature on atomic spectroscopy – Boltzmann distribution 1.3.Understand the principles of Atomic Emission Spectroscopy (AES) 1.4.Discuss flame emission spectroscopy 1.5.Explain the relationship between the emission intensity of colour flame and concentration of substance 1.6. Understand how a flame photometer works	Explain with relevant examples principles of atomic spectroscopy Outline the effect of temperature on atomic spectroscopy – Boltzmann distribution Discuss the effect of temperature on atomic spectroscopy using Boltzmann distribution and application of FIS	Laboratory resources such as ; AAS Machine Flame photometer	Determine alkali and alkaline earth metals using flame photometer (flame AES)	Guide students in sample preparation, demonstrate of equipment	State the principles and applications of atomic spectroscopy in boltmann distribution What are the application of flame emission spectroscopy, including flame photometry.

	1.7. Draw a schematic diagram of a flame photometer 1.8.Understand the applications of flame emission spectroscopy, including flame photometry	and Flame photometer.				
5	1.9.Understand the principles of Atomic Absorption Spectroscopy (AAS) and how it differs to AES 1.10.Discuss the application of the Hollow Cathode Lamp (HCL) as a light source Discuss applications and sensitivity of AAS	Explain the principles of Atomic Absorption Spectroscopy (AAS) and how it differs to AES	Classroom resources	Determination of copper in aqueous solution using AAS and the method of standard additions	Guide students in sample preparation, demonstrate equipment	Explain how to apply Hollow Cathode Lamp as light source in AAS. State the application of AAS.
General Objectives: 3.0. Understand the principles of ion selective electrodes						
6	3.1.Understand how the Nernst equation can be applied to ISEs 3.2.Understand the relationship between activity and concentration 3.3.Discuss the effect of ionic strength on activity and	Explain how Nernst equation can be applied to ISEs. Discuss the activity and concn of ISEs	Classroom resources, calculators	Use of pH electrode in a titration	Demonstrate and guide students	State the purpose of ISEs to Nernst equation.

7	the use of TISAB in ISE experiments Discuss the selectivity of ISEs 3.2 Calculate the percentage error from interfering species 3.3.Describe the glass membrane electrode (pH) Discuss the possible errors in pH measurement 3.4.Describe the types of solid state membrane ISEs Discuss one or two examples of solid state ISEse.g. fluoride electrode 3.5.Describe ion exchange and liquid membrane Electrodes 3.6.Discuss one or two examples of ion exchange and liquid membrane ISEs e.g. Ca^{2+} 3.7.Briefly discuss gas sensing electrodes Discuss calibration of ISEs	Lectures and give notes EXPLAIN ion exchange and liquid membrane Electrodes	Classroom materials Toothpaste, tap water (spiked if necessary), fluoride ISE	Analyse the fluoride content in toothpaste and tap water using the fluoride ISE	Demonstrate and guide students Show and guide students on preparation of ion exchange membrane.	What is the use o TISAB in ISE experiment List step involved in use of TISAB State example of gas sensing electrodes
8	3.8.Discuss the various elements of a mass spectrometer: ioniser, ion analyser, detector Draw a schematic of a mass spectrometer Understand	Lectures and give comprehensive	Classroom resources	Determination of caffeine by UV- visible spectrometry	Guide students on the use of Spectromete in 24/7	List various typs of mass spec available in carry out basic principle of mass

	the basic principles of mass spectrometry 3.9. Discuss the applications of mass spectrometry e.g. determination of RAM, RMM and molecular formulae	Explain the application of mass spectrometry	Display chart of mass spectromety	Use mass spec to determine RAM, RMM	Same activity above	Explain the use of mass spectrometry .
9	3.10.Understand how to identify the molecular ion in a mass spectra and relevant isotopes 3.11. Discuss how to identify possible fragmentations for compounds Interpret basic mass spectra	Explain how to identify molecular ion, fragramentation in a mass spectra and	Classroom resources, sample mass spectra	Experiment: preparation and then analyse printed mass spectra for sample.		State step used in indentify molecular ion using mass spectrometry
10	3.12.Discuss how chemically distinct hydrogens produce a resonance in the NMR spectra	Explain chemical distinct of hydrogen produced in the NMR	Classroom resources	Determination of sodium, calcium and potassium in	Guide students	State the principle of NMR

11	3.13.Discuss how integration provides information on the relative numbers of different hydrogens 3.14.Discuss the basic principles of chemical shift 3.15.Understand the concept of splitting (without J numbers) 3.16.Interpret basic NMR spectra without splitting (using printed examples) 3.17.Interpret basic NMR spectra with simple splitting (using printed examples) Predict NMR spectra for simple example	Lectures/worksho p	Classroom resources, sample NMR Spectra Sample NMR spectra	tap water by flame photometry (flame AES) Analyse printed NMR spectra	Guide students	
General Objective 6: Further understanding of HPLC and GC						
12	6.1 Discuss the effect of migration rates and zone broadening on resolution of chromatographic techniques 6.2. Discuss the types of detector systems used for GC: Flame Ionisation Detectors (FID), Thermal	Dicuss the various techniques in chromatograph Explain various types of dectectors used for flame photometer, TCD	Use practical manual I GC, Micro processor conductivity meter etc.	Determination of caffeine and aspirin in analgesic remedies by HPLC. Compare results with UV-Vis experiment	Supervise students to Carry out techniques use in HPLC to determine aspirin and caffeine in anagestics	State the importance of migration rates and zone broadening in chromatographic techniques State applications and use of Flame ionization dectector,

	Conductivity Detectors (TCD), Sulphur Chemiluminescence Detector (SCD), Electron Capture Detector (ECD), Atomic Emission Detector (AED), Thermionic Detectors (TID), Flame Photometric Detector (FPD) 6.3.Discuss stationary phases and types of column (packed and open tubular columns) and their applications 6.4.Draw a schematic of a gas chromatograph 6.5. Discuss the retention index (I) as a means of identifying solutes from a chromatogram 6.6.Discuss how GC may be coupled to mass spectrometry and FTIR and what advantages this gives	, FID, ECD,AED etc. Explain stationary phases and types of column (packed and open tubular columns) and their applications Sketch schematic of a gas chromatograph Outline the retention index (I) as a means of identifying solutes from a chromatogram Explain how the GC will be coupled to mass spectrometry and FTIR, and state the cons		Perform practicals that involve the use of Flame photo,ECD. FPD,SCD, TID etc	Supervise students to use Flame photo,ECD. FPD,SCD, TID etc	ECD, SCD . Explain the stationary and mobile phase in chromatograph techniques Draw a schematic of a gas chromatograph Explain how the GC will be coupled to mass spectrometry and FTIR, and state the conc.
13	6.7.Understand the properties of liquid chromatographic columns and packings for HPLC	Explain the properties of liquid chromatographic columns and packings for HPLC	Laboratory lecture on HPLC	Determine benziodiazapines	Guide students to use HPLC in run analysis as specified Help students know the	Mention the properties of liquid substance in preparation for column chromatograph and HPLC

					different type of detectors use in Mass spectrophotometers, FTIR etc.	
	6.8.Discuss mobile phase selection 6.9.Discuss the types of detectors used in HPLC e.g. absorbance, fluorescence, electrochemical, FTIR, mass spectrometry etc Discuss applications of HPLC	Explain mobile phase and types of dectectors used in HPLC / the application of HPLC		(namely nitrazepam and diazepam) in proprietary tablets using HPLC		State how to select mobile phase using HPLC Mention different detectors used in AAS, FTIR and mass spectrometry
General Objective 7: Understand the principles of Quality Control						
14	7.1. Discuss the role of Good Laboratory Practice and Quality Control in the laboratory 7.2. Discuss the ISO 9000 series of standards for quality assurance and quality management. Understand the need for Certified Reference Materials (CRM) 7.3.Discuss the role of Standard Operating Procedures (SOP) and what they should cover.	Discuss the role of Good Laboratory Practice and Quality Control in the laboratory	Classroom resources Resources for chosen experiment	Follow an SOP, including sample preparation and results analysis (open choice of method).	Guide students	What are the role of good laboratory practice and quality control in the laboratory What do understand by the word SOP
15	7.4.Discuss the validation of analytical methods:	Explain the analytical	Blackboard, chalk,	Compare class results of above	Guide students	Explain the role od accredited

	specificity or selectivity; accuracy; precision; recovery; range; interferences. 7.5.Discuss the role and scope of accredited laboratories and the accreditation procedure 7.6.Discuss the use of quality control charts and other documentation 7.1 Discuss the use of CRMs and statistics for Inter- laboratory trials 7.10 Quality Assurance Principle 7.11 Quality Control 7.12 Good Manufacturing Practices 7.13 Concept of Computer Application & Validation 7.14 Development of Check Sample 7.15 Proficiency Testing 7.16 Laboratory Management & Administration 7.17 Laboratory Equipment Procurement & Auditing 7.18 Laboratory Equipment Calibration & Validation	methods use for selectivity; accuracy; precision; recovery; range; interferences. Explain the use of CRMs and statistics for Inter- laboratory trials etc. Explain the Concept of Computer Application & Validation Development of Check Sample Proficiency Testing Laboratory Management & Administration Laboratory Equipment Procurement & Auditing Laboratory Equipment Calibration & Validation in the	calculators Magnetic Board and Marker	experiment as part of an 'inter-laboratory trial' This course will provide the students with an awareness and understanding of quality assurance terminology and selected standards and regulatory approaches that they are likely to meet.	and set up collaboration and discussion of results Teach, guide and supervise students Same sa above activity	laboratories and their procedures Explain selectivity; accuracy; precision; recovery; range; interferences. What is the use of CMSs and statistics for inter- laboratory State the importance of Computer Application &Validation Development of Check Sample and Proficiency Testing Explain the following; i)Laboratory Equipment Procurement& Auditing ii) Laboratory Equipment Calibration & Validation

Assessment:
Coursework/ Assignments Course test 10%; Practical 40%; Examination 50%

Recommended Textbooks & References:

D.A. Skoog, F.J. Holler and T.A. Nieman, Principles of Instrumental Analysis, Fifth Edition. Thomson Learning. 1998

J.N. Miller and J.C. Miller. Statistics and Chemometrics for Analytical Chemistry. Fourth Edition. Prentice Hall. 2000.

D.C. Harris. "Quantitative Chemical Analysis", 6th Edition, Freeman, New York. 2002.

D.A. Skoog, D.M. West & F.J. Holler. "Fundamentals of Analytical Chemistry", 7th edition. Saunders and Holt, New York. 1996

R. Kellner, J.-M. Mermet, M. Otto & H.M. Widmer (eds.). "Analytical Chemistry" Wiley-VCH, Chichester. 1998

R. Levinson. More modern Chemical Techniques. The Royal Society of Chemistry. 2001

P.A. Carson & N.J. Dent (eds,) Good Laboratory and clinical practices, Techniques for the quality assurance professional. Heinemann Newnes. 1990.

M. Parkany (ed.) Quality Assurance for Analytical Laboratories. The Royal Society of Chemistry. 1993.

See also Journal of Chemical Education, published by the Division of Chemical Education of the American Chemical Society

Course: Introductory Electronics **Semester:** First	**Code:** STP 211 **Pre-requisite:**	**Total Hours:** 2Hours/Week **Theoretical hours:** 2 Hours/Week **Practical hours STP 213:** **(PRACTICAL FOR STP 211, & STP 212) CH:2 CU= 2**
GOAL: The course is designed to introduce the students to the basic concepts of Electronics.		
GENERAL OBJECTIVES		
On completion of this module students should be able to :		
1	Understand the basic concepts of semiconductors	
2	Understand the construction, operation and simple application of p-n junction diodes	
3	Understand the construction, operation and characteristics of bipolar transistors and circuit properties of the three transistor configurations	
4	Understand the construction and characteristics of vacuum triodes, tetrode and pentode valves	

PROGRAMME: NATIONAL DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY					**Contact hr: 2**	
COURSE TITLE: Introductory Electronics		**COURSE CODE:** STP 211			**Theoretical: 2**	
COURSE SPECIFICATION: Theory (STP 211)					**Practical hours STC 213:** **(PRACTICAL FOR STC 211, & STC 212) CH:2 CU= 2**	
General Objective 1: Understand the basic concepts of semiconductors						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
1 - 2	**Semi Conductor Theory** 1.1 Explain electronic structure of elements. 1.2 Explain covalent bonds, valency band, conduction band and energy gap for forbidden	Lecture Illustrate with diagrams. Make a list of insulators, conductors and semiconductors and ask the students to group them under the heading insulator, semiconductors and conductors	Classroom resources			Teacher verifies students' knowledge by quizzes, assignments on semiconductor types, energy band structure and temperature effects.

	energy band. 1.3 Explain discrete energy levels in atoms. 1.4 Draw the energy band structure for a conductor, a semi-conductor and an insulator. 1.5 Explain the properties of a semiconductor in relation to conductors and insulators. 1.6 State the two common types of semiconductor materials, silicon and germanium. 1.7 Explain qualitatively the structure of intrinsic n- type and p-type semiconductors. 1.8 Explain electrical conduction as apparent movement of holes in p-type semiconductor material and movement of electrons in n-type semiconductor					

	material. 1.9 State the effect of temperature change on intrinsic conduction in semiconductors.					
General Objective 2: Understand the construction, operation and simple application of p-n junction diodes						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
3 - 5	2.1 Explain the formation of the depletion region and the junction potential when ap-type and an n-type semiconductors are brought in contact. 2.2 Draw a p-n junction connected in the:- a) forward bias mode and b) reverse bias mode, indicating for each case the current flow in the diode and external circuit. 2.3 Explain the action of a p-n junction diode in the:- a) forward bias mode b) reverse bias	Lecture and use diagrams to illustrate.	A Multimeter Silicon diode, germanium diode, a rheostat, a voltmeter, a milliammete r, a micro- ammeter, power supply in the range 0 – 50 volts	Demonstrate the action of p-n junction diode in the i) forward bias mode and ii) reverse bias mode	Students should observe what happens when a diode is reversed biased and forward biased	Teacher guides students to make sketches of p-n junction, depletion region, energy band structure, diode characteristics and effect of biasing.

	mode 2.4 Describe with aid of diagram construction of a diode. 2.5 Compare the typical static characteristics for germanium and silicon diodes to illustrate different in forward voltage drop and reverse current. 2.6 State the diode equation for the current flowing at a given applied voltage and temperature and define the symbols used. 2.7 Explain the dynamic (or a.c.) resistance of a diode at a given d.c. voltage. 2.8 Explain reverse saturation current, breakdown voltage and the importance of considering the peak inverse voltage of the diode.			Determine experimentally the current/voltage static characteristic of a germanium and silicon diode	Students should perform the experiment to determine static characteristic of a germanium and silicon diode	

6 - 7	2.9 State the applications of the following diodes and draw the circuit symbols of each :- a) Power diodes b) Zener diodes c) Signal diodes d) Varactor diodes e) Tunnel diode f) Light emitting diode (LED) g) Photo diode 2.10 Explain the action of a semiconductor diode as a half wave rectifier and full wave rectifier illustrating with sketches of the circuit diagrams and wave forms of the applied a.c. voltage and the load current or load voltage for a resistive load. 2.11 Explain avalanche effect and zener effect as the two breakdown mechanisms in semiconductor diodes.	Lecture	Power diodes Zener diodes Signal diodes and Varactor diodes Tunnel diode Light emitting diode (LED) Photo diode Oscilloscope, AC source, rectifiers, wire connectors and keys. DC volt meter, milliammetr e (DC), connection wires, resistor, a rheostat and source of emf	Identify the following diodes:- Power diodes Zener diodes Signal diodes Veractor diodes Tunnel diode Light emitting diode (LED) Photo diode Demonstrate rectification. Perform an experiment to determine the static characteristic of a Zener diode.	Make available the diodes in question and identify each of them With the use of oscilloscope show the students what is meant by rectification of signals. Students should perform an experiment to determine the static characteristic of a Zener diode.	Students are made to identify and characterize different types of diodes.

	2.12 Draw the static characteristic of a zener diode relating it to that of a conventional diode.					
General Objective 3: Understand the construction, operation and characteristics of bipolar transistors and circuit properties of the three transistor configurations						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
8 - 9	**Semi Conductor devices (Bipolar Junction** 3.1 Describe with the help of diagrams and circuit symbols the construction of a bipolar junction transistor as: a) an n-p-n transistor and /or b) a p-n-p transistor 3.2 Identify the electrodes of the bipolar transistor as emitter, base and collector. 3.3 State the three transistor configurations as common base (CB), common emitter (CE) and common collector	Lecture State that the emitter base junction is always forward biased while the collector base junction is always reversed biased	PNP, and NPN transistors	Identify the two types of bipolar transistors	Students should be shown the PNP, and NPN transistors.	Students are made to undertake laboratory/workshop activities to draw bipolar transistor characteristics (CB, CE, CC)

	(CC) 3.4 Draw the n-p-n and p-n-p transistors connected in the common base and common emitter configurations with their associated biasing supplies. Show the directions of the currents:I_c, I_b and I_e 3.5 State the following: i) The current flowing in the transistor including the collector leakage current I_{CBO} ii) The relation between the collector current I_C' emitter current I_E and base current I_B (viz $I_e = I_c + I_b$ iii) Relation between the collector current, emitter current and leakage current viz: $(I_c = h_{FE}I_E + I_{CBO})$ iv) Relation between the collector current, base current and leakage current					

	from C – B mode ($I_c = h_{FB}I_B + I_{CBO}$)					
10 - 12	3.6 List the circuit properties of the three transistor configuration such as input resistance, output resistance, current gains, voltage gains and phase relation between input and output. 3.7 Sketch a circuit diagram for determining common base static characteristics. 3.8 Explain the method of obtaining the CB static characteristics. 3.9 Plot and describe typical families of curves of i) I_C/V_{cb} (out-put characteristics) ii) V_{eb}/I_e (input characteristics) iii) I_c/I_e (transfer characteristics) 3.10 Sketch a circuit diagram for determining the common-emitter			Determine experimentally CB static characteristics of bipolar transistors Determine experimentally the common-emitter static characteristics of a transistor	Students should carry out experiments to determine the common base static characteristics of a transistor. Plot the output characteristics, input characteristics and transfer characteristics Students should perform experiments to determine the ommon emitter static characteristics of a transistor. Plot the output characteristics, the input characteristics and transfer characteristics. They should obtain the output resistance, the input resistance	Assign laboratory/workshop activities for students to determine input, output resistance, current-gain, voltage-gain. Grade plots on accuracy and relevance.

	static characteristics. 3.11 Plot and describe typical families of curves of: i) I_c-V_{ce} (out-put characteristics) ii) V_{be}-I_b (in-put characteristics) iii) I_c – I_b (transfer characteristics)				and the current gain from the plotted characteristics.	
General Objective 4: Understand the construction and characteristics of vacuum triodes, tetrode and pentode valves						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
13	**Vacuum Diodes and Multi-Grid Valves** 4.1 Draw and label diagrams of triode construction and its circuit symbol. 4.2 Describe the principles of operation of triodes. 4.3 Explain the effect of the control grid on the anode. 4.4 Sketch a circuit diagram for determining the static characteristics of a triode. 4.5 Sketch typical	Lecture	Diode valve, triode valve, tetrode valve and pentode valve	Identify the different types of valves.	Students should be made to identify the different types of valve	Students are guided to compare the vacuum diodes and the semiconductor devices.

	families of curves of I_a –V_a (output characteristics) and I_a – V_g (transfer characteristics) of a triode. 4.6 Explain that the input resistance is high since the grid current is normally negligible. 4.7 Define anode slope resistance r_a, mutual conductance g_m and amplification factor u 4.8 State relationship between r_a, g_m and u for a triode equivalent circuit.					
14 -15	4.9 Explain the purpose of the screen grid on the tetrode, (to eliminate the high frequency feedback by the grid to anode capacitance C_{ga}) 4.10 Sketch typical tetrode anode characteristics and screen grid characteristics. 4.11 Explain how the kink in the	Lecture and use diagrams to illustrate. Solve numerical problems associated with the concepts.	Triode, Pentode valves, Milliammeters, Voltmeters, Rheostat wire connectors, Electrical keys.	Determination of the static characteristics of either a triode or pentode	Students should perform an experiment to determine the static characteristics of a triode or pentode.	

	characteristics as due to secondary emission from the anode. 4.12 Explain how the kink in the characteristics limits the use of tetrode as amplifier. 4.13 Sketch the circuit symbol of the pentode indicating anode, cathode heater filament, control grid, screen grid and suppressor grid. 4.14 Explain that the suppressor grid eliminates the secondary emission effects and reduces anode to grid capacitance, C_{ga}. 4.15 Sketch typical families of curves of $I_a - V_a$ (output characteristics). 4.16 Define anode slope resistance r_a, mutual conductance C_m and amplification					

	factor for comparison. 4.17 List typical value of this parameter for the vacuum triode and pentode for comparison. 4.18 Explain the relative advantages and disadvantages of transistors over vacuum tubes.					

Assessment: Give details of assignments to be used:
Coursework/ Assignments 10%; Course test 20%; Practical 30%; Examination 40%

Recommended Textbooks & References:

1. Principles of Electronics by T. Duncan,
2. A Manual of Laboratory Experiment in Electronics by C.O. Oroge

Course: Thermodynamics & Electromagnetism **Semester:** First	**Code:** STP 212 **Pre-requisite:**	**Total Hours: 1Hours/Week** **Theoretical hours: 1Hours/Week** **Practical hours STP 223: (PRACTICAL FOR STP 211, & STP 212) CH:1 CU= 1**
GOAL: This course is designed to enable the students understand Thermodynamics and Electromagnetism.		
GENERAL OBJECTIVES		
On completion of this module students should be able to :		
1	Understand the first law of thermodynamics and its applications	

2	Understand the second law of thermodynamics and its applications
3	Understand the Magnetic effect of current and its applications
4	Understand the concept of electromagnetic induction and its application
5	Understand the principles of a.c circuits and their applications

PROGRAMME: NATIONAL DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY						
COURSE TITLE: Thermodynamics & Electromagnetism		**COURSE CODE:** STP 212/STP 213		**CONTACT HOURS: 1HRS/WEEK**		
COURSE SPECIFICATION: Theory HR				**Practical hours STP 213:** **(PRACTICAL FOR STP 211, & STP 212) CH:1 CU= 1**		
General Objective 1: Understand the first law of thermodynamics and its applications						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
1	**First Law of Thermodynamics** 1.1 Explain the principle of conservation of energy. 1.2 State the first law of thermodynamics:- dQ =du + dw where dQ is amount of heat supplied to the system, du is resultant increase in the internal energy of the system, dw is the increase in the external work done. 1.3 Explain the	Lecture Lecture and give numerical examples and assignments Lecture and give numerical examples and	Classroom resources Classroom resources			Teacher assesses/rates students' understanding of first law from explanation of terms. Rate students' understanding of isothermal, adiabatic, isochoric and isobaric by quiz questions.

	following: ii) Isothermal change iii) Adiabatic change iv) Isochoric change/isovolumetric v) Isobaric change 1.4 Apply the first law of thermodynamics to change in 1.3 above. 1.5 Explain the concept of work done on or by a gas. 1.6 Write the expressions for work done on a gas during: i) Isothermal change. ii) Adiabatic change 1.7 Explain the internal energy changes in a system. 1.8 Distinguish between C_p and C_v where C_p = specific heat capacity at constant pressure. C_v = specific heat capacity at constant volume. 1.9 Interpret the ratio Cp/Cv for gases.	assignments				Set examination questions to gauge students' understanding of: i) difference between isothermal and adiabatic ii) relation between C_p and C_v iii) distinguish between ideal and non-ideal behavior of gases.
2	1.10 Write the expression for the difference between	Solve some numerical problems and give				Students are to be given some exercises on gas equations as tutorial to

	specific heat capacities of an ideal gas. 1.11 Calculate the ratio of specific heat capacities at constant pressure to that at constant volume of gases when the appropriate parameters are given. 1.12 Calculate the final pressure and temperature of gases compressed adiabatically and isothermally using the appropriate equations when the initial temperature, initial pressure and final volume are given.	assignments				enhance better understanding.
General Objective 2: Understand the second law of thermodynamics and its applications						
3	**Second Law of Thermodynamics and Applications** 2.1 State the equation of state of an ideal gas. 2.2 Explain that the internal energy of an gas depends on the absolute temperature. 2.3 Explain the following: i) reversible process	Lecture Lecture with the	Classroom resources			Students are guided by teacher to verbally distinguish between reversible and irreversible processes.

	ii) irreversible process 2.4 Explain the working of the Carnot cycle. 2.5Explain with the aid of a diagram the working of an ideal heat engine. 2.6 Describe the working of the actual heat engine. 2.7 Compare the actual and ideal heat engines. 2.8 Define the efficiency of a heat engine: $\eta = \frac{Q_1 - Q_2}{Q_1} = 1 - \frac{Q_1}{Q_2}$ Where η is efficiency Q_1 is heat transfer by the heat engine at initial temperature and Q_2 is heat transfer at final temperature. 2.9 Express efficiency in terms of absolute temperature i.e. Efficiency = $1 - \frac{T_1}{T_2}$ where T_1 is initial temperature T_2 is final temperature.	help of sketch graph				Teacher identifies relevant data to enable students calculate efficiency values and comment.
4	2.10 State and explain Kelvin – Planck's statement of second law of thermodynamics.	Lecture	Classroom resources			Students are guided to establish the equivalence of different statements of Second Law.

	2.11 State Clausius statement of second law of thermodynamics. 2.12 Describe the internal working of an ideal refrigerator. 2.13 Describe the internal working of actual refrigerator. 2.14 Define the efficiency of the refrigerator (coefficient of performance) 2.15 State the equivalence of Kelvin- Planck's and Clausius statements of the second law of thermodynamics.					
General Objective 3: Understand the Magnetic effect of current and its applications						
5 - 6	**Magnetic Effects of Currents** 3.1 Define magnetic lines of force: magnetic field, flux density, and magnetic linkage. 3.2 State and explain the expression for the force on a charged particle moving in a magnetic field i.e. $\bar{F} = q\bar{v}\,x\,\bar{B}$ where:	Explain magnetic lines of force, magnetic field flux density, and magnetic linkage. State and explain the expressions for the force on a charged particles moving in a magnetic field and for a force acting on a current	Classroom resources Two current carrying conductors and cardboard iron fillings	Demonstrate the existence of forces of attraction and repulsion between two parallel current carrying conductors.	Demonstrate the existence of forces of attraction and repulsion between two parallel current carrying conductors.	Quiz questions to identify magnetic lines of force, magnetic field, magnetic flux density and concept of flux linkage. Students are guided towards the practical application of these principles in electrical meters. Students are asked to explain relative directions

	$\bar{F}$ = force q = charge on the particle $\bar{v}$ = velocity $\bar{B}$ = flux density 3.3 Write and explain the expression for a force acting on a current carrying conductor in a magnetic field F = BIL where : B = flux density of intensity of magnetic field. I = the magnitude of the current L = the length of the conductor 3.4 Explain the principles of: i) the cyclotron ii) mass spectrograph 3.5 Describe and explain the forces of attraction and repulsion existing between two parallel current carrying conductors.	carrying conductor in a magnetic field. Describe and explain with the help of diagrams the forces of attraction and repulsion existing between two parallel current carrying conductors.				of vectors in Lorentz force: F,V,B Students are guided to use right-hand screw and left rules to show relative directions of force, current and magnetic induction.
7 - 8	3.8 Define the ampere. 3.9 Explain the principles of the current balance. 3.10 Explain the	Lecture Explain the principles of	Classroom resources Simple current balance Heavy	Measure current using a simple current balance	Allow the students to measure current using a simple current	Written test ask students to: i) define the ampere ii) explain the behavior of current-carrying coilin

	behaviour of a current carrying coil in magnetic field. 3.11 Explain the principles of: i) electric motors ii) the moving iron ammeter iii) moving coil galvanometer iv) ballistic galvanometer 3.12 State the expression for the force experienced by a current carrying conductor of known length placed at various angles to a uniform field of flux density B. 3.13 Calculate the force on a current carrying conductor in magnetic field placed at various angles to the field. 3.14 State the units in which each quantity in the expressions written in 3.12 above is measured. 3.15 Describe with the aid of diagrams, the direction of current, the magnetic field and the force in each of	operation of electric motors, a moving iron ammeter, moving coil galvanometer, ballistic galvanometer. Use diagrams to illustrate. Lecture. Use diagrams to illustrate the expressions. Solve some numerical problems and give assignments.	duty battery, Rheostat, electrical switch Moving iron ammeter, moving coil galvanomete r, ballistic galvanomete r and source of EMF	Demonstrate the direction of the force on a current carrying conductor in a magnetic field Measure current using moving iron ammeter, moving coil galvanometer, ballistic galvanometer	balance Students should be guided on how to use moving iron ammeter, moving coil galvanometer, ballistic galvanometer to measure current.	magnetic field iii) explain the principle of electric motors and moving coil galvanometer iv) calculate the force on a conductor in a magnetic field.

	the cases stated in 3.12 above.					
General Objective 4: Understand the concept of electromagnetic induction and its application						
9 - 10	**Electromagnetic Induction** 4.1 Explain the concept of electric field. 4.2 Define electric field intensity at a point. 4.3 State Faraday's law of electromagnetic induction. 4.4 State Lenz's law of electromagnetic induction. 4.5 Deduce from 4.3 and 4.4 above the expression for the induced emf. $E = \frac{Nd\theta}{dt}$ where E is induced e.m.f. θ = magnetic flux N = number of turns of the coil 4.6 Explain the variation of induced e.m.f. (E) in a rotating coil at different orientations in the field. 4.7 Calculate the magnitude of current (I) in a coil of resistance R. 4.8 Differentiate between	Lecture	Classroom resources Current carrying coil, magnet. Bar magnet, coil, and galvanometer.	Demonstrate electromagnetic induction using a magnet and a current carrying coil. Describe an experiment which illustrates the statement of Lenz's law of electromagnetic induction.	Demonstrate electromagneti c induction using a magnet and a current carrying coil. Allow the students to perform the experiment which illustrates lenz's law of electromagneti c induction	Students are given multiple choice questions to: i) explain concept of electric field ii) identify electric field intensity E at a point iii) state Faraday's law of electromagnetic induction iv) state Lenz's law v) explain symbols in Faraday's law of electromagnetic induction vi) differentiate between mutual and self induction vii) explain the priciples of operation of a transformer

	mutual and self induction.					
11	4.9 Explain back e.m.f. and eddy currents. 4.10 Explain the principle of operation of the induction coil stating its uses 4.11 Explain the principle of operation of a transformer. State the uses	Explain back emf and eddy current mentioning where they occur Lecture	Classroom resources Induction coil, car battery Step up transformer, step down transformer, AC sources, multimeter	Demonstrate how the induction coil operates Demonstrate how the transformer functions.	Demonstrate how the induction coil operates showing the students the spark gap. Demonstrate how the transformer is used to step up, or step down voltage	
General Objective 5: Understand the principles of a.c circuits and their applications						
12 - 13	**Alternating Current Circuits** 5.1 State the expression for alternating current and voltage: $I = I_0 Cos\{\omega t + \pi\}$ where I is the steady state current, Io the maximum current, = $2\pi f$, f is frequency, and π is phase angle 5.2 Define phase angle, instantaneous, peak and root mean square (r.m.s) values of the a.c and voltage	Lecture Use diagrams (sketch graph) to illustrate. Write an expression to show the relationship between R.M.S and peak values of alternating current and voltage	Classroom resources			Students to identify different terms in equation: $I = I_0 Cos\{\omega t + \pi\}$
14 - 15	5.3 Write and explain expressions for a.c. through a resistor, a	Lecture	Classroom Resources	Investigate the voltage/current relationship for	Students should perform an experiment to	Students are guided to answer questions to: i) evaluate a.c through

	capacitor and an inductor. 5.4 Explain the terms reactance, inductive reactance and capacitive reactance. 5.5 Write and explain expressions for a.c. through a resistor and capacitor R-C, resistor and inductor R- L in series circuit. 5.6 Explain the term impedance. 5.7 Write and explain expression for the a.c. in R-L-C series circuit. 5.8 Explain the resonance phenomenon in R-L-C series circuit. 5.9 Explain quality factor. 5.10 Calculate the reactance of inductors of known values at given frequencies. 5.11 Calculate the voltage across each part of circuits consisting of an inductor and capacitor in series.	Solve some numerical examples and give assignments	Low voltage AC source, coil of large self inductance and negligible resistance, AC volt meter, AC ammeter. Low voltage AC source, non-inductive variable resistor, fix resistor of negligible resistance Low voltage AC source, capacitor, AC volt meter, AC ammeter Low voltage AC source, non-capacitive variable resistor and fixed Capacitor.	a simple AC inductive circuit Investigate the voltage/current relationship for a simple AC circuit with inductance and resistance Investigate the voltage/current relationship for a simple AC capacitive circuit Investigate the voltage/current relationship for a simple AC circuit with capacitance and resistance	investigate the voltage/current relationship for a simple AC inductive circuit Students should perform an experiment to investigate the voltage/current relationship for a simple AC circuit with inductance and resistance Perform an experiment to investigate the voltage/current relationship for a simple AC capacity circuit Investigate the voltage/current relationship for a simple AC circuit with capacitance and resistance	a resistor, capacitor and inductor ii) explain the terms: reactance, inductive reactance, capacitive reactance iii) explain impedance iv) evaluate R-C, L-C, and R-L-C circuits v) explain quality factor Test questions for calculation of reactance of known inductor and calculation of voltage across different parts of inductors and capacitors in series.

Assessment: Give details of assignments to be used:
Coursework/ Assignments 10%; Course test 20%; Practical 30%; Examination 40%
Recommended Textbooks & References: Advanced Level Physics by Nelkon and Parker Physics Practical Manual by Tyler

Course: GENETICS **Semester: SECOND**	**Code:** STB 221 **Pre-requisite:**	**Total Hours: 2 Hours/Week** **Theoretical hours: 2 Hours/Week** **Practical hours STB 223: (PRACTICAL FOR STB 221, & STB 222) CH:2 CU= 3**

Goal: This course is intended to give student's knowledge of genes and their manifestation in organisms.	
GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand basic concept of Genetics
2	Understand the rudiments of Mendelian Genetics
3	Understand the concept of dominance and deviations from Mendelian Genetics
4	Understand sex determination and sex linkage
5	Understand the mechanism of variation and mutation
6	Understand the basic concepts in genetic engineering

	Course: Genetics	**Course Code**: STB 212			**Credit Hours:** 2	
					Theoretical: 2 hours/week	
	Year: 2 Semester: 1	**Pre-requisite:**			**Practical hours STC 223: (PRACTICAL FOR STB 221, & STB 222) CH:2 CU= 3**	
	Theoretical Content			**Practical Content**		
General Objective 1.0: Understand basic concept of Genetics						
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**

1	**Basic Concepts In Genetics** 1.1. Define genetics. 1.2. Define genes 1.3. Explain the importance of chromosomes 1.4. Explain genes in heredity.	Explain genetics and the significance of chromosomes and genes, Give assignments	Classroom White Board and marker,	Observe the structure of the chromosome	Supervise the students to study and draw the structure of the chromosome	Briefly explain the term chromosome and its importance in living organisms
General Objective 2.0: **Understand the rudiments of Mendelian Genetics**						
2-3	2.1. Explain Mendel's experiments and points out the conclusions drawn from the experiments 2.2. Explain the following terms, monohybrid, dihybrid, alleles, linkage, recessive gene, dominant gene, phenotype, genotype 2.3. State the two Mendelian laws of inheritance. 2.4. Explain, the first and the second laws of Mendel, in relation to meiosis.	Lecture Explain common genetic terms, State and discuss Mendels first and second laws	Prepared slides Charts, Microscope, Classroom	Identify chromosomes in prepared slides of mitosis. Observe the behavior and types of chromosomes based on the centromere location.	Guide students in the practical works.	Discuss briefly Mendel's experiments. State Mendels first and second laws
4-5	2.5. List examples of monohybrid inheritance in fruit fly (***Drosophila melanogaster***) albinism, cystic fibrosis, and chondrodystrophic dwarfism in men. 2.6. Describe dihybrid inheritance by means of plant height/flower colour; seed coat/position of flower, or any other combination of character of pea plant (*Pisum Sativum*). 2.7. Explain the deviations from Mendelian ratio	Explain monohybrid and dihybrid inheritance with relevant examples, Give assignments	fruit fly, magnifying lens, charts, watch glass	Identify chromosomes, observe the external features of fruit fly. Identify reasons why fruit fly and pea plant are used in genetic experiments	Assist students to use the laboratory materials Guide them in the experiments	Differentiate between monohybrid and dihybrid inheritance. State reasons why the fruit fly and pea plant are used in genetic experiments

General Objective 3.0: **Understand the concept of dominance and deviations from Mendelian Genetics**						
6 – 7	3.1. Describe complete dominance as in Mendel's experiments where heterozygous allele is expressed in the phenotype. 3.2. Explain deviations from Mendelian ratio by linkage; multiple alleles, dominance; lethal genes in mice, incomplete dominance 3.3. Explain the genetic basis of ABO blood group.	Lecture, Discuss exceptions from Mendelian ratio, genetic basis of blood group. Explain the ABO blood group system and mention the ABO blood type	White board, and marker, Charts, Classroom resources.	Identify the various degrees of dominance, complete and incomplete dominance	Supervise students to identify various degrees of dominance in genetic practical work.	Briefly describe complete dominance, Explain deviations from Mendelian ratio with emphasis on the genetic basis of the ABO blood group, List the ABO blood phenotype
General Objective 4.0: **Understand sex determination and sex linkage**						
8 - 9	4.2. Explain the mechanism of sex determination 4.2. Describe sex linked inheritance as in eye colour in Drosophila; colour blindness and haemophilia in man. 4.3. Explain the relevance of genetics in disputed paternity.	Classroom Lecture, Outline the relevance of genetics in disputed paternity. Explain how sex is determined	White board, and marker, Charts, Classroom Fruit fly, magnifying lens, charts, watch glass, Microscope	Identify the characteristics that qualify an organism for use in genetic experiments with references to *Drosophila* and *Neurospora*. Field observation	Assist students to observe and identify the organisms used in genetic experiments	Describe the mechanism of sex determination in named organisms(*Slipper limpert* Explain the importance of genetics in disputed paternity.
General Objective 5.0: **Understand the mechanism of variation and mutation**						
10	5.1. Define variation 5.2. Differentiate between continuous and discontinuous variations. 5.3.Explain the role of meiosis in causing variation	Lecture and discussions, Explain variation and the role of meiosis in causing variation	Classroom white board and marker, fruit fly genetic corn	Separate individual characteristics, genetic organism e,g, fruit fly	Assist students to examine the individual characteristics.	Outline the differences between continuous variations stating the role of meiosis in causing variation
11-12	5.4.Define mutation 5.5.State the causes of mutation 5.6 Describe the kinds of mutation	Explain the causes of mutation and its	Classroom white board and	Characterize individual genetic organism e,g, fruit	Assist students to examine the individual	Mention and describe the various types of

	5.7.Explain the role of mutation in variation 5.8. Explain the following:- Mongolism/Down's syndrome, Klinefelter's syndrome; Terner's Syndrome and XYZ combinations.	role in variation. Explain some genetic syndromes	marker, fruit fly genetic corn	fly	characteristics	mutation and their role in variation
General Objective 6.0: Understand the basic concept in genetics Engineering						
13	**6.1:** Define Biotechnology **6.**2. Explain Nucleic acid and non-nucleic acid in biotechnology	With references to biotechnology, Explain nucleic and non-nucleic acid, highlight the different techniques in Genetic Manipulation	Classroom white board and marker, 96 well PCR machine, Eppendorf centrifuge, Gel electrophoresis tank, electrophorese tank, Power pack and pestle and mortar, Heating block	Insert plasmid in *E. coli*, Isolate DNA	Supervise students to isolate DNA	Describe genetic manipulation and the techniques
14-15	6.2. Explain Genetic manipulation techniques 6.3. State the importance of biotechnology in development.					

Course: ECOLOGY **Semester: SECOND**	**Code:** STB 222 **Pre-requisite:**	**Total Hours: 2 Hours/Week [2-0-0]** **Theoretical hours: 2 Hours/Week** **Practical hours STC 223: (PRACTICAL FOR STC 221, & STC 222) CH:2 CU= 2**

PROGRAMME: NATIONAL DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY						
COURSE TITLE: ECOLOGY		**COURSE CODE: STB 222**			**CONTACT HOURS: 2-0-0 HRS/WEEK**	
COURSE SPECIFICATION: Theory 1					**Practical Content**: 1	
Goal : Goal: This course is designed to provide students with the basic understanding of the relationships between organisms and their physical surrounding						
General Objective:						
On completion of this module students should be able to :						
1	Know the various ecological terminologies and types of habitats					
2	Understand the concept of succession					
3	Understand the problems confronting organisms in their habitats					
4	Know the concept of population ecology					
5	Understand the soil as an ecosystem					
6	Know the pollutants and effect of pollution on the environment, vegetation and animal life					
General Objective: 1 Know the various ecological terminologies and types of habitats						
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Evaluation**
1- 4	1.1Define ecology 1.2 Define habitat 1.3 Identify different kinds of habitats i.e. aquatic,	Explain ecology and its terms such as Habitat, i.e. aquatic, terrestrial	Quadrant, Transect, puppet, pond, desert zones, Savannah, fresh water, marine and	Identify different ecological zones in	Organize visits to identify different ecological zones	Identify different kinds of habitats: aquatic,

	terrestrial and arboreal habitats. 1.4 Differentiate between fresh water habitat, marine habitat and brackish water habitat. 1.5 Differentiate between forest, savannah and desert. 1.6 Identify various vegetation zones of Nigeria and Africa. 1.7 Identify the diagnostic features of mangrove forest, tropical rainforest and deciduous forest. 1.8 Identify the diagnostic features of guinea savannah, Sudan Savannah and Sahel Savannah 1.9 Define ecological niche. 1.10 Describe the status of a terrestrial arthropod e.g. wood louse by observing its response to light, temperature, humidity and gravity. 1.11Define environment. 1.12 List environmental factors and their effect on	and arboreal habitats. List the differences between fresh water habitat, marine habitat and brackish water habitat. Differentiate between forest, savannah and desert. List various vegetation zones of Nigeria and Africa such as mangrove forest, tropical rainforest and deciduous forest. guinea savannah, Sudan Savannah and Sahel Savannah Define ecological niche. Describe the status of a terrestrial arthropod e.g. wood louse by observing its response to light, temperature, humidity and gravity. Mention environmental factors affecting various	brackish water habitat. Different forest zones: Mangrove forest, tropical rainforest and deciduous forest. Guinea savannah, Sudan Savannah and Sahel Savannah. Different terrestrial Arthropods Climate change, cyclones, volcanoes,	Nigeria. Illustrate different vegetation zones in Nigeria. Show different Arthropods. Show different environmental	in Nigeria. Take students to see different vegetation zones in Nigeria. Take students out for field trip Lead students on virtual field trip	terrestrial and arboreal habitats. Explain different forest zones: Mangrove forest, tropical rainforest and deciduous forest. guinea savannah, Sudan Savannah and Sahel Savannah Explain wood louse response to light, temperature, humidity and gravity. List environmental

	various beings. 1.13 Identify the instruments used in measuring the various environmental factors.	beings. 1.13 Explain the instruments used in response to light, temperature, humidity and gravity.	flooding, etc Sac chi, thermometer, hygrometer, klinostat,	effect on beings Demonstrate the instruments used in weather station.	on the internet. Visit the weather station with the students.	factors and their effects on living things. What are the instrument used for temperature, light, humidity and gravity?
General Objective: 2 Understand the concept of succession						
5-7	2.1 Define Successions. 2.2 Explain primary succession. 2.3 Describe factors such as erosion, strong winds, hurricanes, volcanic actions etc. as being responsible for primary bare surfaces such as bare land, depositing dunes, volcanic ash etc 2.4 Define secondary succession. 2.5 Describe factors that give rise to secondary succession. 2.6 Describe the series of communities in a succession – pioneers, the intermediate or transitory communities and the climax community. 2.7 Describe the processes	Explain primary succession. Explain the following factors such as erosion, strong winds, hurricanes, volcanic actions etc. as being responsible for primary bare surfaces such as bare land, depositing dunes, volcanic ash etc. Explain secondary succession Describe the series of communities in a succession – pioneers, the intermediate or transitory communities and the climax community.	Open farmland. Virtual field trip Fallow farmland	Show primary succession. Show erosion, strong winds, hurricanes, volcanic action as factors responsible for bare surfaces. Illustrate secondary succession	Take students to farmland. Lead students on virtual field trip on internet. Take students to fallow farmland.	Explain succession Explain factors responsible for bare surfaces. Describe the series of communities in the farmland.

	involved in ecological successions, nudation, immigration, acesis, reaction and stabilization.	Explain the processes involved in ecological successions, nudation, immigration, acesis, reaction and stabilization.				
General Objective: 3 Understand the problems confronting organism in their habitat						
8-11	3.1 List the problems of plants living in fresh water habitats such as the problems of buoyancy inadequate sunlight, low oxygen tension, reproduction etc.	Explain the problems of plants living in fresh water habitats such as the problems of buoyancy inadequate sunlight, low oxygen tension, reproduction	Pond, stagnant water.	Illustrate ways plants living in fresh water cope.	Visit nearby pond/stagnant water with the students.	What are the problems of plants living in fresh water?
	3.2 Explain the problems of animals living in fresh water habitats – the problems of buoyancy, breathing, feeding, reproduction and enemies.	Describe the problems of animals living in fresh water habitats – the problems of buoyancy, breathing, feeding, reproduction and enemies.	Biological Garden, pond.	Illustrate ways animals living in fresh water cope.	Visit the nearby river/water course.	What are the problems of animals living in fresh water?
	3.3 Identify the various adaptive features employed by plants and animals in overcoming their problems in fresh water habitats.	List the various adaptive features employed by plants and animals in overcoming their problems in fresh water habitats.				
	3.4 List the problems of plants living in brackish water habitat – problems of buoyancy, flooding, respiration,	Explain the problems of plants living in brackish water habitat – problems of buoyancy, flooding, respiration, osmotic balance.	Brackish water / estuarine, virtual field trip (VFT).	Show the problems of plants living in brackish water habitat.	Take students to estuarine / lead students on virtual field trip on the internet.	What are the problems of plants living in brackish water?

	osmotic balance. 3.5 Identify the adaptations of mangrove plants to life in their habitat – red mangrove (Rhizophara) and white mangrove (Avicenia). 3.6 List the problems of animals living in brackish water – problems of wave action, salinity, Water current. 3.7 Describe the adaptations of animal communities to life in brackish water habitat 3.8 Explain poor light condition as a major problem of organisms living in tropical rainforest. 3.9 Describe the adaptation of plants as a means of solving the problem of poor light in rainforest – long petioles of plants, climbing habit, mosaic arrangement of leaves etc. 3.10 List the problems of organisms in the savannah – drought, poor soils, fires, seasonal food scarcity and	Explain the adaptations of mangrove plants to life in their habitat – red mangrove (Rhizophara) and white mangrove (Avicenia). Explain the problems of animals living in brackish water – problems of wave action, salinity, Water current. Explain the adaptations of animal communities to life in brackish water habitat. Describe poor light condition as a major problem of organisms living in tropical rainforest. Explain the adaptation of plants as a means of solving the problem of poor light in rainforest – long petioles of plants, climbing habit, mosaic arrangement of leaves etc. Describe the problems of organisms in the savannah – drought, poor soils, fires, seasonal food scarcity	Brackish water / estuarine, VFT Forest reserve. Grassland	Illustrate the problems of animals living in brackish water. Demonstrate poor light condition as problem of organisms living in tropical rain forest. Illustrate the problems of organisms in the Savannah	Take students to estuarine / lead students on VFT on the internet. Visit forest reserve with the students. Take students to a Grassland.	Explain the problems of animals living in brackish water. What are the problems of organisms living in tropical rain forest? Enumerate the problems of organisms in the Savannah

	shelter. 3.11 Explain the xeromorphic features of savannah plants. 3.12 Describe the adaptations of plant communities for surviving annual grass fires – tick bark, vigorous regeneration, fire resistant seeds, underground perenating organs (e.g. tuber, bulbs and rhizomes). 3.13 Explain the physiological adaptations of savannah species – deciduous habit, pre-rain flushing and flowering for life in their habitat.	and shelter. List the xeromorphic features of savannah plants. Explain the adaptations of plant communities for surviving annual grass fires – tick bark, vigorous regeneration, fire resistant seeds, underground perenating organs (e.g. tuber, bulbs and rhizomes). Describe the physiological adaptations of savannah species – deciduous habit, pre-rain flushing and flowering for life in their habitat.				
General Objective: 4 Know the concept of population ecology						
12-15	4.1 Describe transect sampling technique. 4.2 Find population size applying the formula. N = n x A a When N = population size, A = area covered by the population: a = average of the number of sample plots; n = average of the number of individuals in the sample 4.3 Explain the use of	Explain transect sampling technique. Find population size applying the formula. Describe the use of	Pegs, rope/twine rope, field. Fish pond, water, hand	Demonstrate transect sampling technique. Demonstrate	Lead students to carry out transect sampling technique. Lead student to	How do you determine the population of a given species of grass in an area of land?

	lincohl Index in estimating population size – say in a restricted volume of Water like fish pond. 4.4 Describe the capture-release- recapture method of population size estimation. 4.5 Explain the various precautions and assumptions in the use of capture – release – recapture method.	lincohl Index in estimating population size – say in a restricted volume of Water like fish pond. Describe the capture-release- recapture method of population size estimation. Describe the various precautions and assumptions in the use of capture – release – recapture method.	net, fish, and stain.	lincohl Index in estimating population.	carry out capture – release – recapture method	How do you determine the population of a given species of fish in a pond?
	4.5 Describe the regression method of estimating population size. 4.6 Explain the assumptions underlying the regression method of estimating population size. 4.7 Explain population growth and rate of growth. 4.8 Describe the growth curves – J – shaped and S-shaped growth curves. 4.9 Explain the various factors influencing sizes of populations – natality, mortality, fecundity, immigration, emigration etc	Explain the regression method of estimating population size. List the assumptions underlying the regression method of estimating population size. Describe population growth and rate of growth. Explain the growth curves J- shaped and S-shaped growth curves. Describe the various factors influencing sizes of populations; natality, mortality, fecundity, immigration, emigration etc				

	4.10 Identify the density – dependent and density – independent factors of populations. 4.11 Identify the biotic and abiotic factors and their effect on population sizes.	Explain the density – dependent and density – independent factors of populations. Explain the biotic and abiotic factors and their effect on population sizes.				
General Objective: 5 Understand the soil as an ecosystem						
	5.1 Explain soil 5.2 List the methods of soil formation. 5.3 Describe the components of soil 5.4 Explain the properties of soil – soil texture, soil structure, soil profile. 5.5 Explain the influence of temperature, air, moisture, pH flora and fauna of the soil. 5.6 Describe the role of micro-organisms in soil 5.7 Describe soil macroflora and macrofauna and their influence on soil 5.8 Describe the measurement of soil physical and chemical factors such as porosity (i.e. water retention capacity): particle size, pH, water content, organic matter content etc.	Define soil Describe the methods of soil formation. List the components of soil. Describe the properties of soil – soil texture, soil structure, soil profile. Describe the influence of temperature, air, moisture, pH flora and fauna of the soil. Explain the role of micro-organisms in soil. Explain soil macroflora and macrofauna and their influence on soil. Explain the measurement of soil physical and chemical factors such as porosity, particle size, pH, water content, organic matter content etc. Explain ways by which	Soil sample, crucible / evaporation disc, wire gauge, Bunsen burner, tripod stand, beaker, and water.	Demonstrate measurement of soil physical and chemical factors	Lead students to carry out the experiments	Describe the measurement of soil water content, organic matter content.

	5.9 Describe ways by which soil fertility is lost. e.g. erosion, leaching, burning, over cultivation etc. 5.10 Identify types of erosion, water (Gully, Sheet) erosion, and wind erosion. 5.11 Describe methods of controlling water erosion. 5.12 Describe methods of controlling wind erosion.	soil fertility is lost. E.g. erosion, leaching, burning, over cultivation etc. Describe types of erosion, water (Gully, Sheet) erosion and wind erosion. Explain methods of controlling water erosion. Explain methods of controlling wind erosion.				
General Objective: 6 Know the pollutants and effect of pollution on the environment, vegetation and animal life						
	6.1 Define Pollution and Pollutants 6.2 List examples of pollutants – like carbon monoxide sulphur dioxide, oils, scraps, sewage etc. 6.3 Explain the effects of the pollutants on plants and animal life including man. 6.4 Identify different types of pollution: water pollution, air pollution: soil pollution: industrial pollution: oil pollution etc. 6.5 Explain the need for frequent medical checkups	Explain Pollution and Pollutants. Mention examples of pollutants – like carbon monoxide sulphur dioxide, oils, scraps, sewage etc. Enumerate the effects of the pollutants on plants and animal life including man. Explain different types of pollution: water pollution, air pollution: soil pollution: industrial pollution: oil pollution etc State the need for frequent medical	Film show, video clips, and VFT on the internet	Illustrate different types of pollution.	Lead students on VFT on the internet.	Explain different types of pollution.

	for industrial employees. 6.6 Describe different ways of sewage treatment: sewage farming: stabilization ponds; filter beds; cesspits and septic tanks; activated sludge. 6.7 Identify each of the sewage treatment plants described in 6.6 above.	checkups for industrial employees. Explain different ways of sewage treatment: sewage farming: stabilization ponds; filter beds; cesspits and septic tanks; activated sludge. Explain each of the sewage treatment plants described in above		Illustrate different ways of sewage treatment.	Lead students on VFT on the internet.	Describe different ways of sewage treatment.

Code: STC 221	**Total Hours: 1 Hours/Week**

Course Title: Organic Chemistry II **Pre-requisite:**	**Theoretical hours: 1Hours/Week** **Practical hours STC 223:** **(PRACTICAL FOR STC 221, & STC 222) CH:2 CU= 2**

General Objectives

1.Understand the chemistry of ethers

.2Know the chemistry of amines

.3Understand the chemistry of aromatic compounds

4Understand some chemical reactions of benzene

5Understand the mechanism of electrophilic and nucleophilic substitution in aromatic compounds

6Understand the chemistry of phenol

7Understand the chemistry of carbonyl substituted benzene

8Understand the chemistry of benzoic acid

9Understand the chemistry of benzoic acid derivatives

10 1Understand the chemistry of benzamides and phthalic anhydride

11 Understand the chemistry of aniline

1.2 Understand the chemistry of diazonium compounds and azo-dyes

	National Diploma	**Course Code: STC 212**			**Credit Hours: 4**	
	Organic Chemistry 11	STC 221			**Theoretical: 1 hours/week**	
	Year: Semester:	**Pre-requisite:**			**Practical: 3 hours /week**	
	Theoretical Content			**Practical Content**		
	General Objective 1.0: Understand the chemistry of ethers					
Weeks	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
1-2	1.0.Write the functional group of ethers 1.2. Write general formula of ethers as R-O-R with examples. 1.3.Name simple ethers using IUPAC 1.4. Describe methods of preparation of ethers. 1.5.Use curly arrows to show the mechanism of the formation of an ether by the Williamson reaction 1.6. Describe the physical properties of diethyl ether. 1.7. Write equations for the cleavage of ether by acids. 1.8. Describe uses of diethyl ether.	Outline the functional group of ethers and their general formula of ethers as R-O-R with examples	Teaching Board Benzyl alcohol ethyl iodide sodium hydride solvents glassware	Prepare a simple ether in the laboratory e.g. Neonerolin	Guide and supervise students laboratory preparation of R-O-R Use curry arrow show mechanism of ethers using Williamson reaction	What are the functional groups of ethers. Explain simple method use in preparing ethers. State uses of diethl ether in the laboratory and in industry.
	General Objective : 2.0 Know the chemistry of amines					

3-4	2.1.Relate amines to ammonia structurally. 2.2.Describe the methods of preparation of 1^o amides. 2.3.Classify amines as 1^o, 2^o,3^o, and 4^o 2.3.State the general formula for the classes under 2.2 above and give examples. 2.4.Discuss the basicity of amines 2.5.Use curly arrows to show the reaction of an amine with a hydrogen ion 2.6.Describe the following reactions of 1^o amides – Hofmann's reaction, nitrosation, and acylation. 2.7.Use curly arrows to show the mechanism of acylation of an amine with an acyl chloride 2.8..Describe the uses of amines	Lectures with charts Practical identification to relate amines to ammonia structurally Illustrate with example classes of amines	Glassware Aminophenol acetic anhydride chemicals glassware aminophenol acetic anhydride chemicals glassware	Prepare tests to distinguish 1^o, 2^o, 3^o, among the amine by chemical tests.	Guide and supervise students on same test	Draw structural formular of amines State the preparation of 1^0 amines State general rest for amines Use curry arrows show mechnismes of amine reacting with hydrogen ion. Mention the use of amine.
	General Objective 3.0 Understand Chemistry of Aromatic Compounds					
	Chemistry of Aromatic Compounds 3.1 Write the structures of benzene and its homologues.	Illustrate with examples the structures of benzene and its homologues.	Laboratory resources	Prepare paracetamol in the lab by acylation of aminophenol	Ensure students prepare paracetamol in the laboratory	Draw the structure of a named aromatic compound and it homologues series

	3.2. Explain aromaticity: resonance, resonance theory 4Π + 2 rule. 3.3.Explain the fulfilment of the rule in Benzene and its homologues. 3.4.Explain the physical properties of benzene and alkyl benzene, e.g. M.P. and b.p.	Discuss aromaticity: resonance, resonance theory 4Π + 2 rule. Outline the fulfilment of the rule in Benzene and its homologues.			using acylation of aminophenol	List physical chemical properties of benzen
	General Objective 4: Understand some chemical reactions of Benzene					
6	4.1.Describe the physical and chemical properties of benzene 4.2.Describe the following reactions of benzene: Friedel-Crafts (Alkylation and Acylation) Nitration, Sulphonation and halogenation. 4.3.Describe some examples of nucleophilic substitution of derivatives of benzenes such as fluorobenzene	Outline the physical and chemical properties of benzene and reaction of it with Alkylation and Acylation) Nitration, Sulphonation and halogenation. Illustrate with examples nucleophlic substitution of benzene.	Laboratory resources Nitration of bromobenzene Bromobenzene Con nitric conc. sulphuric acids etc	Prepare bromobenze in the laboratory using Con nitric conc. sulphuric acids	Guide and supervise students in the preparation of bromobenze in lab.	Explain the reaction of benzene with Alkylation Acylation) Nitration, Sulphonation and halogenation. Write a nucleophilic reaction of benzenes with Br, Cl
	General Objective 5: Understand the mechanism of electrophilic and nucleophilic substitution in aromatic compounds					

7	5.1.Describe the mechanism of nucleophilic and electrophilic aromatic substitution reactions of mono substituted benzene 5.2. Describe the following i) effect of substituents ii) effects of solvents orientation of incoming group.	Explain the electrophilic and nucleophilic mechanism of aromatic substitution of benzene	Chemicals glassware tlc equipment	React dinitro fluoro benzene with either an amine or an amino acid	Guide and supervise students	Write an equation on nucleophilic and electrophilic aromatic substitution reactions of mono substituted benzene what is the effect of substieuents and solvent on the incoming group
	General Objective 6: Understand the Chemistry of Phenol					
8	Describe the preparation of Phenol. Explain physical properties and chemical reactions of phenol. List uses of phenol .	Lecture with illustration	Classroom resources	Investigate the solubility of alcohols, phenols and carboxylic React phenol with bromine water	Laboratory work	acids in water, bicarbonate and hydroxide solutions. React phenol with bromine water
	General Objectives: 7.0. **Understand the chemistry of carbonyl substituted benzene**					
9	7.1.Describe the preparation of benzaldehyde and benzophenone. Explain properties and chemical reactions of the above List uses of benzaldelhyde and benzophenone	Explain the benzaldehyde and benzophenone and uses	Laboratory resources Toluene and toluoyl chloride and aluminium trichloride Or toluene toluic acid and phosphoric	Prepare demethyl benzophenone or similar in the lab	Guide and supervise students to prepare benzaldehyde and benzophenone.	Write the structure of benzaldehyde and benzophenone. Mention uses of benzaldehyde and benzophenone.

			acid			
	General Objectives: 8.0 Understand the Chemistry of Benzoic acid					
10	8.1.Describe the preparation of benzoic acid. 8.2.Explain the physical properties and chemical reactions of benzoic acids 8.3. list uses of benzoic acids.	Lecture	Laboratory class/ Laboratory consumables Laboratory class	prepare benzoic acid from toluene and/or benzyl alcohol by oxidation with permanganate isolate and purify by recrystalization and identify the product by its melting point	Supervice students to prepare benzoic acid from toluene and/or benzyl	Explain the prepation of benzoic acid in the laboratory Mention uses of benzoic acid and it chemical properties
	General Objectives: 9.0 Understand the chemistry of benzoic acid derivatives					
11	9.1. Describe the preparation of benzoyl chloride and esters. . 9.2. Use curly arrows to show the mechanism of the reaction between benzoyl chloride and methanol 9.3. List uses of benzoyl chloride and benzoyl esters.	Explain the preparation of benzoyl chloride and esters. Illustrate with examples the use of curly arrows to show mechanism of reaction between benzoyl chloride and	Laboratory resources Chemicals source of heat (not Bunsen	Either : React benzoic acid with thionyl chloride and then methanol to give the methyl ester Or : saponify methyl benzoate	Guide and supervise students	State the preparation of benzoyl chloride and esters. Mention the uses of benzoyl chloride and benzoyl esters commercially

		methanol .				
	General Objectives: 10 **Understand the chemistry of benzamides and phthalic anhydride**					
12-13	10.1Describe the preparation of benzamide and phthalic anhydride 10.2.Use curly arrows to show the mechanism of the reaction between benzoyl chloride and ammonia 10.3.Explain physical properties and chemical reactions of benzamide and phthelic anhdride. 10.4.List uses of benzamide and phthalic anhydride.	Outline the preparation of benzamide and phthalic Illustrate with examples physical properties and chemical reactions of benzamide	Laboratory resources	Prepare benzamide from benzoyl chloride and aqueous ammonia See above consumales	Supervise students to prepare the preparation of benzamide and phthalic Same above activity	Carry-out preparation of benzamide and phthalic anhydride Mention physical and chemical reactions of benzamide and phthelic anhdride.
	General Objectives: 11 Understand the chemistry of Aniline					
14	11.1 Describe the laboratory and industrial preparation of Aniline 11.2.Describe the physical properties and chemical reactions of aniline with emphasis on the basic nature of aniline 11.3. List uses of aniline	Discuss the preparation of Aniline. outline physical properties and chemical reactions of aniline with emphasis on the basic nature of aniline and the	Laboratory resources consumables'	prepare aniline by reduction of nitrobenzene with Sn or Fe and acid	Supervise students to carry out the preparation of aniline in the laboratory	Explain industrial preparation of Aniline State both physical, chemical properties of Aniline

		uses of aniline				
	General Objectives: 12.Understand the chemistry of diazonium Compounds and Azo-dyes					
15	12.1.Describe the preparation of diazonium salts. 12.2.Describe the conversion of diazonium salts to chloride bromide, and cyano compounds. 12.3.Explain the formation of sample azo dyes.	Explain the preparation of diazonium salts. Explain the conversion of diazonium salts to chloride bromide, and cyano.	Laboratory work	Prepare an azo dye such as orange II in the lab	Guide and supervise students	Carry out the formation of diazonium salt from azo dyes

Assessment:
Coursework/ Assignments 10%; Practical 40%; Examination 50 %

Recommended Textbooks & References:

Chemistry by M.J. Sienko and R.A. Plane (Mc Graw Hill)

Organic Chemistry by McMurray. 6th edition. Thompson/Brooks-Cole.

Classic Chemistry Experiments published by The Royal Society of Chemistry (UK) and free on the internet at http://www.chemsoc.org/networks/learnnet/classic_exp.htm

Salters Advanced Chemistry Activities and Assessment Pack published by Heinemann Small scale synthesis by M.Zanger and J.R.McKee published by Wm.C.Brown

Code: STC 222 Course Title: Introduction to Biolchemistry **Pre-requisite:**	**Total Hours: 1 Hours/Week** **Theoretical hours: 1Hours/Week** **Practical hours STC 213:** **(PRACTICAL FOR STC 221, & STC 222) CH:2 CU= 2**

General Objectives

This course id designed to introduce students to basic principles of Biochemistry

1. **Understand the molecular organization of the living cell and its topochemistry**
2. **Understand the importance of water and the concepts of pH and buffers**
3. **Understand the properties, sources, uses and structure of carbohydrates**
4. **Understand the properties, structures and reactions of monosaccharides**
5. **Understand the structures and uses of disaccharides and polysaccharides**
6. **Understand nature, biological and industrial importance of lipids**
7. **Understand the structure, properties and functions of proteins**
8. **Understand the classification of amino acids**
9. **Understand the structure and behaviour of Proteins**
10. **Understand the nature of enzymes**
11. **Understand vitamins and minerals found in the Living cell**

	National Diploma	**Course Code: STC 222**			**Credit Hours: 1**	
	Introduction to Biochemistry				**Theoretical: 1 hours/week**	
	Year: Semester:	**Pre-requisite:**			**Practical hours STC 213:** **(PRACTICAL FOR STC 221, & STC 222) CH:2 CU= 2**	
	Theoretical Content			**Practical Content**		
	General Objective 1.0: General Objective 1.0: Understand the molecular organization of the living cell and its topochemistry					
Weeks	**Specific Learning Outcomes**	**Teacher's activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation of students work**

1-2	**Molecular Organisation of the living cells** 1.1 List cell organelles 1.2. Explain centrifugation 1.3. Explain the structure, functions and fractions of intracellular organelles. 1.4. Describe chemical composition of the (i.e. carhohydrate, protein, lipids, DNA, RNA Nucleoproteins etc.) 1.5 What are cell membrane 1.6. Explain cell structure and organization fractions of cellular organelles, diversity, characteristics of living things,reproduction, interrelationship, element of ecology and types of habitat. 1.6 Principle of histogenesis from generation in biological structures. 1..7. Environmental influence on cell association and histogenesis. Basic	Explain cell organelles,- centrifugation structure, functions and fractions of intracellular organelles. Discuss chemical composition of the carhohydrate, protein, lipids, DNA, RNA Nucleoproteins etc.) What are cell membrane Explain the Principle of histogenesis from generation in biological structures. Illustrate with examples Environmental influence on cell association and	Centrifugation of fractions. Centrifuge a. experimental animal Dissecting set c. .Homogeniser. .Glasseware Classroom resources Textbooks Charts of Plants/animal models	Perform lab analysis on organelles, centrifugation	Ensure students properly carry out practicals cell fractionation	State the use of centrifuge in fractionation of cell Draw the structure of DNA, RNA in cell organells What is cell organization. State characteristic of cell in terms of diversity, reproduction etc.

	tissue types and histology of the major organ systems. – physical and chemical processes in animal and plant physiology. 1.7 Describe chemical composition of carbohydrate 1.8 Explain the sum total of breakdown of carbohydrates, lipids and proteins 1.9 Describe the ATP cycle and explain how ATP forms the energy currency in biological system.	histogenesis. Basic tissue types and histology of the major organ systems. – physical and chemical processes in animal and plant physiology. Discuss chemical composition of carbohydrate and calculate the sum total of breakdown of carbohydrates, lipids and proteins Discuss the ATP cycle and explain how				

		ATP forms the energy currency in biological system.				
	General Objective 2.0: Understand the importance of water and the concepts of pH and buffers					

	2.1 Explain the importance of water as a major cellular component. 2.2 List the properties of water which makes it suitable as the liquid of living systems. 2.3 List the common laboratory and physiological buffer systems with their components. 2.4 Explain how the buffers above function to resist pH changes particularly in physiological systems. 2.5. The physical and chemical properties of water, acidity and alkaline, pH, p0H, pKa, pKb values and their effect on cellular activities, 2.5 What are buffer solution preparations of buffer solutions. 2.6 Importance of buffer in a biological system	Outline the importance of water as a major cellular component. Explain the importace of water that make suitable as liquid of living system Enumerate the physical and chemical properties of water, acidity and alkaline, pH, p0H, pKa, pKb values and their effect on cellular activities,	Lovibond comparator Indicator papers pH metre Indicator solutions. Glassware's Tiles	Choose the appropriate acid and its salts (base and its salt) for a buffer system at a given pH from a list of weak acids/bases. Measure the pH of systems using lovibond comparator or pH meter.	Demonstrate the use of the pH metre. Conduct practicals on the measurement of pH of solutions	Explain why water is refers to as living properties of living system. State why buffer function to resist ph changes in physiological system Generally , outline both physical and chemical properties of buffer on cellular activities State an importace of buffer in biological system
	General Objective 3.0: Understand the properties, sources, uses and structure of carbohydrates					
3	**Carbohydrates** 3.1 .Explain carbohydrates as polyhydroxyketones of polyhydoxyaldes and their derivatives. 3.2 .List the general properties of	Define carbohydrates as polyhydroxyketones of polyhydoxyaldes and their derivatives.	Blackboard Textbooks Practical manual	Test for carbohydrates in the laboratory by e.g. meish test Fehling's etc.	Ensure students Conduct practical test on carbohydrates	Discuss , and explain the structures of carbohydrate and its derivatives.

	carbohydrates. 3.3 .Explain the general properties of carbohydrates. 3.4.List common sources of carbohydrates. 3.5. List domestic and industrial uses of carbohydrates 3.6. Classify carbohydrates as mono-di-oligo and polysascharides. 3.7. Draw structural formula of named examples of the families in 3.5 above. 3.6.List the enzymes and products of digestion of carbohydrates 3.8. Explain the term substrate level phosphorylation 3.9. Define glycolysis as the pathway of breakdown of phosphorylated sugars to provide energy and lactate. 3.10.List the key enzymes of glycolysis.	Outline the domestic and industrial uses of carbohydrate Outline enzymes requires in the digestion of carbohydrate Discuss glycolysis as the pathway of breakdown of phosphorylated sugars to provide energy and lactate List the key enzymes of glycolysis				Mention the domestic and industrial uses of carbohydrate What type of enzyme is require in the digestion of carbohydrate. Outline the glycolytic pathway of phosphorylated sugars to provide energy and lactate Mention the key enzyme responsible in the breakdown of phosphorylated sugar to release energy and lactate

	3.11.What are the special characteristics of carbohydrate, properties and function of carbohydrate. 3.10.How does the structure of carbohydrate allow its functions and performance. 3.11.Role and structure of lipids/fatty acids, carbohydrates and amino acid, proteins anabolic/catabolic pathways and fundamentals of bioenergetics and metabolism.	Explain the function and characterratics properties of carbohydrate Discuss Role and structure of lipids/fatty acids, carbohydrates and amino acid, proteins anabolic/catabolic pathways and fundamentals of bioenergetics and metabolism.				What are the of carbohydrates and amino acid, proteins in anabolic/catabolic pathways of bioenergetic and metabolism.
	General Objective 4.0: Understand the properties, structures and reactions of monosaccharide**s**					
4	4.1 Name monosaccharides systematically according to the number of carbon atoms in the molecule. 4.2 Explain the concepts of stereoisomerism opticalisomerism and the property of optical	Lectures with comprehensive notes Outline the concepts of stereoisomerism	Glassware s Polarimete r Reagent such as Bial's, Bendict's etc	Measure experimentally optical acivity in sugars using polarimeter.	Quide students to Conduct practical on measurement of optical planes	State/ sketch a named a monosaccharide compound List the different between epimers,

	activity. 4.3 Distinguish between epimers, stereoisomers and optical isomers 4.4 List examples of other biochemical substances that relate the plane of polarized light. 4.5 Distinguish between Dextrorotary (+) and laevorotatory() compounds on one hand and D and L structure on the other hand.	opticalisomerism and the property of optical				stereoisomers and optical isomers State method use in estimating reducing sugar in a substance
	4.6 Name monosaccharides systematically according to the number of carbon atoms in the molecule. 4.7 Explain the concepts of stereoisomerism opticalisomerism and the property of optical activity. 4.8 Distinguish between epimers, stereoisomers and optical isomers 4.9 List examples of other biochemical substances that relate the plane of polarized light. 4.10 Distinguish between Dextrorotary (+) and laevorotatory() compounds on one hand and D and L structure on the other hand.	Explain monosaccharides systematically according to the number of carbon atoms in the molecule. Outline the concepts of stereoisomerism, opticalisomerism and the property of optical activity. Explain the	Glassware s Polarimete r Reagent such as Bial's, Bendict's etc	Measure experimentally optical activity in sugars using polarimeter.	Ensure students properly determine the optical isomer of a polarized light	Mention uses of polarimeter What is the impotance of stereisomerism in optical activity

	4.11 Outline methods for estimating reducing sugars	difference between epimers, stereoisomers and optical isomers				
	General Objective 5.0: Understand the structures and uses of disaccharides and Polysaccharides					
5	5.1 Define glycosidic linkage. 5.2 Write equation for the formation of glycosidic linkage. 5.3 List the different types of glycosidic linkages. 5.4 State the sources of some common disaccharides. 5.5 Draw the structures of disaccharides in 3.26 above. 5.6 Distinguish between reducing and non reducing disaccharides. 5.7 State the biological and industrial importance of disaccharides. 5.8 List the common polysaccharides and their sources. 5.9 List the monomers of polysaccharides.	Lecture Conduct practical grade reports on reducing and non- reducing starch and glycogen the sketch out structures of common disaccharides and state the different between reducing and non reducing disaccharides. Outline the biological and industrial importance of disaccharides. Outline the	Blackboard Glassware burners Water bath	hydrolyse a non- reducing disaccharide to give reducing monosaccharide and test for their presence	Ensure students carry out practical on glycosidic compounds	What is glycosidic linkage. write an equation for the linkage Mention different types of linkage available and draw the structure of disaccharides. State the difference between reducing and non reducing disaccharides. List commom sorces of polysaccharides and monomers we have.

	5.10 State the types of glycosidic linkages in Polysaccharides. 5.11 Draw in the outline, the pattern and arrangement of the sub-units in the following:	common polysaccharides and their sources. Explain monomers of polysaccharides. State the types of glycosidic linkages in Polysaccharides				
	i) amylose ii) amylopectin iii) glycogen iv) cellulose 5.12 State the biological and industrial importance of polysaccharides.	Illustrate diagrammatically the structure of I) amylose ii amylopectin iii) glycogen iv) cellulose .		Distinguish between starch and glycogen.	Ensure students carry out test on starch etc	Draw the structure of the following compound; i) amylose ii) amylopectin iii) glycogen iv) cellulose
	General Objective 6.0: Understand nature, biological and industrial importance of lipids					
6	**Lipids** 6.1 Define lipids as fats and fat like substance. 6.2 Define fat as mono-di- and tri – carboxylic esters of glycerides e.g. monoglycerides, diglycerides and triglycerides. 6.3 List natural sources of fats.	Enumerate lipids as fats and fat like substance and fat as mono-di- and tri – carboxylic esters of glycerides e.g. monoglycerides, diglycerides and triglycerides.	Classrooms resources Textbooks Glasswares Bunsin burner Water bath Saturated and unsaturated fat	Test for fats in the laboratory e.g. by solubility test.	Assist students to carry out laboratory experiments Ensure students properly carry out the specify experiment	Define fat and fat like substances List types of mono, di,and tri fatty esters.

	6.4.Classify lipids into simple and complex lipids. List members of classes in 6.4 above. 6.5 Draw structures of named saturated and unsaturated fatty acids most abundant in acylglycerols.	Explain the structures of named saturated and unsaturated fatty acids that is most abundant in acylglycerols.	Liquid and solid fats.	Practical test for fats Carry out simple chemial tests for triacylglycerides	Ensure students carryout chemical test on saturated and unsaturated fatty acids	What is saturated and unsaturated fatty acids
	6.6.Explain why fatty acids obtained from lipids are almost always even numbered carbon atoms. 6.7 Distinguish between essential and non-essential fatty acids. 6.8. Write the general chemical structure of mono- di- and triacylglycerols. 6..9. state physical properties and uses of triacylglycerols. 6.10. describe with equation the hydrolysis of triacylglycerols with alkali to yield a mixture of a soap and glycerol (saponification) 6.11. Define saponification number , iodine number and free fatty acids(FFA) value of listed above.	Describe the fatty acids obtained from lipids carbon atoms. Define essential and non-essential fatty acids. Sketch the general chemical structure of mono- di- and triacylglycerols. 6..9. state physical properties and uses of triacylglycerols. Illustrate with equation the hydrolysis of	Liquid fat Solid fat		Guide students on fatty acid experiments	What are fatty acid Differentiate between essential and non-essential fatty acids. What is saponification number, iondine number, free fatty acid .

	6.12 Explain the hardening of oils. Relate it to commercial production of fats as margarine. Draw the structure formula of phosphatidic acid. Explain that phosphatic acid is the parent compound to phosphoglycerides Draw structure of the following compound; a) Phosphatidylethanolaime b) Phosphatidylcholine c) Phosphatidylserine d) Phosphadidylglycerol 6.221 List other important glycerophosphatides. 6.22 State the cellular location or sources of glycerophosphatides. 6.23 Explain the significance of the variations in the size, shape, polarity and electric charge of the polar heads of glycerophosphatides.	triacylglycerols with alkali to yield a mixture of a soap and draw the structure of phosphatidic acid Explain that phosphatic acid is the parent compound to phosphoglycerides Sketch structure of the following compound; a)Phosphatidylethanolaime e) Phosphatidylcholine f) Phosphatidesylserine g) Phosphdyl glycerol List other important glycerophosphati				List various types of phosphatic acid present in fatty acid and draw their structures. Outline the other of importance of the acid ist various free fatty

	6.24.Enumerate the functions of glycerophosphatides in the living systems and their roles in food and chemical industries. List the products of hydrolysis of glycerophosphatides by: a)alkaline acid and b) Enzymes c)	des. State the cellular location or sources of glycerophosphatides Explain the functions of glycerophosphatides in the living systems and their roles in food and chemical industries and the products of hydrolysis of glycerophosphatides by: a)alkaline acid and Enzymes				What is the importance of glycerophosphatides in the living systems, and their roles in food and chemical industries. What is the role of glycerophosphatides In alkaline, acid and enzymes phases.
	General Objective 7.0: Understand the structure, properties and functions of proteins					
8	**Proteins** 7.1 Classify proteins as globular or fibrous. 7.2. List natural courses of proteins 7.3.State the characteristics properties of the classes in 7.1 above.	Explain and Classify proteins as globular or fibrous, natural courses of proteins, and characteristics properties of the classes .	Protein sample,: Millon's reagent Biuret reagent tiles. dropers. Glassware Colorimeter or Spectrophoto	Identify proteins in the laboratory Isolate albumin from egg white by size exclusion chromatography	Guide students to carry out Practical identification of proteins classes	State classes of protein and enumerate their function in the living matter. List chacteristics properties of proteins

	7.4 Explain with examples the role of different proteins in the functioning of living matter e.g. transport, structural catalytic, regulatory defence etc. 7.5. Define prosthetic group as a non-protein moiety of a complex protein. 7.6. Describe proteins in terms of their prosthetic groups e.g. hemoproteins, glycoproteins, lipoproteins etc. 7.7 Describe structure of a protein as a chain of amino acids which are chemically linked together by chemical bonds between carboxyl alpha amino groups on amino acids (Co NH)	Explain with examples the role of different proteins in the functioning of living matter e.g. transport, structural Explain prosthetic proteins group as a non-protein moiety of a complex protein. Define proteins in terms of their prosthetic groups e.g. hemoproteins, glycoproteins, lipoproteins etc. Explain structure of a protein as a chain of amino acids which are chemically linked together by chemical bonds between carboxyl alpha amino groups on amino	meter Water bath	Denature the albumin purified above and conserve its	Ensure students group protein into group as a non-protein moiety of a complex protein, and know proteins in terms of their prosthetic groups e.g. hemoproteins, glycoproteins, lipoproteins . know the structure of a protein as a chain of amino acids which are chemically linked together by chemical bonds between	Group group protein into non-protein moiety of a complex protein, and know proteins in terms of their prosthetic groups e.g. hemoproteins, glycoproteins, lipoproteins draw structure of protein as chain of amino acids which are chemically linked together by chemical bonds between carboxyl alpha amino groups on amino acids (Co NH)

		acids (Co NH)			carboxyl alpha amino groups on amino acids (Co NH)	
	General Objective 8.0: Understand the Classification of Amino Acids and their structures					
9	8.1 Classify amino acids on the basis of the chemical nature of the side groups. 8.2 Describe the hydrolysis of protein to give amino acids as their final product. 8.3 Place given structural formula of any amino acid in the correct class as in 5.11 above. 8.4 Explain D and L isomers within the amino acids. 8.5 Explain the amphoterism of amino acids. 8.6 Write equations to show the ionization of a named amino acid in solutions. 8.7 Interprete a given titration curve for a given amino acid 8.8 Define the term isoelectric point. 8.9 Determine the isoelectric point from a given titration curve. 8.10 State the solubility of	Explain that amino acid is basis chemical nature of side groups, and the hydrolysis of protein to give amino acids as their final product. Define D and L isomers within the amino acids. Explain in details ionization of a named amino acid in solutions, solubility of an amino acid on either side of the isoelectric and why proteins are	Protein sample,: Millon's reagent Biuret reagent tiles. dropers. Glassware Colorimeter or Spectrophoto meter Water bath	Identify proteins in the laboratory Isolate albumin from egg white by size exclusion chromatograph y Denature the albumin purified above and conserve its	Practical identification of protein Ensure students Carry out solubility curve on ionization of amino acid	Discuss that amino acid is basis chemical nature of side groups, and the hydrolysis of protein to give amino acids as their final product and write equation on D and L isomers within the amino acids. Write equation. ionization of a named amino acid in solutions. Then , Interprete a given titration curve for a given amino acid State reason why proteins are precipitated at their

	an amino acid on either side of the isoelectric point. 8.11 Explain why proteins are precipitated at their isoelectric points. 8.12 Explain the application of 5.18 above in the separation of amino acids. 8.13 Explain the general reactions of amino acids due to (a) NH2 group and (b) –CooH group. 8.14 Describe the specific reactions of amino acids due to the side groups. 8.15 Explain that peptides are formed by condensation of amino acids and hydrolysis of proteins. 8.16 Write an equation to show the formation of dipeptide.	precipitated at their isoelectric points. Discuss the general reactions of amino acids due to (a) NH2 group and (b) –CooH group. Explain the specific reactions of amino acids due to the side groups.				isoelectric points. Outline general reaction of amino acid
	General Objective 9.0: Understand the structure and behavior of Proteins					
	Explain the primary, secondary, tertiary and quartenary structure of proteins. 9.2 List the types of interactions involved in:- a) Secondary	Describe primary, seconary, tertiary and quartenary structure of proteins.	Classroom resources Textbooks	Identify primary, secondary, tertiary and quartenary structure of proteins.	Ensure students primary, secondary, tertiary and quartenary structure of proteins.	What is; primary, secondary, tertiary and quartenary structure of proteins.and enumerate the interaction involved inbetween the

	b) Tertiary and c) Quartenary structures of proteins. 9.3 List examples to illustrate the structural organization in 5.27 above. 9.4 Describe denaturation of proteins with examples. 9.5 Explain that the denaturation is the result of an unfolding of the natural structure of the protein molecule and may or may not be reversible. 9.6. Expain why proteins are precipitated at their isoelectric point.	Describe the result of denaturation i an unfolding of the natural structure of the protein molecule and may or may not be reversible.		Protein from solution at its IEP and show that at other pH values it remains in solution		levels of proteines What is known as denaturation of proteins with examples Give reason why proteins are precipitated at their isoelectric point.
	General Objective 10.0: Understand the nature of enzymes					
11-13	**Enzymes** 10.1 Define enzymes as proteins specialized to catalyse biological reactions at a rapid rate within a narrow range of temperature and pH.	**Explain the role of** enzymes as proteins specialized to catalyse biological reactions at a rapid rate within a narrow range of temperature and pH.	Yeast as source of catalase, hydrogen peroxide burette for measuring gas production stop clock glassware etc	experimental on steps required for an enzymes to catalyze a biological reaction To act as site as that region of the enzyme molecule where substrate	Ensure students Determine the effect of pH of the velocity of enzyme catalyses reaction.	What are enzymes What level would protein act as an enzymes specialized to catalyse biological reactions within a narrow range of temperature and pH.

	10.2 Define substrate as the substance on which the enzyme acts. 10.3 Define active site as that region of the enzyme molecule where substrate transformation occurs.	Enumerate substrate as substance on which the enzyme acts		transformation occurs.		What is active site where enzymes act as susbtrate transformation
14	10.4 Explain the distinctive features of enzymes i.e. specificity, high catalytic rate and directive effect. 10.5 .1 Illustrate with examples the distinctive features in 10.4 above.	Discuss the distinctive features of enzymes i.e. specificity, high catalytic rate and directive effect, and state the example				Describe in details, general features of enzymes .
	Classify enzymes as oxido-reductases, Transfeases, Hydrolases, Lyases,isomerases and ligases. 10.6 List examples of enzymes belonging to each the classes in 6.6 above 10.7 Explain that many enzymes require metal ions and/or organic molecules which act as cofactors.	Describe enzymes as oxido-reductases, Transfeases, Hydrolases, Lyases,isomerases and ligases.				List classes of enzymes’
	10.8 Explain that the	Discuss that				Outline the factors

	efficiency of enzyme action is dependent on such factors as P^H, temperature, substrate concentration, ionic environment activators and inhibitors.	the efficiency of enzyme action is dependent on such factors as P^H, temperature, substrate concentration, ionic environment activators and inhibitors.				responsible for enzymes efficiency.
	10.9.Draw profiles to show the effect of P^H, temperature and substrate concentration on the rate of enzyme activity 10.11 Define the terms optimums pH and optimum temperature. 10.12 Thermodynamics of catalysis, types and mechanisms of enzymes, Substrate binding, active site, specificity and role of reaction. 10.13 Effect of temperature, pH, concentration, Michaelis – Menten, Line weaver – Burk, Enzyme inhibition/regulation, reversible, non-reversible,	Illustrate with example profiles to show the effect of P^H, temperature and substrate concentration on the rate of enzyme activity				What is optmum pH and temperature pH Explain enzymes kinetics and nature, classification and enzymes.

	allosteric molecules. 10.14 Introduction to enzymes kinetics. 10.15 The nature, classification and function of enzymes.					
	General Objective 11.0: Understand vitamins and minerals found in the Living cell					
15	**Vitamins** 11. 1 Explain the importance of vitamin supplements 11. 2 Define the water soluble vitamins 11. 3 Explain the general functions of water soluble vitamins. 11. 4 List the deficiency diseases. 11. 5 Define fat soluble vitamins 11. 6 Explain the general functions and the deficiency diseases of fat soluble vitamins.	Lecture with visual aides	Overhead projector Ascorbic acid standard, Burette, Colorimeter and accessorie	Determination of Ascorbic acid using titration\colorimetric method.	Assist students to carry out the experiment.	What is vitamin supplement List disease related to lack of vitamin supplement What is fat soluble vitamins, water soluble vitamins, water soluble vitamins and state their related dissases.

Assessment:
Coursework/ Assignments 10%; Practical 40%; Examination 50%

Recommended Textbooks & References:

Biochemistry by Stryer, published by Freeman
Salters Advanced Chemistry Activities and Assessment Pack published by Heinemann

PROGRAMME: NATIONAL DIPLOMA						
COURSE: General Laboratory Techniques III GLT Module (v) Vacuum Techniques, and Module (vi) Glassblowing Techniques and Scientific			**COURSE CODE:** GLT 222	**CONTACT HOURS: 1** **CREDIT HOUR: 1**		
GOAL: This Course is designed to acquaint the student with the basic principle of vacuum techniques and technique of scientific blowing						
COURSE SPECIFICATION: THEORETICAL CONTENT				**COURSE SPECIFICATION:** PRACTICAL CONTENT2 hour/Week		
Week						
	GENERAL OBJECTIVE : On completion of this course, the students should be able to: **1.0 Know the principle of vacuum production.** **2.0 Know common types of vacuum pumps** **3.0 Know the use of vacuum gauges** **4.0 Know the different types of glasses used as laboratory ware** **5.0 Know the glassblowing hazards and precautions/safety** **6.0 Know the construction of simple glass ware**					

PROGRAMME: NATIONAL DIPLOMA						
COURSE: General Laboratory Techniques III GLT Module (vii) Vacuum Techniques and Module (vi) Glassblowing Techniques and Scientific		**COURSE CODE:** GLT 222		**CONTACT HOUR: 1**		
GOAL: This Course is designed to acquaint the student with the basic principle of vacuum techniques and technique of scientific blowing						
COURSE SPECIFICATION: THEORETICAL CONTENT				**COURSE SPECIFICATION: PRACTICAL CONTENT**		
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVE 1.0: Know the principle of Vacuum Production					
9	1.1 Explain the fundamentals of vacuum technology and basic definition 1.2 Explain pressure regimes of vacuum 1.3 Classify vacuum pressure gauges e.g. low, medium high and ultra high. 1.4 Explain the classification of 1.3 above. 1.5 Explain the units in vacuum technology e.g. the torr; the mmHg; the micron, the Newton; the pascal; etc. 1.6 Explain the effects of temperature on the relationship between pressure (P) and the number of molecules (M)	Explain the fundamentals of vacuum technology and basic definition Explain and classify vacuum pressure gauges e.g. low, medium high and ultra high Explain the units in vacuum technology Explain the effects of temperature on the relationship between pressure (P) and	Vacuum pressure gauge	Operate a simple vacuum system	Demonstrate to students on how to operate vacuum systems	Explain fundermentals of vacuum technology Explain the classifications of vacuum pressure gauges Explain the effects of temperature on the relationship between pressure and the number of molecules

	within a giving vacuum system. 1.7 List the various component of a simple vacuum set-up. 1.8 Explain the sequence of operation of a simple vacuum system	the number of molecules (M) within a giving vacuum system. Explain the sequence of operation of a simple vacuum system				
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 2.0: Know common types of vacuum pumps Know common types of vacuum pumps					
	2.1 List common types of vacuum pumps: rotary and diffusion pumps. 2.2 Describe the application of each of the pumps in 2.1 above	List the common types of vacuum pumps Emphasize areas of application of pumps	Rotary pump Diffusion pump Vacuum pump			List common types of vacuum pumps
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 3.0: General Objective 3: Know the use of vacuum gauges					
	3.1 List common gauges e.g. McLeod gauge; the vacustat; the prirani gauge; cold and hot ionization gauges and U-tube mano meters. 3.2 Explain the principle	Describe common gauges Explain the principle of	McLeod gauge Vacustat Pirani gauge U-tube manometer - do – Test-coil	Detect vacuum leaks using leak detectors. Use of high performance detectors	Guide students to detect vacuum leaks using detectors Demonstrate how to use performance detectors	List common gauges and explain the principle of operation of guages. Explain the

	of operation of the gauges in 3.1 above 3.3 Explain the care and handling of the gauges in 3.1 3.4 Explain leak detection e.g. by the use of High Frequency tester (Test coil). 3.5 Explain the importance of Leakages in vacuum system	operation of the gauges Explain the care and handling of the gauges Explain leak detection Explain the importance of Leakages in vacuum system				causes of leakages.
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	Module VI Scientific Glassblowing Techniques GENERAL OBJECTIVES 4.0: Know the different types of glasses used as laboratory wares					
	4.1 List types of glasses suitable for laboratory glass wares e.g. borosilicate, soda lime (soda glass), silica glass 4.2 State properties of glasses in 4.1 above e.g. resistance to thermal shock, resistance to chemical attack etc	Explain types of glass suitable for laboratory wares Outline the properties of the galsses listed in 4.1	Soda glass, Borosilicate and silica glass Beaker soda/pyrex			List types of glass suitable for laboratory wares and state their properties

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objectives	Teacher's Activities	Evaluation
	GENERAL OBJECTIVES 5.0 Know glassblowing hazards and precautions					
	5.1 List hazards associated with gas e.g. explosion, toxicity, fire etc. 5.2 Enumerate safety measures adopted in glass blowing e.g. use of didymium goggles and handling gloves etc.	List hazards associated with gas Enumerate safety measures adopted in glass blowing workshop	Didymium goggles Handling gloves Goggles safety spectacles			List glassblowing laboratory hazards and profer solution
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objectives**	**Teacher's Activities**	**Evaluation**
	GENERAL OBJECTIVES 6.0: Know the construction of simple glass wares					
10-15	6.1 Identify various tools and equipment used in glass blowing workshops. 6.2 Describe glass cutting techniques. 6.3 Describe various methods of glass manipulation e.g. simple point pulling. 6.4 Explain safety in the glass laboratory 6.5 Explain Glass blowing equipment such as Bench mounted torch file or glass knife graphite rod blow	Identify various tools and equipment used in glass blowing workshops.	Glass cutting knife Calliper gauges Three way fuel gas filling top Glass inspection polarizer Cork borer set. Cork borer set. Rotary air blower e.g. compressors types EB 3B Tweezers Glass blowing hanging tools (cones)	Join two glass tubes. Blow bulbs at the end and in the middle of tubes. Construct T.Y joints Construct U bends Construct simple glass wares e.g. pipettes, burettes, and test tube. Calibrate the glass ware. Anneal glass apparatus after	Guide and supervise students to do the constructions in turns Demonstrate how to construct simple glass ware	Outline the various tools and equipment used in glass blowing workshop Describe various methods of glass manupulation

	hose etc.		Glass blowing tapers 13x13mm. Diamond glass cutter Bunsen burner for annealing Oxygen/air/gas burners Wooden corks (Assorted)	construction. Important rules for the glass laboratory which include safety glasses, didymium glass blowing, glass ware, heat and glass blowing rules, protective clothing, first aid and general safety rules		.

Assessment: Practical 60%, Assignment/course work 10%, Exams 30%

Recommended Textbooks & References:

A handbook of Laboratory Glass – Blowing by Bernard D. Bolas – PAF
Vaccum Techniques: A handbook of Vacuum Science and Technology by Dorothy M. Hoffman Bawa Singh – e-copy
Essentials in Laboratory Techniques, Photographing, Glassblowing and Vacuum Technology, By Ibe, Colman Chikwem Etal, 20

LIST OF EQUIPMENT FOR ND SLT

S/No	Description of Items	Quantity Required
	BIOLOGY/MICROBIOLOGY LABORATORY	
1.	Balance: Top loading balance	5
2.	Analytical balance	2
3.	Blood grouping kit	2
4.	Clinostat clockwork	4
5.	Desiccators	5
6.	Filter funnels, plastic, 6.5cm diameter	10
7.	Forceps, line points & blunt	20
8.	Magnifiers, hand lens, 7.5 diameter for folding magnifier x 10	30
9.	Microscopes, light with x 10 wild field eyepiece and, x (or x5) x 10, x 30 (or x 50 and x 100 objectives)	30
	Microscope, slides (plain)	Assorted
	Microslids storage box	For 100 slides
10.	Microtome, hand type	1
11.	Dissecting kits	60
12.	Dissecting boards (or trays with wax)	60
13.	Net (pond)	60
14.	Net, butterfly	60
15.	Netpole, aluminum, 120cm long	30
16.	Plant press	5
17.	Photometry measurement (photometer)	2
18.	Respirometer, simple	5
19.	Retort stand with rod	70
20.	Soil sieves, set of 5 of different known sizes	5
21.	Soil test kit	5
22.	Thistle funnel	5
23.	PH meter	5
24.	Kjedahl apparatus	1

25.	Heating mantle (with at least 5 burners)	5
26.	Water bath	5
27.	Water distiller	1
28.	Blender	2
29.	Amino acid analyzer	1
30.	Autoclave	11
31.	Staining troughs	4
32.	Refractometer	10
33.	Column chromatograph	1
34.	Auxanometer	5
35.	Magnetic stirrer	4
36.	Colony counter	2
37.	Incubator	2
38.	Wire loop	60
39.	Centrifuge (various types)	2
40.	Oven	2
41.	Vacuum pump	1
42.	Ice coolant	1
43.	Glass still distiller	1
44.	Spatula	60
45.	Photosynthesis apparatus	1
46.	Forceps	10
47.	Scissors	10
48.	Scalpel	10
49.	Blood lancet	Many
50.	Haematocrit	1
	Slides	
51.	Histological slides	Assorted
52.	Embryology slide	Assorted
53.	Animals and plant whole mount (for smaller plants & animals)	Models
	Charts	
54.	Blood and lymph circulation	1
55.	Blood structure	1

56.	Nervous system	1
57.	Muscles	1
58.	Reproductive organ (mammal)	1
59.	Growth of foetus	1
60.	Developmental stages of embryo	1
61.	Plant structure (monocot and dicot)	1
62.	Flowers fertilization	1
63.	Fruit and seed dispersal	1
64.	Seed germination	1
65.	Taxonomical charts	1
66.	Genetic charts	1
67.	Meiosis and Mitosis	1 each
68.	Mammalian organs	Assorted
	Models	
69.	Human brain	1
70.	Human jaw	1
71.	Human eye, ear	1 each
72.	Human heart, kidney	1 each
73.	Human skin	1
74.	Full size skeleton of man, rabbit, birds, snakes, toads etc	1 each
75.	Units of vertebrate bone	1
	Preserved Specimen	
76.	Fish	1
77.	Snakes	1
78.	Mammalian foetus	1
79.	Rabbits, rats	1
80.	Mammalian organs – liver, kidney, brain eye, ears, sex organs etc.	1 each
81.	Worms	Assorted
82.	Birds	Assorted
83.	Plant & animal tissues	Assorted
	INSTRUMENTATION	
84.	Chromatography	1

85.	Column thin layer gas liquid paper	1
86.	Soxblet apparatus	2
87.	Distillation still	1
88.	Insect traps	5
89.	Animals cages	10
90.	Electronic balances (analytical beam)	5
91.	Microscopes (various)	3
92.	Hot plates	1
93.	Autoclaves	1
94.	Oven	1
95.	Freez drier	1
96.	Water circulator	1
97.	Thermometers	1
98.	Pyrometers	1
99.	Microtomes	1
100.	Over head projectors	1
101.	Tape recorder	
	METEOROLOGICAL STATION	
102.	Rain gauge	1
103.	Psychrometer	1
104.	Light meter	1
105.	Secchi disc	1
106.	Atemometer	1
107.	Hygrometers	1

LIST OF CHEMISTRY/ BIOCHEMISTRY EQUIPMENT

S/N	**ITEMS :**	**NUMBER REQUIRED**
1.	Balance (Top loading)	4
2.	Centrifuge (Electric & 8 Buckets)	2
3	Distillation Apparatus	2
4	Kipp’s Apparatus	4
5	Oven (Electric thermostatic	2

	control)	
6	Khejedahl Apparatus	1
7	Vacuum pump	2
8	Thermometers (Assorted)	6pks
9	Water Bath with eccentric rings	2
10	Water Manesty	2
11	Water Deioniser	2
12	Heating Mantle	4
13	Hot Plate	4
14	Muffle Furnace	1
15	Thermostated Water Bath	2
16	Vacuum Dry Oven	-
17	Melting Point Apparatus	2
18	Soxhlet Apparatus	4
19	Flame Photometer	1
20	Thin Layer Chromatograph	2
21	Lovibond Comparator	2
22	Column Chromatograph	2
24	Paper Chromatograph Apparatus	2
25	Voltameter (copper)	2
26	Voltameter (Hoffman H-Type)	2

LIST OF INSTRUMENTATION EQUIPMENT

S/N	ITEMS	NUMBER REQUIRED

1	Analytical Balance	5
2	Magnetic Stirrer	2
3	Abe Refractometer (Hand held type)	1
4	PH Meter	4
5	Flame Photometer	1
6	Conductivity Meter	2
7	Spectrophotometer (UV/Visible)	1
8	Polarimeter	2
9	Electrophoresis Equipment	2
10	Atomic Absorption spectrophotometer (AAS)	1
11	colorimeter	2
12	Higher performance chromatograph (HPLC)	1
13	FTIR	1

LIST OF EQUIPMENT FOR GENERAL LABORATORY TECHNIQUES
VACUUM TECHNIQUES

S/N	ITEM	QUANTITY
1	Vacuum Pump	2
2	Leak Detector	2
3	Radiation Desemeter	2
4	Rubber Tubing	2
5	Pyrex Buchner Flak (250 ml)	5
6	Set of Filter Cones	2
7	Cable Ties	2
8	Procelein Buchner funnel	2
9	7cm filter Poper	Assorted

GLASSBLOWING

S/N	ITEM	QUANTITY
1	Glass Cutting Knives	5
2	Caliper Gauge (Steel)	5
3	3-Way Fuel Gas Filing Top	15
4	Glass Inspection Polarizer	2
5	Rotary Air Blower	1
6	Safety Google	30
7	Tweezers	15
8	Glassblowing Flanging Tools (Cones)	15
9	Glassblowing Tapers 13x13mm	15
10	Diamond Glass Cutter	5
11	Bunsen Buners	15
12	Gas Cylinder 10Kg (Oxygen and Acetylene Gas)	2
13	Foreceps	5
14	Safety Kit	1
15	Oxygen/Air/Gas/Burners	15
16	Wooden Corks (Assorted)	100
17	Rubber Stoppers (Assorted)	100
18	Didymium Spectacles	15
19	Reamers	5
20	Abestors Gloves	15
21	Spanners	15
22	Panthograph /Engraving Machine	2

OBSERVATION ON BIOLOGY COMPONENT OF THE ND SLT REVIEWED CURRICULUM

A) Plant and Animal Taxonomy (STB 111)

1) Course Title:
   - Modified to “Fungi, Plant and Animal Taxonomy”, the modification is based on modern classification, fungi is no longer classified under plant kingdom. It is a kingdom on its own.

2) General Objectives:

- Three (3) general objectives were added, this is in line with the modified course title to cover the modification of the course title.

B) Cell Biology (STB 112)
1) General Objectives
   - General objective 13 and 14 were merged to read “know the process of ion and water absorption in plants”, the topics to be treated under each objective mentioned above were scanty to be treated in two weeks.

2) Practical contents were added under general objective 11, this is to cover the topics that were treated under the theoretical content.

C) Microbiology (STB 121)
1) The course title is modified to read Introductory Microbiology. This is because the content of the course is at the foundation level.

D) Pathology (STB 212)
1) The general objectives for pathology was modified and rearranged because the present content is majorly parasitology which actually is a deviation from what it ought to be.

2) Specific objectives for all the general objectives were modified to cover both plant and animal.