



NATIONAL BOARD FOR TECHNICAL EDUCATION, KADUNA

CURRICULUM AND COURSE SPECIFICATIONS

FOR

NATIONAL DIPLOMA (ND)

IN

ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY

September, 2022

FOREWORD

The National Diploma in Environmental science and management curriculum is designed to be used by training institutions to produce manpower for the health sector nationwide.

The shortage of professionally-trained manpower in the health sector in Nigeria as well as the need to produce professional practitioners with good ethics and career progression, through the acquisition of desirable knowledge and skills, necessitated the production of this national curriculum.

It is my belief that this curriculum and course specifications which is the minimum required to produce health practitioners with sound knowledge and skills in Environmental science and management if properly implemented with the required resources (qualified teaching staff in adequate number and mix, adequate consumables, training materials, teaching aids), and qualified candidates are admitted into the programme will lead to the production of competent and skilled practitioners required in the sector.

I wish to express my deep appreciation to those that made the review of this curriculum possible especially the invaluable contributions of all the members of the committee and resource persons during the national review workshop are appreciated.

I hope that the curriculum would be properly implemented, so as to produce the required Work Force of our dream.

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EXECUTIVE SECRETARY,
NBTE KADUNA.

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GENERAL INFORMATION

1.0 TITLE AND CERTIFICATION OF THE PROGRAMME: The title of the programme is National Diploma in Environmental Science and management Technology

2.0 GOAL AND OBJECTIVES:

2.1 GOAL The programme is designed to produce skilled technologists who should be able to manage the environment.

2.2 OBJECTIVES

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

- i. Operate environmental equipment used in industries.
- ii. Maintain environmental equipment.
- iii. Collect, collate and analyse environmental data
- iv. Undertake quality control tests in environment.
- v. Participate in Environmental Impact Assessment, Environmental Management, etc.
- vi. Set up and manage an enterprise in the areas of environmental management and other disciplines

4.0 MANPOWER REQUIREMENTS:

4.1 Headship of The Department

The HOD should be at least a Senior Lecturer who has a minimum of second Degree in any of the Basic Science courses or related discipline.

He should have at least 10 years cognate experience and must be registered with relevant professional body.

4.2 Teaching Staff

At the point of entry Assistant Lecturers should have first degrees (BSc, BTech.or HND+PGD) in any of the Basic Science courses. The Instructor should have HND (upper credit) in any of the Basic Science courses or related discipline.

4.2.1 Lecturer/Instructor Cadre

4.2.2 Technologist Cadre

4.2.2.1 Technologist

Technologist should have HND (upper credit) in any Basic Science programme or Environmental Science and Management Technology or related discipline

4.2.3 Technician Cadre

Technicians should have ND (lower credit) as stated in 2.1

4.3 Criteria for appointment of ND External Examiners

5.0 CAREER PROSPECTS

- i) Environmental and Safety Health Management Sector
- ii) Pest Control Management
- iii) Small and medium Scale Business Owners/Manager
- iv) Data Processor (Environmental and Safety)
- v) Research and Academic Laboratories
- vi) Ministries of Environment at Federal and State levels
- vii) Regulatory and Enforcement Agencies at the Federal and State level
- viii) Waste Management Authorities
- ix) Emergency Management Agencies
- x) Industrial Sector

5.0 Academic Progression

6.0 CURRICULUM

6.1 The curriculum of all ND programmes consists of the following four (4) main components:

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

6.2 The General Education Components shall include courses in:

English Language, Communication, Industrial Management and Engineer in Society, The General Education component shall account for not more than 15% of the total contact hours for the programme.

6.3 Foundation Courses include courses in Mathematics, The number of hours for the programme may account for about 10-15% of the total contact hours.

6.4 Professional Courses are courses of the programme which give the student the theory and professional skills he needs to practice his field of calling at the technician/technologist level. These may account for between 60-70% of the contact hours.

6.5 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.

7.0 Curriculum Structure:

The structure of the National Diploma programme consists of four semesters of classroom, laboratory and workshop activities in the college. Each semester shall be of 17 weeks duration made up as follows:

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

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

8.0 PROJECT

Final year students in this programme are expected to carry out a project work. This could be on individual basis or group work; but reporting must be undertaken individually. The project should, as much as possible incorporate basic element of design, drawing and complete fabrication of a marketable item or something that can be put to use. Project reports should be well presented and should be properly supervised.

The departments should make their own arrangement of schedules for project work.

9.0 ACCREDITIATION

10.0 The programme shall be accredited by the National Board for Technical Education before the diplomates can be awarded the National Diploma certificates. Details about the process of accrediting a programme for the award of the National Diploma are available from the office of the Executive Secretary, National Board for Technical Education, Plot “B”, Bida Road, P.M.B. 2239, Kaduna, Nigeria.

9.1 Conditions for the Award of ND:

Conditions for the award of National Diploma include the following:

- a. Satisfactory performance in all prescribed course work which may include class work, tests, quizzes.
- b. Workshop practice, laboratory work and field work.
- c. Satisfactory performance at all semester examinations.
- d. Satisfactory completion of final year project work.

Normally, continuous assessment contributes 30%, project work 10% while semester examinations are weighted 60% to make a total of 100%.

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

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 2.50-2.99
Pass	-	CGPA 2.00-2.49

11.0 Guidance Notes for Teachers of the Programme:

10.1 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/she is transferring.

10.2 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.

10.3 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.

10.4 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.

CURRICULUM TABLE

YEAR I SEMESTER I

S/N	COURSE CODE	COURSE TITLE	L	P	CU	CH
1	GNS 101	Use of English I	2	0	2	2
2	STA 111	Introduction to Statistics	2	-	2	2
3	GNS 111	Citizenship Education I	2	-	2	2
4	MTH 111	Logic and Linear Algebra	2	-	2	2
5	COM 111	Introduction to Computing	2	1	3	3
6	STC 111	General Principles of Chemistry	2	1	3	3
7	ESM 111	Introduction to Environmental Management	2	-	2	2
8	ESM 112	Introduction to Ecology	2	1	3	3
9	ESM 113	Introduction to Geography	2	1	3	3
Total			18	4	22	22

YEAR I SEMESTER II

S/N	COURSE CODE	COURSE TITLE	L	P	CU	CH
1	GNS 121	Citizenship Education	2	0	2	2
2	GNS 102	Communication in English I	2	0	2	2
3	ENT 126	Introduction to Entrepreneurship I	2	1	3	3
3	STM 211	Introduction to Microbiology	2	1	3	3
4	ESM 121	Analytical Laboratory Skills I	-	2	2	2
5	ESM 122	Environmental Chemistry I	2	1	3	3
6	ESM 123	Occupational Safety	2	1	3	3
7	ESM 124	Introduction to Hydrology	2	1	3	3
8	ESM 125	Introduction To Geographic Communication	2	1	3	3
9	ESM 126	Environmental Sampling and Analysis	2	1	3	3
Total			18	9	27	27

YEAR II SEMESTER I

S/N	COURSE CODE	COURSE TITLE	L	P	CU	CH
1	GNS 201	Use of English II	2	0	2	2
2	ENT 216	Introduction to Entrepreneurship II	2	1	3	3
3	ESM 211	Man and Environment	2	-	2	2
4	ESM 212	Environmental and Social Risk Communication	2	-	2	2
5	ESM 213	Environmental Law	2	-	2	2
6	ESM 214	Environmental Pollution and Control	2	1	3	3
7	ESM 215	Environmental Assessment	1	1	2	2
8	ESM 216	Environmental Monitoring	2	1	3	3
10	ESM 217	Environmental Chemistry II	2	1	3	3
11	ESM 218	Water and Wastewater Treatment	2	1	3	3
12	SIW 219	SIWES	0	4	4	4
Total			19	10	29	29

YEAR II SEMESTER II

S/N	COURSE CODE	COURSE TITLE	L	P	CU	CH
1	GNS 202	Communication in English II	2	0	2	2
2	ESM 221	Climate Change	2	1	3	3
3	ESM 222	Solid Waste Management	2	-	2	2
4	ESM 223	Renewable Energy and Sustainability	2	1	3	3
5	ESM 224	Pests and Pest Control	1	2	3	3
6	ESM 225	Analytical Laboratory Skills II	-	3	3	3
7	ESM 226	Research Project	-	4	4	4
Total			9	11	20	20

NOTE: Borrowed/Foundation/General Courses in *italics* above are to be obtained from the respective programme curricula.

KEY: L= Lecture hours, T= Tutorial hours, P= Practical hours, CU= Credit Units, CH= Contact Hou

YEAR ONE, SEMESTER ONE COURSES

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: INTRODUCTION TO ENVIRONMENTAL MANAGEMENT	CODE: ESM 111	Credit Unit: 2.0	CONTACT HOURS: 2 HOURS/WEEK
GOAL: This course is designed to expose students to the scope, importance and the multi –disciplinary nature of environmental management technology.			
YEAR: ONE (1), SEMESTER: ONE (1)	PRE-REQUISITE: NONE	PRACTICAL: 0 HOURS/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <ol style="list-style-type: none"> 1.0 Know basic concepts of environmental management 2.0 Understand the scope and importance of environmental management 3.0 Understand the multidisciplinary nature of the environment. 4.0 Understand the classification and management of natural resources 5.0 Understand the classification of Natural Resources. 6.0 Understand the natural ecosystem and the impact of human activities in the environment 7.0 Understand energy and environmental management 			

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY								
Course: Introduction to Environmental Management		Course Code: ESM111		Credit Unit: 2.0		Contact Hours: 2-0-0		
GOAL: This course is designed to expose students to the scope, importance and the multi –disciplinary nature of environmental management technology.								
Course Specification:				Theoretical Content: 2 hrs		Practical Content: 0 hrs		
GENERAL OBJECTIVE 1.0: Know basic concepts of environmental management								
Course Specification:		THEORETICAL CONTENT			PRACTICAL CONTENT			
Week	Specific Outcome	Learning	Teachers' Activities	Learning Resources	Specific Outcome	Learning	Teachers' Activities	Evaluation
1-2	1.1 Define environmental management 1.2 Explain some of the relationships between environmental management and the environment 1.3 Explain the basic terms and concepts in environmental studies e.g. <ul style="list-style-type: none"> • Components of environment, • environmental stabilization, • environmental degradation etc. 		<ul style="list-style-type: none"> • Explain in details with appropriate notes the concepts of environmental management technology. 	<ul style="list-style-type: none"> • Multi-media • Whiteboard, • Internet link materials, etc. 	<ul style="list-style-type: none"> ▪ - 		<ul style="list-style-type: none"> ▪ - 	Explain some of the relationships between environmental management and the environment
GENERAL OBJECTIVE 2.0: Understand the scope and importance of environmental management								

3-4	<p>2.1 Explain the role of environmental management technology in the study of environment.</p> <p>2.2 Explain environmental problems such as:</p> <ul style="list-style-type: none"> • Degradation, • denudation, • natural disaster (earthquake, flood, volcanic eruption, mass movement, etc) • ecological problems (deforestation, soil erosion, desertification, land degradation, pollution, wildlife extinction) etc. <p>2.3 Suggest ways of providing relevant solution to some of the problems highlighted in 2.2 above.</p>	<ul style="list-style-type: none"> • Explain the role of environmental management technology in the study of environment. 	<ul style="list-style-type: none"> • Multi-media • Whiteboard, • Internet link <p>Pictures video clips materials, etc.</p>	<ul style="list-style-type: none"> ▪ - 	<ul style="list-style-type: none"> ▪ - 	<p>State the importance of environmental management technology.</p>
<p>General Objective 3.0 Understand the multidisciplinary nature of the environment.</p>						

5-6	<p>3.1 Describe the interdisciplinary nature of environmental science.</p> <p>3.2 Identify other branches of science such as geography, forestry, botany, Zoology, Geology, Physics, Chemistry, and Engineering etc.</p> <p>3.3 Describe the role of scientists from various disciplines in solving some of the environmental problems mentioned in 3.1 above.</p> <p>3.4 Establish some of the links in the individual approach in 3.2 above.</p>	<ul style="list-style-type: none"> • Explain in details with appropriate notes the multidisciplinary nature of environmental management technology. 	<ul style="list-style-type: none"> • Multi-media • Whiteboard, • Internet link materials, etc. 	<ul style="list-style-type: none"> ▪ - 	<ul style="list-style-type: none"> ▪ - 	Describe the interdisciplinary nature of environmental science involving other branches of science.
GENERAL OBJECTIVE 4.0: Understand the classification and management of natural resources						
7-9	<p>4.1 Define natural resources.</p> <p>4.2 Give examples of natural resources.</p> <p>4.3 Classify natural resources i.e Renewable and non-renewable</p> <p>4.4 Define Forest and forest resources.</p>	<p>Explain in details with appropriate notes the basic concepts of natural resources</p> <p>Explain Forest and forest resources types.</p>	<ul style="list-style-type: none"> • Multi-media • Whiteboard, • Internet link materials, etc. • Multi-media • Whiteboard, • Internet link 	<ul style="list-style-type: none"> - ▪ - 	<ul style="list-style-type: none"> - ▪ - 	<p>Explain with examples natural resources</p> <p>Explain the effect of timber</p> <p>State the problems associated with use, over</p>

	<p>4.5 Differentiate types of forest resources and their resources.</p> <p>4.6 List associated problems such as: use and over exploitation, deforestation, desertification.</p> <p>4.7 Define human activities in environment e.g :</p> <ul style="list-style-type: none"> • timber extraction, • mining and dam construction. on forest and tribal people <p>4.8 Explain the effect of human activities listed in 5.4 above.</p> <p>4.9 Explain the different type of water resources.</p> <p>4.10 List associated problems such as: use and over utilization of surface and ground water resulting in flood, drought, conflict over water e.g. dam conflict and problems</p>	<p>sources such as renewable and non- renewable energy sources, growing energy needs, and use of alternate energy sources.</p> <p>Explain why land is regarded as a resource. Discuss the problem associated with land resources such as: land degradation, man induced landslides, soil erosion and desertification.</p> <ul style="list-style-type: none"> • Explain with appropriate note the problems associated with the use, over utilization and over exploitation of natural resources 				<p>utilization and exploitation of natural resources</p>
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	<p>4.11 Describe the mineral resource and associated problems with use and exploitation e.g environmental effect of mineralextraction</p> <p>4.12 Discuss problems associated with food resources such as world food crises caused by agricultural problems, overgrazing, fertilizer and pesticide problem, water logging, salinity, climate changes etc.</p> <p>Performance objectives</p> <p>4.13 Describe the energy sources such as renewable and non-renewable energy sources, growing energy needs, and use of alternate energy sources.</p> <p>4.14 Describe land as a resource and identify the</p>					
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	<p>problem associated with land resources such as landdegradation, man induced landslides, soil erosion and desertification.</p> <p>4.15 Explain different management approaches natural resources e.g conservation, preservation, protection.</p>					
GENERAL OBJECTIVE 5.0: Understand the Natural Ecosystems and the impact of human activities on the environment.						
10-11	<p>5.1 Define the terms Ecosystem, population, community, habitat, niche.</p> <p>5.2 Describe the biotic (living) and abiotic (non-living) components of an ecosystem</p> <p>5.3 Describe biotic interactions Describe the process of photosynthesis</p> <p>5.4 Describe energy flow using food chains, food web and trophic level.</p> <p>5.5 Describe</p>	<p>Discuss in details with appropriate notes the problems associated with naturalecosystems and the</p> <ul style="list-style-type: none"> • impact of human activities on the 	<ul style="list-style-type: none"> • Multi-media • Whiteboard, • Internet link materials,etc. 	<ul style="list-style-type: none"> ▪ - 	<ul style="list-style-type: none"> ▪ - 	Describe the causes and impacts of deforestation

	<p>ecological pyramids based on number and energy</p> <p>5.6 Describe the causes and impacts of habitat loss</p> <p>5.7 Describe the causes and impacts of deforestation</p> <p>5.8 Explain the need for the sustainable management of forests</p> <p>5.9 Describe methods of estimating biodiversity</p> <p>5.10 Evaluate national and international strategies for conserving the biodiversity and genetic resources of natural ecosystems.</p>					
General Objective 6.0: Understand Energy and Environmental Management.						
12-14	<p>6.1 Describe the formation of the fossil fuels, coal, oil and gas</p> <p>6.2 Classify the following energy</p>	Explain items 6.1-6.9	<ul style="list-style-type: none"> • Multi-media • Whiteboard, • Internet link materials,etc. 	▪ --	▪ -	State the strategies for minimizing the impacts of oil spills in

	<p>resources as renewable or non-renewable:</p> <ul style="list-style-type: none"> • fossil fuels, • nuclear • power, • biofuels, • geothermal power, • hydro-electric power, • tidal power, wave power, • solar and • wind power. E.t.c <p>6.3 Describe how each of these energy resources is used to generate electricity</p> <p>6.4 Describe the environmental and social-economic advantages and disadvantages of each of the energy resource.</p> <p>6.5 Describe and explain the factors affecting the demand of energy</p> <p>6.6 Describe and explain strategies for</p>					<p>marine and coastal Ecosystems</p>
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	<p>the efficient management of energy resources</p> <p>6.7 Describe the causes and impacts of oil pollution on marine and coastal ecosystems.</p> <p>6.8 State the strategies of reducing oil spills in marine and coastal ecosystems.</p> <p>6.9 State the strategies for minimizing the impacts of oil spills in marine and coastal ecosystems</p>					
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ASSESSMENT: The continuous assessment; tests and quizzes will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Introduction to Ecology	CODE: ESM 112	Credit Unit: 3.0	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course is designed to introduce students to Ecology, Ecological concepts and their applications to residential and industrial situations			
YEAR: ONE (1), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 2HOURS/WEEK	
<p>General Objectives:</p> <p>On completion of this course, the student should be able to:</p> <ol style="list-style-type: none"> 1.0 Understand the importance of Ecology as a field of study. 2.0 Understand the population growth and industrial activities on environment. 3.0 Understand the effects of Abiotic Factors on Organisms and Industrial Activities in the Environment 4.0 Understand the critical roles soil plays in ecosystems. 5.0 Understand the concepts of living organism living strategies and its applications in industrial situations. 6.0 Understand the different types of terrestrial and aquatic communities and major eco zones in Nigeria. 7.0 Understand the Major Ecozones In Nigeria. 8.0 Understand the various concepts of species Richness, Biodiversity, Community Equilibrium, Succession, And Biogeography 9.0 Understand the concept of trophic structure and its applications in industrial situation 10.0 Understand the concept of energy flow as it applies to industrial situation. 11.0 Understand the Phosphorous, Carbon, Nitrogen, Sulfur cycles and their applications in solving industrial issue. 12.0 Understand the concept of Evolutionary Ecology, Conservation Biology, Industrial Ecology and their relationship 13.0 Understand the concepts of Group Selection, Individual Selection, And Life History Variation 			

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
Course: Introduction to Ecology		Course Code: ESM112		Credit Unit: 3.0		Contact Hours: 3
GOAL: This course is designed to introduce students to Ecology, Ecological concepts and their applications to residential and industrial situations						
Course Specification:						
			THEORETICAL CONTENT		PRACTICAL CONTENT	
General Objective 1.0: Understand the Importance of Ecology as a field of study.						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Define ecology 1.2 Describe the importance of the study of ecology. 1.3 Explain why the concept and principles of ecology is important to industry.	Explain the importance of Ecology and its significance to the industry.	<ul style="list-style-type: none"> • Multi-media • Internet link Materials, etc. 	▪ -	▪ -	Explain the importance of the study of ecology
General Objective 2.0: Understand the population growth and industrial activities on environment.						
4-5	2.1 Define population growth 2.2 Compare and contrast population growth strategies of organisms with short life spans to longer-lived organisms. 2.3 Define survivorship curves. 2.4 List the three	Explain the various concepts of population growth. Explain deterministic and stochastic models of population growth.	<ul style="list-style-type: none"> • Multi-media • Internet link materials, etc. 	Identify short and long-life span organism	Guide student to carry out practical on the identification of short and long-life span organism	Compare and contrast population growth strategies of organisms with short lifespans to longer-lived organisms. List the types of survivorship curves.

	<p>types of survivorship curves.</p> <p>2.5 Define deterministic and stochastic models of population growth.</p> <p>2.6 Explain carrying capacity in an environment</p> <p>2.5 Explain the various elements that could influence carrying capacity.</p> <p>2.6 Explain the concepts presented as they relate to an industrial situation.</p>	<ul style="list-style-type: none"> • Give a case study and apply the concepts presented. 				
General Objective 3.0: Understand the effects of Abiotic Factors on Organisms and Industrial Activities in the Environment.						
6-7	<p>3.1 List the abiotic factors of the environment</p> <p>3.2 Describe that limit the distribution patterns of many organisms.</p> <p>3.2 Describe, using examples, the abiotic factors and how they potentially can limit the distribution patterns of organisms</p> <p>3.3 Explain how changes in abiotic factors can influence</p>	<p>Explain in details the features of various abiotic factors of the environment that can affect local distribution patterns of organism.</p> <p>Explain how changes in abiotic factors can influence population growth and densities of an organism.</p> <p>Give a case study</p> <ul style="list-style-type: none"> • and apply the concepts presented. 	<ul style="list-style-type: none"> • Multi-media • Internet link materials, etc. 	carry out practical on plant and animals' population density	Guide the student to carry out practical on plant and animals' population density	Explain the abiotic factors of the environment and how changes in abiotic factors can influence population growth and densities of organisms.

	<p>population growth and densities of an organism.</p> <p>3.4 Explain the concepts presented as they relate to an Industrial situation.</p>					
General Objective 4.0: Understand the critical roles Soil Play in Ecosystem.						
8-10	<p>4.1 Describe the components of the Soil system.</p> <p>4.2 Classify different types of soils.</p> <p>4.3 Describe the sources and fate of mineral nutrients.</p> <p>4.4 Explain the key role of water in soil and soil formation.</p> <p>4.5 Describe the impact different types of soil have on ecosystem formation.</p> <p>4.6 Describe the impact of different types of soil on industrial activities</p>	<p>Explain the different types of soil profile, their characteristics and properties.</p> <p>Classify different type of soils and the key role of</p> <ul style="list-style-type: none"> • water in soil and soil formation. <p>Describe the impact of different types of soil on industrial activities</p> <p>Give a case study and apply the concepts presented</p>	<ul style="list-style-type: none"> • Multi-media • Whiteboard, • Internet link materials, soil samples 	<p>carry out practical to identify types of soil profile.</p>	<p>Guide student to carry out practical to identify types of soil profile</p>	<p>List the components of the Soil system</p> <p>Classify different type of soils.</p> <p>Write down the sources and fate of mineral nutrients</p> <p>Describe the impact different types of soil have on industrial activity</p>

General Objective 5.0: Understand the Concepts of living Organism Living Strategies and its applications in industrial situations						
11	5.1 Discuss the interactions of different types of organism in an environment. 5.2 Discuss the effect of ecological chain within the environment.	Explain in detail the concepts of organism living strategies and their application in an industrial situation.	<ul style="list-style-type: none"> • Multi-media • Whiteboard, • Internet link materials,etc. 	Carry out practical to determine species diversity of a group of organisms using Simpson index	Guide student to carry out practical to determine species diversity of a group of organisms using Simpson index	Describe the different types and subtypes of species interactions
General Objective 6.0: Understand the Different Types of Terrestrial and Aquatic Communities and Major Eco zones In Nigeria						
12-13	6.1 Define an ecological community and its importance 6.2 Describe the different types of terrestrial community 6.3 Describe the different types of aquatic communities. 6.4 Explain why the study of communities and their classification is important to an industrial situation	Describe the various types of communities in Ecology. Explain the significances of the study of communities and their classifications to the study of Ecology in industrial <ul style="list-style-type: none"> • situation. 	<ul style="list-style-type: none"> • Multi-media • Internet link materials,etc. 	Identify different ecological communities	Guide the student on how to identify different ecological communities	Define an ecological community Describe the different types of aquatic and terrestrial communities.
General Objective 7.0 Understand the Major Ecozones In Nigeria						
14	7.1 List the different groups of Nigeria ecozones.	Explain in detail the major Ecozones and Ecoregions in Nigeria	<ul style="list-style-type: none"> • Multi-media • Internet link materials,etc. 	▪	▪	List the different groups of Nigeria ecozones.

<p>7.2 Describe the general biophysical characteristics of each of the different groups of Nigeria ecozones.</p> <p>7.3 Compare and contrast the general biophysical characteristics of the different groups of Nigeria ecozones.</p> <p>7.4 List the Nigeria ecozones and ecoregions.</p> <p>7.5 Describe the biophysical characteristics of the Nigeria ecozones and Eco regions.</p> <p>7.6 Recognize the biophysical characteristics of the Nigeria ecozones.</p> <p>7.7 Describe the limitations and problems associated with industrial activities in the Nigeria ecozones and ecoregions.</p>	<p>emphasizing on the general biophysical characteristics.</p> <p>Outline the limitations and problems associated with industrial activities in the Nigeria ecozones and ecoregions. Compare and contrast the general biophysical characteristics of the different groups of Nigeria ecozones.</p>				<p>Describe using examples the limitations and problems associated with industrial activities in the Nigeria ecozones and ecoregions.</p>
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	7.8 Explain using a case study of ecoregion(s) and ecoregions(s), their limitations and problems with industrial activity in the area under consideration.					
General Objective 8.0: Understand the various concepts of species Richness, Biodiversity, Community Equilibrium, Succession, and Biogeography						
	<p>8.1 Explain the concepts of species richness.</p> <p>8.2 Explain the concepts of biodiversity.</p> <p>8.3 Explain the concepts of community stability, equilibrium, and non-equilibrium.</p> <p>8.4 List different types of succession.</p> <p>8.5 Give a case study to apply the concepts of succession</p> <p>8.6 Explain how succession can be deviated.</p> <p>8.7 Explain using examples the concept of island</p>	<p>Explain the concepts of species richness, biodiversity, community stability, equilibrium and non-equilibrium, succession,</p> <p>Explain the concept of Island biogeography with the aid of a case study.</p> <p>Give a case study to apply the concepts of island biogeography</p>	<ul style="list-style-type: none"> • Multi-media • Internet link • materials, etc. 	<p>▪</p>	<p>▪</p>	<p>List examples of species richness, biodiversity, community stability, equilibrium and non-equilibrium, succession. List different types of succession.</p>

	biogeography. .					
	8.8 Explain the concepts presented above as they relate to an industrial situation.					
General Objective 9.0: Understand the concept of Trophic Structure and its applications in industrial situation						
	9.1 Define ecosystem 9.2 Describe using examples the two major ways in which organisms derive energy. 9.3 Define food chain and food web 9.4 Describe using examples the three types of food webs. 9.5 List the problems associated with food webs. 9.6 Define keystone species 9.7 Explain the concepts presented as they	Explain the relationship among different trophic levels with examples Explain food web and food chain from the first trophic level using photosynthesis to the trophic pyramid. Explain keystone species e.g sea urchins, sea otter. others are large mammalian predator	<ul style="list-style-type: none"> • Multi-media • Internet link • materials, etc. 	▪	▪	Define ecosystem Define using examples, food web and keystone species

	relate to an industrial situation.					
General Objective 10.0: Understand the Concept of Energy Flow and applications to Industrial Situation.						
	<p>10.1 Describe using example the concept of energy flow</p> <p>10.2 Describe the similarities and differences between energy flow and chemical flow</p> <p>10.3 Describe using examples the positive and negative results from different energy flows and nutrient cycles interaction</p> <p>10.4 Explain the concepts presented in 10.3 as they relate to an industrial situation.</p>	<p>Explain Energy flow in an ecosystem.</p> <p>Describe the similarities and differences between energy flow and chemical flow</p> <p>Give a case study to apply the concepts of island biogeography</p>	<ul style="list-style-type: none"> • Multi-media • Whiteboard, • Internet link • materials, etc. 	▪	▪	<p>Describe using examples the concept of energy flow</p> <p>Describe the similarities and differences between energy flow and chemical flow</p>
General Objective 11.0: Understand the Phosphorous, Carbon, Nitrogen, And Sulfur Cycles and applications in Solving Industrial Issue						
	<p>11.1 Describe the general concept of the following nutrient cycles with examples: phosphorous cycle. carbon cycle. nitrogen cycle. sulphur cycle.</p> <p>11.2 Describe using</p>	<p>Explain items 11.1-11.4</p>	<ul style="list-style-type: none"> • Multi-media • Internet link • materials, charts 	▪	▪	<p>Describe using examples the phosphorous and carbon Cycles</p>

	<p>example how nutrient turnover time is affected by species and location.</p> <p>11.3 Describe how anthropogenic changes can affect nutrient cycling.</p> <p>11.4 Explain the concepts presented as they relate to an industrial situation.</p>					
<p>General Objective 12.0: Understand the concept of Evolutionary Ecology, Conservation Biology, Industrial Ecology and their relationship</p>						
	<p>12.1 Define industrial ecology.</p> <p>12.2 Explain using examples the key components and relationships of an industrial ecosystem</p> <p>12.3 Compare and contrast the key components and relationships of a natural (i.e., traditional) ecosystem with an industrial ecosystem</p>	<p>Define industrial ecology</p> <p>Explain using examples the key components and relationships of an industrial ecosystem</p>	<ul style="list-style-type: none"> • Multi-media • Internet link • materials, etc. 	<p>▪</p>	<p>▪</p>	<p>Explain industrial ecology</p>
<p>GENERAL OBJECTIVE 13.0: Understand the concepts of Group Selection, Individual Selection, And Life History Variation</p>						
	<p>13.1 Describe the concept of population</p>	<p>Explain items 13.1-13.10</p>	<ul style="list-style-type: none"> • Multi-media • Internet link 	<p>▪</p>	<p>▪</p>	<p>Explain the concept of population variation</p>

	<p>variation</p> <p>13.2 list the importance of population variation Describe how population variation can occur or reduced</p> <p>13.3 Describe the concept of natural selection.</p> <p>13.4 Describe how organisms can become extinct</p> <p>13.5 Explain the concepts presented as they relate to an industrial situation</p> <p>13.6 Describe the concepts of group selection and individual selection.</p> <p>13.7 Describe the concept of reproductive strategy.</p> <p>13.8 Explain how to identify different types of reproductive strategy</p> <p>13.9 Describe what</p>		<ul style="list-style-type: none"> • materials, etc. 			
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	<p>determines the reproductive success of an organism.</p> <p>13.10 Explain the concepts presented in 14.1 to 14.4 as they relate to an industrial situation</p>					
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ASSESSMENT: The continuous assessment; tests, quizzes, field works etc. will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Introduction to Geography	CODE: ESM 113	Credit Unit: 3.0	CONTACT HOURS: 2 HOURS/WEEK
Goal: This course is designed to expose students to basic geographic principles and their influence on physical earth forms.			
YEAR: ONE (1), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 2 HOURS/WEEK	

General Objectives:

On completion of this course, the student should be able to:

- 0.1 Understand the Sciences that are involved in surface and subsurface environmental studies**
- 0.2 Understand processes that form igneous rocks**
- 0.3 Understand process that form metamorphic rocks**
- 0.4 Understand processes that form sedimentary rocks.**
- 0.5 Understand the Porosity and Permeability in Rocks**
- 0.6 Understand the types of aquifer as geological formations based on their Physical Properties**
- 0.7 Understand and Interpret a Table of Formation**
- 0.8 Understand the differences between confined and unconfined aquifers.**
- 0.9 Understand the Effect of Nonconformities on Ground water Movement**
- 10.0 Understand the processes that form Geological structures and their effect on surface water and groundwater**
- 11.0 Understand how subsurface relationship developed between rock units and their influence on groundwater flow.**
- 12.0 Understand basic climatological factors.**

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
Course: Introduction to Geography			Course Code: 113	Credit Unit: 3.0	Contact Hours: 3	
Goal: This course is designed to expose students to basic geographic principles and their influence on physical earth forms.						
Course Specification:			THEORETICAL CONTENT	PRACTICAL CONTENT		
General Objective 1.0: Understand the Sciences that are involved in surface and subsurface environmental studies						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Define geography 1.2 Explain the relationship of geography with the environmental 1.3 Explain the branches of geography based on the subjectmatter and application. 1.4 List types of data that thatare required in the field of environmental science and management.	Explain in details various concepts of geography in the environment Explain the relevance of geography in environmentalstudies.	Lab Coat, coveralls, safetyGlasses with solid side shields.	▪ -	▪ -	Define geography and explainthe relationshipof geography with the environment
General Objective 2.0: Understand processes that form igneous rocks						

4-5	<p>2.1 Define rock</p> <p>2.2 Describe types of rock</p> <p>2.2 Describe rock textures.</p> <p>2.3 Classify rocks on the basis of their composition and texture.</p> <p>2.4 Explain volcanic processes.</p> <p>Describe the formation and characteristics of plutons.</p>	<p>Explain Rock And its types</p> <p>Classify rocks on the basis of composition and texture.</p> <p>Explain volcanic processes.</p> <ul style="list-style-type: none"> • Exemplify the formation and characteristics of plutons. 	<p>Lab Coat, coveralls, safetyGlasses with solid side shields.</p>	<p>Identify special features on igneous rocks.</p>	<p>Guide students to identify special features on igneous rocks</p>	<p>Classify igneous rocks on the basis of composition and texture.</p> <p>2.3 Classify igneous rocks on the basis of composition and texture</p>
General Objective 3.0: Understand processes that form metamorphic rocks						
6-7	<p>3.1 Define igneous, metamorphic and sedimentary rock</p> <p>Explain the formation of each type of rocks.</p> <p>3.2 Classify metamorphic rocks on the basis of their texture (foliated on non-foliated)</p> <p>3.3 Describe the grade of Metamorphism as indicated by foliated textures.</p>	<ul style="list-style-type: none"> • Explain the types, texture and formation of the three types of rocks 	<p>Metamorphic rock samples</p>	<p>Identify special features on metamorphic rocks.</p>	<p>Guide students identify special features on metamorphic</p>	<p>Explain how metamorphic rocks are</p>
General Objective 4.0: Understand processes that form sedimentary rocks.						

8-10	<p>4.1 Define sedimentary rocks and explain how they form.</p> <p>4.2 Describe, name and classify common sedimentary rocks.</p> <p>4.3 Classify clastic rocks on the basis of grain size and shape.</p> <p>4.4 Classify chemical sedimentary rocks on the basis of composition.</p> <p>Classify organic sedimentary rocks on the basis of origin.</p>	<ul style="list-style-type: none"> • Explain sedimentary rocks in terms of form, classification, size, shape, composition and origin. 	Sedimentary rock samples	Identify special features on sedimentary rocks.	Guide students to identify special features on sedimentary rocks.	Classify chemical sedimentary rocks on the basis of composition.
General Objective 5.0: Understand the Porosity and Permeability in Rock						
11	<p>5.1 Define porosity and permeability</p> <p>5.2 Classify different porosity types.</p> <p>5.3 Describe the rates of porosity and permeability in different types of rocks.</p>	Describe porosity, permeability and different porosity and permeability types of rocks.	Lab Coat, coveralls, safety Glasses with solid side shields.	Determine porosity and permeability of rock	Guide students to determine porosity and permeability of rock	Define porosity and permeability
General Objective 6.0: Understand the types of aquifer as geological formations based on their Physical Properties						

12-13	<p>6.1 Describe the various types of aquifers (aquifer, aquitard, aquifuge)</p> <p>6.2 Describe subsurface zonation based on water saturation.</p> <p>6.3 Describe the characteristics of aquifers.</p> <p>6.4 Categorize rocks as aquifers or Aquicludes.</p> <p>6.5 Describe the variety of subsurface aquifers being used globally.</p>	<p>Classify rocks as aquifers or Aquicludes.</p> <ul style="list-style-type: none"> • And the variety of subsurface aquifers that is used globally 	<p>Lab Coat, coveralls, safety Glasses with solid side shields</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Describe the various types of aquifers (aquifer, aquitard, aquifuge)</p>
General Objective 7.0: Understand and Interpret a Table of Formation						
14	<p>7.1 Describe criteria used to categorize rock units as Formations.</p> <p>7.2 Explain the Eras of the Geological time Scale and their relative ages.</p> <p>7.3 Describe effects of erosion, tilting and uplift on relationship between rock units.</p>	<p>Explain rock Formations, Eras of the Geological time Scale and their relative ages.</p> <ul style="list-style-type: none"> • List effects of erosion, tilting and uplift on relationship between rock units. 	<p>Lab Coat, coveralls, safety Glasses with solid side shields.</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Describe effects of erosion, tilting and uplift on relationship between rock units</p>
General Objective 8.0: Understand the Differences between confined and unconfined aquifers.						

	<p>8.1 Recognize recharge and discharge areas of aquifers.</p> <p>8.2 Describe the difference between confined and unconfined aquifers.</p> <p>8.3 Determine water flow directions in confined and unconfined aquifer.</p> <p>8.4 Explain how to use a potentiometric surface to predict water behavior in an artesian well.</p>	<p>Explain aquifers recharge and discharge areas, confined and unconfined aquifers.</p> <p>Explain water flow</p> <ul style="list-style-type: none"> • directions in confined and unconfined aquifers. 	<p>Lab Coat, coveralls, safety Glasses with solid side shields.</p>	<p>Identify recharge and discharge areas</p> <p>Determine water flow directions in confined and unconfined aquifer</p> <p>Use a potentiometric surface to predict water</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -identify recharge and discharge areas -determine water flow directions in confined and unconfined aquifer 	<p>Visual aids, chalk and chalkboards</p>
<p>General Objective 9.0: Understand the Effect of Nonconformities on Ground water Movement</p>						
	<p>9.1 Differentiate between 3 major unconformity types.</p> <p>9.2 Describe processes that form unconformities</p> <p>9.3 Different types of erosion surfaces and their effect on subsurface fluid flow.</p>	<ul style="list-style-type: none"> • Explain the concept of nonconformity and unconformity, erosion and types of erosion. 	<p>Lab Coat, coveralls, safety Glasses with solid side shields.</p>	<p>Identify the different types of conformities.</p>	<p>Guide students to identify the different types of conformities</p>	<p>Describe processes that form unconformity</p>

General Objective 10.0: Understand the processes that form Geological structures and their effect on surface water and groundwater.						
<p>10.1 Define the Law of Original Horizontality</p> <p>10.2 Differentiate types of stress and strain involved in the formation of rocks.</p> <p>10.3 Explain processes that create faults and folds.</p> <p>10.4 Explain faults and fold types.</p> <p>10.5 Explain how to Interpret strike, dip, fold and fault symbols on maps.</p> <p>Differentiate surface water drainage patterns and their relationship to underlying geological features.</p> <p>10.7 Explain the effect of structural geology on groundwater aquifers</p>	<p>Explain various aspects of structural geology such as: Stress and strain involved in the formation of rocks, processes that create faults and folds.</p> <ul style="list-style-type: none"> • Explain processes that are involved in Interpreting strike, dip, fold and fault symbols on maps. • Describe surface water drainage patterns and their relationship to underlying geological features 	<p>Lab Coat, coveralls, safety Glasses with solid side shields.</p>	<p>Identify and differentiate the different types of rock formation.</p>	<p>Guide students to identify and differentiate types of rock formations</p>	<p>Differentiate types of stress and strain involved in the formation of rocks</p>	
General Objective 11.0: Understand how Subsurface relationship developed between rock units and their influence on groundwater flow.						

	<p>11.1 Explain terrestrial, marine and transitional depositional environment.</p> <p>11.2 Explain Depositional environments depositional Differentiate between depositional environmental on the basis of sedimentary features.</p> <p>Describe the aquifer potential of different depositional environments on the basis of geological characteristics.</p>	<p>Explain terrestrial, marine and transitional depositional environment.</p> <p>Explain the differences between depositional environmental on the basis of sedimentary features.</p> <p>And the aquifer potential of different depositional environments on the basis of geological characteristics.</p>	<p>Lab Coat, coveralls, safety Glasses with solid side shields.</p>	<p>Identify terrestrial, marine and transitional depositional environment</p>	<p>Guide students to identify terrestrial, marine and transitional depositional environment</p>	<p>Identify terrestrial, marine and transitional depositional environment.</p>
<p>General Objective 12.0: Understand the basic climatological factors</p>						
	<p>12.1 Describe the difference between climate and weather.</p> <p>12.2 Describe different types of climate Describe the various apparatus used for measuring weather elements.</p>	<p>Explain weather and climate, their occurrences, distribution.</p> <p>Explain the concept of climate change and the effects on human settlements.</p> <p>Describe the operations of equipment's used in</p>	<p>Lab Coat, coveralls, safety Glasses with solid side shields.</p>	<p>▪</p>	<p>▪</p>	<p>Describe the various apparatus used for measuring weather elements</p>

	12.4 Describe the factors/ causes responsible for climate change. (temperature, precipitation, wind, pressure etc)	<ul style="list-style-type: none"> •measuring weather elements 				
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ASSESSMENT: The continuous assessment; tests, quizzes, field works etc. will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.

YEAR ONE, SEMESTER TWO COURSES

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Analytical Laboratory Skills I	CODE: ESM121	Credit Unit: 2.0	CONTACT HOURS: 2 HOURS/WEEK
GOAL: This course is designed to give students the basic laboratory techniques that will enable the learner to become competent in: laboratory safety, identifying equipment, reading instruments and measuring devices.			
YEAR: ONE (1), SEMESTER: TWO (2)	PRE-REQUISITE: none	PRACTICAL: 2 HOURS/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <ol style="list-style-type: none"> 1.0 Demonstrate safe laboratory practices, be able to dispose of lab chemicals in a safe manner, and maintain a clean laboratory area. 2.0 Identify laboratory equipment and follow Chemical Stores procedures. 3.0 Weigh objects and samples on electronic balances 4.0 Operate conductivity meter and carry out conductivity related calculations 5.0 Determine the pH of solutions using both a pH meter and pH paper, and perform an acid-base titration using a pH meter. 6.0 Carry out care and maintenance of laboratory glassware, transfer liquids using volumetric pipets and amicro-pipet, and perform acid-base titrations. 			

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
COURSE: Analytical Laboratory Skills I			Course Code: ESM121	Credit Unit: 2.0	Contact Hours: 0-0-2	
GOAL: This course is designed to give students the basic laboratory techniques that will enable the learner to become competent in: laboratory safety, identifying equipment, reading instruments and measuring devices.						
Course Specification:			THEORETICAL CONTENT	PRACTICAL CONTENT		
General Objective 1.0: Demonstrate safe laboratory practices, be able to dispose of lab chemicals in a safe manner, and maintain a clean laboratory area						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2			Lab coat, safety eye goggle, weighing balance, recommended lab manuals and report notebooks.	1.1 Apply laboratory safety rules and procedures. 1.2 Locate safety equipment available in and outside of the laboratory. 1.3 Review WHMS requirements for labeling chemicals in the laboratory. 1.4 Dispose of chemical wastes in a safe and responsible manner. 1.5 illustrate the required emergency	Guide students to perform 1.1-1.7	List the various laboratory safety rules and procedures State how to dispose chemical waste in a safe manner

				<p>response procedures to follow.</p> <p>1.6 Illustrate the safety Obligation Form to indicate the learner's agreement to follow</p> <p>1.7 Apply the safety rules and chemical waste disposal practices as a student in the Environmental Technology program.</p>		
General Objective 2.0 Identify laboratory equipment and follow Chemical Stores procedures.						
4-5			<p>Lab coat, safety eyegoggle, Weighing balance, recommended lab manuals and report notebooks.</p>	<p>2.1 Review storeroom and equipment checkout procedures.</p> <p>2.2 Obtain tool checks.</p> <p>2.3 Take Inventory of assigned locker and drawer.</p> <p>2.4 Identify</p>	<p>Guide students to perform 2.1-2.4</p>	<p>State various equipment check out procedures</p>

				pieces of common laboratory equipment.		
General Objective 3.0: Weigh objects and samples on electronic balances.						
6-7		•	Lab coat, Safety eye goggle, weighing balance, lab manuals and report notebooks	<p>3.1 Calibrate two different types of electronic analytical balances.</p> <p>3.2 Compare the ease and accuracy of weighing on analytical and top loading balances.</p> <p>3.3 Compare the weight of the same object measured on two different analytical balances.</p> <p>3.4 Weigh out a sample on an</p>	Guide students to perform 3.1-3.8	<p>State the way to calibrate electronic analytical balances</p> <p>State when it is appropriate to use a top loading or analytical balance to weigh objects or samples</p>

				<p>analytical balance using two different techniques: “weigh a sample by tarring the container” and “weigh a sample in a weigh boat and quantitatively transfer to a container”.</p> <p>3.5 Demonstrate weight loss, over time, due to trace amounts of moisture on</p> <p>3.6 damp glassware. Observe the effects of temperature and static electricity on the weight of an object by measuring the weight of an object under</p>		
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				<p>different conditions.</p> <p>3.7 Identify when it is appropriate to use a “top loading” or “analytical” balance to weigh objects or samples.</p> <p>3.8 Select the correct type of electronic balance to use for a weighing procedure and calculate the acceptable range of mass values for an individual sample weighed on an Electronic balance.</p>		
General Objective 4.0: Operate conductivity meter and carry out conductivity related calculations.						

8-10		•	Lab coat weighing balance Samples to be weighed Lab notebook, etc.	4.1 Calibrate a conductivity meter. 4.2 Measure the electrical conductivity of some solutions. 4.3 Measure the conductance of brine water standards and graphically determine the NaCl concentration of an unknown sample. Determine The accuracy and precision of the Analyses	Guide students to perform 4.1-4.4	State how to measure electrical conductivity of some solutions
General Objective 5.0 Determine the pH of solutions using both a pH meter and pH paper, and perform an acid-base titration using a pH meter.						
11			Equipment Lab coat, pH meter pH paper Practical note, etc.,	5.1 Estimate the pH of a solution using P ^H paper. 5.2 Measure the P ^H of	Guide students to perform 5.1-5.5	State how to titrate a solution that contains an unknown amount of Hydrochloric acid to determine its concentration using a pH electrode and pH meter

				<p>different solutions at different temperatures and observe the effect of temperature on the P^H value.</p> <p>5.3 Perform a “2-point calibration” to calibrate a pH meter using 2 buffer solutions, each with a different pH value.</p> <p>5.4 Titrate a solution that contains an unknown amount of hydrochloric acid to determine its concentration using a and pH</p>		
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				meter. 5.5 Plot a graph of a data of a titration using the “parallel tangent” method to determine the endpoint of the titration and use the value to calculate the concentration of hydrochloric acid in an unknown solution.		
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General Objective 6.0: Carry out care and maintenance of laboratory glassware, transfer liquids using volumetric pipets and a micro-pipet, and perform acid-base titrations

12-13		•	Equipment Lab coat, Coverall, Practical note etc.	<p>6.1 Interpret the meaning of markings found on examples of common laboratory volumetric glassware.</p> <p>6.2 Examine laboratory glassware for cleanliness and select the correct method to remove the contamination present.</p> <p>6.3 Inspect volumetric glassware for cleanliness using the water bead test.</p> <p>6.4 Transfer an accurate volume of</p>	Guide students to perform 6.1-6.6	<p>State how to examine laboratory glassware</p> <p>State how to prepare a burette and perform acid-base titrations</p>
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				liquid using avolumetric pipet. 6.5Precisely Transfer an accurate volume of liquidusing a micro-pipet. 6.6 Prepare a burette and perform acid-base titrations.		
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ASSESSMENT: The continuous assessment; tests, quizzes, field works etc. will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Environmental Chemistry I	CODE: ESM122	Credit Unit: 3.0	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course is designed to provide students with knowledge and skills of the application of stoichiometry, thermodynamics, and kinetics to physical and chemical changes that affect ozone, ground level chemistry, greenhouse gases, global warming, and carbondioxide emissions and energy use			
YEAR: ONE (1), SEMESTER: ONE (2)	PRE-REQUISITE: none	PRACTICAL: 2HOURS/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <ol style="list-style-type: none"> 1.0 Know the effect of pH on natural waters. 2.0 Understand the thermodynamic and kinetic factors that affect the steady state concentrations of Tropical and Antarctic stratosphericozone 3.0 Understand the Stoichiometry, Thermodynamics and kinetics to describe ground level air chemistry 4.0 Know the Stoichiometry, thermodynamics and kinetics to describe the greenhouse effect and global warming. 5.0 Know the Stoichiometry, thermodynamics and kinetics to describe carbon dioxide emission and energy use. 			

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
COURSE: Environmental Chemistry I			Course Code: 112	Credit Unit: 3.0	Contact Hours: 3	
GOAL: This course is designed to provide students with knowledge and skills of the application of stoichiometry, thermodynamics, and kinetics to physical and chemical changes that affect ozone, ground level chemistry, greenhouse gases, global warming, and carbondioxide emissions and energy use						
Course Specification:			THEORETICAL CONTENT	PRACTICAL CONTENT		
General Objective 1.0: Know the effect of pH on natural waters						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 List the main sources and uses of fresh water, 1.2 Explain the different locations of groundwater. 1.3 Calculate the voltage of a redox reaction from tables of half reactions, and do stoichiometry calculations with these reactions. 1.4 Describe various factors that affect the oxidizing environmental natural water. 1.5 Define BOD (Biochemical Oxygen Demand) and COD (Chemical Oxygen Demand). 1.6 calculate the reactions, of C S, N and various metals of environmental	Explain the sources and uses of fresh water and locations of groundwater. Illustrate the redox reactions with calculation and give the students assignment. Explain in details activities in 1.3 –1.7 Explain to students how to calculate PH of water, dissolved metals, solubility of salts in water, and alkalinity and hardness index of natural water.	Magic board, lecture notes and recommended textbooks. Journals	Identify fresh water and ground water Determine the BOD, COD, DO, pH, and PE of fresh water and ground water etc.	Guide students to - identify fresh water and ground water -determine the BOD, COD, DO, pH, and PE of fresh water and ground water etc	Explain how does pH affect reduction in potential Define the following BOD & COD List the factors affecting oxidizing natural water

	<p>importance at low high values of P^H and P^E.</p> <p>1.7 Explain equilibrium calculations involving K_{sp} and K_a.</p> <p>1.8 Explain distribution diagrams to describe the speciation of a carbonate system.</p> <p>1.9 Calculate the pH of waters dominated by dissolved CO_2, and/or dissolved $CaCO_3$, and predict the effect of various dissolved metals on P^H.</p> <p>1.10 Calculate the solubility of various salts in the water, and the alkalinity and hardness index of natural water</p>					
General Objective 2.0: Understand the thermodynamic and kinetic factors that affect the steady state concentrations of Tropical and Antarctic stratospheric ozone.						
4-5	<p>2.1 Characterize the four different regions of the atmosphere.</p> <p>2.2 Describe the nature of the “ozone hole”, and interconvert between concentrations units used in atmospheric chemistry.</p>	<p>Characterize the four different regions of the atmosphere.</p> <p>Describe the nature of the “ozone hole”, and interconvert between concentrations units used in atmospheric</p>	<p>Magic board, lecture notes and recommended textbooks, Journals.</p>	▪ -	-	<p>Briefly explain the two elementary steps in the production of stratospheric ozone</p> <p>Using the graphs of concentration vs altitude, give the evidence to prove</p>

	<p>2.3 State the energy ranges in J and μ for the three regions of the Ultra Violet spectrum.</p> <p>2.4 Describe some biological consequences of radiation from these three regions.</p> <p>2.5 Describe how the photochemistry of oxygen changes the spectrum of sunlight above the troposphere</p> <p>2.6 Write the two elementary steps in the production of stratospheric ozone</p> <p>2.7 Describe the two factors that affect the production of ozone.</p> <p>2.8 Explain first kinetically why the ozone layer exists at an altitude of 15-35 km.</p> <p>2.9 Explain thermodynamically why there's a temperature inversion above the troposphere</p>	<p>chemistry.</p> <p>State the energy ranges in J and μ for the three regions of the Ultra Violet spectrum.</p> <p>Explain biological consequences of radiation Explain how the photochemistry of oxygen changes the spectrum of sunlight above the troposphere Describe the two factors that affect the production of ozone.</p> <p>Explain first kinetically why the ozone layer exists at an altitude of 15-35 km.</p> <p>Explain the non-catalytic mechanism of ozone destruction in the stratosphere and</p>				<p>ozonehole</p> <p>State non catalytic mechanism of ozone destruction in stratosphere</p> <p>State the factors that affects the rate of destruction of ozone</p> <p>State various important catalyst in a reaction</p> <p>State condition that result in PSC and in type II crystals during the polar right.</p> <p>Mention role of the technician to solve strategic problem of reducing ozone destruction.</p>
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	<p>2.10 State the non-catalytic mechanism of ozone destruction in the stratosphere and provide kinetic and thermodynamic reasons why this is not a threat to the Concentration of ozone.</p> <p>2.11 Use the graphs of ozone concentration vs. altitude to describe what is meant by the term ozone hole and given evidence to prove its existence.</p> <p>2.12 Explain mechanism I for the catalytic destruction of ozone give thermodynamic reasons why this is not an important mechanism at low stratospheric altitudes. List the factors that affect the rate of destruction of ozone.</p> <p>2.14 Exemplify mechanism II for the catalytic destruction of ozone.</p> <p>2.15 List some important</p>	<p>provide kinetic and thermodynamic reasons.</p> <p>Using the graphs of ozone concentration vs. altitude to describe what is meant by the term ozone hole and given evidence to prove its existence.</p> <p>Explain mechanism I for the catalytic destruction of ozone give thermodynamic reasons why this is not an important mechanism at low stratospheric altitudes.</p> <p>List the factors that affect the rate of destruction of ozone.</p> <p>Explain mechanism II for the catalytic destruction of ozone and the important of catalysis.</p>				
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	<p>catalysis.</p> <p>2.16 List the kinetic factors that affect the rate of destruction of ozone and describe the factor that effects the steady state concentration of ozone.</p> <p>2.17 Give reasons why atomic chlorine is produced “naturally” from Sea salt, and give some anthropogenic sources of chlorine.</p> <p>2.18 List the two inactive or “reservoir” forms of Cl.</p> <p>2.19 State the reactions that show how they form from Cl and can react to release Cl⁻</p> <p>2.20 Explain how HCl provides a Tropospheric sink for elemental chlorine and why elemental Bromine is 40-50 times more effective than Chlorine at destroying ozone</p> <p>2.21 Describe the conditions that result in PSC. And TypeII crystals during the polar right.</p>	<p>Explain the kinetic factors that affect the rateof destruction of ozone and describe the factor that effects the steady state concentration of ozone.</p> <p>Explain how atomic chlorine is produced “naturally” from Sea salt, and givesome anthropogenic sources of chlorine.</p> <p>effective than Chlorine at destroying ozone</p> <p>Explain 2.18 to</p> <ul style="list-style-type: none"> • 2.25 				
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	<p>2.22 Explain how inactive chlorine in the lower stratosphere is converted to active chlorine through the polar night and Antarctic spring.</p> <p>2.23 Explain in general terms how the concentration of ozone returns to “normal” after the Antarctic spring.</p> <p>2.24 List examples of ozone destruction that are not yet understood.</p> <p>2.25 Describe the role of the technician either in further study of the problems, or in current strategies for reducing ozone destruction</p>					
General Objective 3.0: Understand the Stoichiometry, Thermodynamics and kinetics to describe ground level air chemistry						
6-7	<p>3.1 Describe the role of oxidation in the cleansing of air.</p> <p>3.2 List the primary and secondary pollutants of photochemical smog</p> <p>3.3 Describe the production and abatement of the primary and secondary pollutants involved in photochemical</p>	<p>Explain the role of oxidation in air clearing and describe primary and secondary pollutants.</p> <p>Describe the features of acid rain and particulates and their effects.</p>	<p>Magic board, lecture notes and recommended textbooks, Journal</p>	<p>Carry out REDOX titration</p>	<p>Guide student to carry out REDOX titration</p>	<p>What does oxidation mean in terms of air pollution</p> <p>Differentiate between greenhouse effect and global warming</p>

	smog.	Explain health effects of photochemical smog and particulates on Man				
General Objective 4.0: Know the Stoichiometry, thermodynamics and kinetics to describe the greenhouse effect and global warming						
8-10	<p>4.1 Describe black body radiation.</p> <p>4.2 Describe the earth's energy balance in terms of sources and sinks by comparing how to emission spectra of the sun and the earth are absorbed, reflected, or emitted by the earth's surface and its atmosphere.</p> <p>4.3 Describe the greenhouse effect and the enhanced greenhouse effect in terms of energy transfer from the sun's input to the earth's output, thermal scattering, and subsequent heating.</p> <p>4.4 Describe sources and sinks of atmospheric CO_{2(g)} and H₂O(g).</p> <p>4.5 Describe sources and sinks of atmospheric gases</p>	<p>Explain the following: black body radiation, the earth's energy balance in terms of sources and sinks, emission spectra of the sun and the earth are absorbed, reflected, or emitted by the earth's surface and its atmosphere.</p> <p>Explain the greenhouse effect and the enhanced greenhouse effect in terms of energy transfer from the sun's input to the earth's output, thermal scattering, and subsequent heating.</p>	Magic board, lecture notes and recommended textbooks.	▪	▪	<p>What is black body radiation</p> <p>What causes black body radiation</p>

	<p>contributing to the enhanced greenhouse effect.</p> <p>4.6 Compare the importance of atmospheric molecules that contribute to the greenhouse and enhanced greenhouse effects.</p> <p>4.7 Describe sources and sinks of atmospheric aerosols.</p>					
General Objective 5.0: Know the Stoichiometry, thermodynamics and kinetics to describe carbon dioxide emission and energy use.						
	<p>5.1 List potential consequences of global warming.</p> <p>5.2 Quantify (using the value of Q) global energy use for developed and developing countries</p> <p>5.3 Compare proven and estimated energy reserves from different sources (including methyl hydrates), and relate this information to estimates of global releases of carbon dioxide</p> <p>5.4 Mention variety of schemes for reducing the amount of carbon dioxide</p>	<p>Explain consequences of global warming</p> <p>Quantify (using the value of Q) global energy use for developed and developing countries</p> <p>5.4 Mention variety of schemes for reducing the amount of carbon dioxide emitted.</p> <p>Explain advantages and disadvantage of each scheme</p>	<p>Magic board, lecture notes and Recommended textbooks.</p>	<p>▪</p>	<p>▪</p>	<p>Mention the advantages and disadvantages of schemes for reducing the amount of carbon dioxide omitted</p>

	<p>emitted.</p> <p>5 Explain advantages and disadvantage of each scheme.</p> <p>5.5 Compare the various forms of solar energy currently contributing to the energy grid giving advantages and disadvantage of each type.</p> <p>5.6 Describe the production and properties of the mixture called gasoline.</p> <p>5.7 Explain why the different components are added to gasoline.</p> <p>5.8 Compare quantitatively and qualitatively the advantages and disadvantages of gasoline, methane, CNG, and the fuel additives methanol, ethanol and their derivatives including synthetic pathways and the energy required to produce them.</p> <p>5.9 Explain the advantage and disadvantages of hydrogen as a fuel.</p>					
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	5.10 Explain the advantages and disadvantages of radioactive material as a fuel					
ASSESSMENT: The continuous assessment; tests, quizzes, field works etc. will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.						

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Occupational Safety	CODE: ESM 123	Credit Unit: 3.0	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course is designed to expose students to occupational safety hazards, safety problems and safe practices which would be encountered in the various industries during day-to-day fieldwork.			
YEAR: ONE (1), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 1 HOUR/WEEK	

GENERAL OBJECTIVES

On completion of this course, the Student should be able to:

- 1.0 Know the legislation concerned with Occupational Health and safety
- 2.0 Know the general procedures involved in the isolation of plant equipment
- 3.0 Understand how to control Hazard at a work site
- 4.0 Understand the general procedures involved in the isolation of mechanical and electrical equipment
- 5.0 Understand the equipment available for fall protection
- 6.0 Understand static electricity produced by the movement of materials/equipment and the procedures needed to enter into, or worksafely in, confined spaces
- 7.0 Know the significance of the Workplace Hazardous Materials Information System (WHAIMS) and its application.
- 8.0 Understand the nature of radioactive materials and the impact of ionising radiation on human health and the environment.
- 9.0 Know the use, selection and care of personal protective equipment
- 10.0 Understand the essential role of respiration protection in the workplace
- 11.0 Know the purpose and benefits of incident reporting, investigation and analysis
- 12.0 Know the use, handling and transport of dangerous goods in accordance with the Transportation of Dangerous Goods regulations

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY								
Course: Occupational Safety		Course Code: 123		Credit Unit: 3.0		Contact Hours: 3		
GOAL: This course is designed to expose students to occupational safety hazards, safety problems and safe practices which would be encountered in the various industries during day-to-day fieldwork.								
Course Specification:				Theoretical Content		Practical Content:		
GENERAL OBJECTIVE 1.0: Know the legislation concerned with Occupational Health and safety								
Course Specification:				THEORETICAL CONTENT		PRACTICAL CONTENT		
Week	Specific Outcome	Learning	Teachers' Activities	Learning Resources	Specific Outcome	Learning	Teachers' Activities	Evaluation
1-2	1.1 Describe the Nigeria Occupational Health and Safety Act. 1.2 Explain the history of Occupational health and safety. 1.3 Describe the components of Occupational safety: <ul style="list-style-type: none"> • Occupational health medicine • Industrial hygiene • Industrial welfare service • Ergonomics 		Give the history and list out the Nigeria of Occupational Health and Safety Act. Explain the components of Occupational safety: <ul style="list-style-type: none"> • Occupational health medicine • Industrial hygiene • Industrial welfare service • Ergonomics • Physiologic activities 	Audio visual, multi-media, magnetic board, etc	▪ -		▪ -	List the components of Occupational safety:

	<ul style="list-style-type: none"> • Physiologic activities • Psychologic activities <ul style="list-style-type: none"> • And others <p>1.4 Explain the Nigeria Regulations related to health and safety.</p> <p>1.5 List some of the responsibilities of workers and employers in relation to health and safety.</p> <p>1.6 Describe the conditions that must exist before a worker can refuse work.</p>	<ul style="list-style-type: none"> • Psychologic activities • And others <p>Explain the Nigeria Regulations related to health and safety, workers and employers in relation to health and safety.</p>				
GENERAL OBJECTIVE 2.0: Know the general procedures involved in the isolation of plant equipment						
3-4	<p>2.1 Explain the proper procedures for the isolation of equipment.</p> <p>2.2 List safety precautions which are related to equipment isolation.</p>	<p>Explain items. 2.1</p> <ul style="list-style-type: none"> • – 2.2 	Magnetic board, multi-media	carry out practical on proper procedures for the isolation of plant equipment	Guide student to carry out practical on proper procedures for the isolation of plant equipment	List safety precautions which are related to equipment isolation.
GENERAL OBJECTIVE 3.0: Understand how to control Hazard at a work site						

5-6	<p>3.1 Explain how to Identify some of the common physical hazards associated with the work site, and describe methods of controlling them.</p> <p>3.2 Define engineering controls.</p> <p>3.3. Describe some of the key components of safety management and hazard control.</p> <p>3.4 Describe major principles of controlling occupational environment such as:</p> <ul style="list-style-type: none"> • Mechanical control e.g. shielding, ventilations, noise, lighting, etc. • Administrative control, e.g. works practices, etc. • Personal Protective 	<p>Engage students in a discussion to list out physical hazards associated with the work site, and describe methods of controlling them. Explain engineering controls and the key components of safety management and hazard control.</p> <p>Explain major principles of controlling occupational environment such as:</p> <ul style="list-style-type: none"> • Mechanical control e.g. shielding, ventilations, noise, lighting, etc. • Administrative control, e.g. works practices, etc. • Personal Protective 	Magnetic board, markers, etc.	properly use PPE	Guide student on how to properly use PPE	<p>Describe some of the key components of safety management and hazard control.</p> <p>List the components of controlling occupational environment</p>
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	<p>Equipment (PPE)</p> <ul style="list-style-type: none"> • Engineering Control (e.g. Engine Design) • Ergonomic control <p>3.5 Describe the importance of standards, codes and laws.</p> <p>3.6 Explain the role of personal protective equipment in hazard control</p>	<p>Equipment (PPE)</p> <ul style="list-style-type: none"> • Engineering Control (e.g. Engine Design) 				
GENERAL OBJECTIVE 4.0: Understand the general procedures involved in the isolation of mechanical and electrical equipment						
7-9	<p>4.1 Explain the proper procedures for the Mechanical and Electrical isolation of equipment.</p> <p>4.2 List safety precautions that are related to equipment isolations.</p> <p>4.3 Describe the safe use of ladders and scaffolding.</p> <p>4.4 Explain</p>	<p>Explain the Mechanical and Electrical isolation of equipment and precautions which are related to equipment isolations</p> <ul style="list-style-type: none"> • Explain the safe use of ladders and scaffolding, also describe the regulations 	<p>magnetic board, markers, etc</p> <p>, ladder, scaffold, etc</p>	<p>Properly use mechanical and electrical equipment</p>	<p>Guide student on how to properly isolate mechanical and electrical equipment</p>	<p>List safety precautions which are related to equipment isolations. Describe rigging methods and safety concerns</p>

	<p>regulations related to ladders and scaffolding.</p> <p>4.5 Describe rigging methods and safety concerns.</p>	<p>related to ladders and scaffolding.</p>				
GENERAL OBJECTIVE 5.0: Understand the equipment available for fall protection						
10-11	<p>5.1 Describe the current legislation pertaining to fall protection.</p> <p>5.2 Describe the various fall protection systems.</p> <p>5.3 Describe the selection, care and use of fall protection Equipment;</p> <p>5.4 Define the terms related to fall protection.</p> <p>5.5 Explain the current Occupational health and safety act and regulations pertaining to worker hearing protection and conservation.</p>	<p>Explain the current legislation pertaining to fall protection systems and the selection, care and use of fall protection. Explain activities in Nos. 5.5 – 5.7</p> <ul style="list-style-type: none"> • 	<p>Audio visual aids, magnetic board</p> <p>Audio visual aids, magnetic board</p>	<p>carry out practical on the use of hearing protection devices</p>	<p>Guide student to carry out practical on the use of hearing protection devices</p>	<p>Describe the various fall protection systems</p> <p>Describe how a hearing protection device is used</p>

	<p>5.6 Describe methods for establishing hearing protection and conservation programs.</p> <p>5.7 Explain why hearing conservation failures occur.</p> <p>5.8 Explain hearing protection devices, selection and ease of use.</p> <p>5.9 Explain the “real-world” use of hearing protection devices.</p> <p>5.10 Explain hearing protection program elements, Optimization, enhancement, and audits.</p>					
GENERAL OBJECTIVE 6.0: Understand static electricity produced by the movement of materials/equipment and the procedures needed to enter into, or work safely in, confined spaces						
12-14	<p>6.1 Describe how static electricity is produced.</p> <p>6.2 List the hazards of static electricity.</p>	<p>Explain how static electricity is produced, the hazards of static electricity and how static electricity can be</p>	<p>Magnetic board, markers,</p>	<p>produce electricity using static materials</p>	<p>Demonstrate to student how to produce electricity using static materials</p>	<p>Describe how static electricity can be controlled when flammable liquids are transported.</p>

	<p>6.3 Describe how static electricity can be controlled when flammable liquids are transported.</p> <p>6.4 Describe how to reduce problems with static electricity when solids are moved through piping and ducting</p> <p>6.5 Define a confined space.</p> <p>6.6 Define what constitutes a confined space entry</p> <p>6.7 Describe the hazards of being in a confined space.</p> <p>6.8 Describe procedures to</p>	<p>controlled when flammable liquids are transported.</p> <p>Explain a confined space and what constitutes a confined space entry.</p> <ul style="list-style-type: none"> List out the hazards of being in a confined space and procedures to be used when performing confined space entry. 				
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	6.9 be used when performing confined space entry.					
General Objective 7.0: Know the significance of the Workplace Hazardous Materials Information System (WHMIS) and its application.						
	<p>7.1 Describe the elements and responsibilities of the Workplace Hazardous Materials System.</p> <p>7.2 Describe the six (6) classes of controlled products under WHMIS.</p> <p>7.3 Use proper labels for controlled products.</p> <p>7.4 Describe Material Safety Data Sheets.</p> <p>7.5 Describe training requirements under WHMIS</p>	<p>Explain the elements and responsibilities of the Workplace Hazardous Materials System.</p> <p>Explain the six (6) classes of controlled products under WHMIS.</p>	marker, magnetic board, etc	Complete a material safety data sheet	Demonstrate how material safety data sheet is completed	Show how a material safety data sheet is completed
General Objective 8.0: Understand the nature of radioactive materials and the impact of ionising radiation on human health and the environment						
	8.1 State sources of natural such as: radiation and radiation sources used by industry.	Explain the hazards and possible impact of radiation, radioactive	magnetic board, etc	carry out practical on how to dispose Radio Active Material	Guide student to carry out practical on how to dispose Radio Active Material	List the common sources of radiation

	<p>8.2 Describe the basic elements of radioactive decay</p> <p>8.3 Describe the hazards and possible impact on the environment caused by uncontrolled release of radioactive materials used by industry.</p> <p>8.4 Describe the methods used to contain and safely handle ionising radiation.</p> <p>8.5 Describe the correct procedure to dispose of a device containing radioactive material.</p> <p>8.6 Describe the major nuclear radiation particles and the SI units used to</p> <p>8.7 measure their presence in the environment.</p>	<p>materials used by industry on the environment caused by their uncontrolled release.</p> <p>Explain the methods used to contain and safely handle ionizing radiation.</p> <p>Describe the correct procedure to dispose of a device containing radioactive</p>				
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General Objective 9.0: Know the use, selection and care of personal protective equipment						
	9.1 Describe the personal protective equipment available for head/body protection. 9.2. Describe safety features required in safety belts, body harnesses and lanyards.	Explain various forms of PPE with examples.	magnetic board, etc			Explain how PPE equipment for head/body protection
General Objective 10.0: Understand the essential role of respiration protection in the workplace.						
	10.1 Explain the purpose and goals of respiratory protective programs. 10.2 Describe the respiratory health risks associated with exposure in the workplace. 10.3 Describe the benefits of respiratory equipment 10.4 List the various pieces of respiratory equipment available. 10.5 Describe the essential maintenance	Explain items 10.1 –10.6	magnetic board, marker, PPE (Respiratory Equipment) etc	carry out CPR using mannequin	Demonstrate to student how to carry out CPR using mannequin	Describe how respiratory equipment can be properly used

	requirements					
	10.6 Describe the proper use of respiratory equipment.					
General Objective 11.0: Know the purpose and benefits of incident reporting, investigation and analysis.						
	<p>11.1 Describe incident, nearmiss and accident.</p> <p>11.2 Describe the reporting and investigation requirements of the Occupational Health and Safety Act.</p> <p>11.3 List the uses and limitations of an incident report.</p> <p>11.4 Explain how incident reporting is used to prevent recurrence of similar incidents.</p> <p>11.5 Describe the content and maintenance of records and documents</p>	<p>Explain incident, nearmiss and accident, reporting and investigation requirements of the Occupational Health and Safety Act.</p> <p>List the uses and limitations of an incident report and how incident reporting is used to prevent recurrence of similar incidents.</p> <p>Explain how incident investigations are used to determine the contributing factors and causes</p>	Marker, magnetic board, etc	-	-	Describe how incidence can be investigated and reported

<p>11.6 Explain how incident investigations are used to determine the contributing factors and causes of an incident.</p> <p>11.7 Describe a standard incident investigation form.</p> <p>11.8 Explain why a standard incident investigation form is an essential part of a safety investigation.</p> <p>11.9 Describe how incident analysis and hazard control affect management of the workplace performance</p>	<p>of an incident. Describe a standard incident investigation form. Explain why a standard incident investigation form is an essential part of a safety</p>				
<p>General Objective 12.0: Know the use, handle, and transport of dangerous goods in accordance with the Transportation of Dangerous Goods regulations</p>					
<p>12.1 Describe process of handling and transporting dangerous goods in safety and legality.</p> <p>12.2 Describe the proper procedure to follow in case of an incident with</p>	<p>Explain safe procedures of handling dangerous goods.</p>	<p>Marker, magnetic board, etc</p>	<p>-</p>		<p>Describe how to handle and transport dangerous goods safely and legally</p>

	<p>dangerous goods.</p> <p>12.3 State two sources they can use or contact for further assistance.</p>					
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ASSESSMENT: The continuous assessment; tests and quizzes will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Introduction to Hydrology	CODE: ESM 124	Credit Unit: 3.0	CONTACT HOURS: 3HOURS/WEEK
Goal: This course is designed to expose students to practical hydrology and groundwater development, including an overview of construction, maintenance, rehabilitation and monitoring techniques for water investigation and supply, and investigations of contaminated sites.			
YEAR: ONE (1), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 1 HOUR/WEEK	

GENERAL OBJECTIVES

On completion of this course, the Student should be able to:

- 1.0 Understand hydrogeology,
- 2.0 Understand the concept of runoff
- 3.0 Understand Precipitation and the mechanisms that drive it
- 4.0 Understand the unit of hydrograph
- 5.0 Understand the measurement of stream flow
- 6.0 Understand the various drilling technologies commonly used in the environmental and water well industries.
- 7.0 Understand flood estimation and control
- 8.0 know how to Interpret pumping test data and the reasons for completing pumping tests.
- 9.0 know how to Complete a detailed borehole log and well completion log
- 10.0 Understand the various groundwater contaminants, their sources and transport processes.

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
Course: Introduction to Hydrology		Course Code: ESM 124		Credit Unit: 3.0		Contact Hours: 3
GOAL: This course is designed to expose students to practical hydrology and groundwater development, including an overview of construction, maintenance, rehabilitation and monitoring techniques for water investigation and supply, and investigations of contaminated sites						
Course Specification:		THEORETICAL CONTENT		PRACTICAL CONTENT		
General Objective 1.0: Understand hydrology						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Define hydrology 1.2 Describe the hydrologic cycle. 1.3 Explain the branches and scope of hydrology 1.4 Explain the field of applications of hydrology, the techniques of hydrology and the problems of applied hydrology	Explain the hydrologic cycle, the branches and scope of hydrology and the field of applications of hydrology.	Multi-media Whiteboard, Internet link Materials, etc.	Demonstrate the role of the hydrologist in integrated development Show concept of contaminants hydrology	Guide students to: -demonstrate the role of the hydrologist in integrated development show concept of contaminants hydrology	Define hydrology List the field of application of hydrological knowledge

General Objective 2.0: Understand the concept of runoff						
4-5	<p>2.1 Explain the meaning of runoff and the components of runoff or stream flow</p> <p>2.2 Explain the components of runoff and the methods of estimating surface runoff.</p> <p>2.3 State the factors affecting runoff</p> <p>2.4 Explain the types of runoff</p>	<p>Explain the meaning of surface runoff</p> <p>State the factors affecting surface runoff</p> <p>Explain the concept of surface water estimation</p>	Multi-media Whiteboard, Internet link Materials, etc.	Show the characteristics of estimating surface runoff and the factors affecting runoff.	Guide students to show the concept of surface runoff, its components and the factors affecting runoff and the method of surface runoff estimation.	State the factors affecting runoff
General Objective 3.0: Understand Precipitation and the mechanisms that drive it						
6-7	<p>3.1 Define precipitation and state its different forms</p> <p>3.2 Explain the mode of formation of the different types of precipitation</p> <p>3.3 Explain the method and instruments used in measuring precipitation</p> <p>3.4 Explain the drivers of precipitation</p>	<p>Describe the mode of Precipitation formation.</p> <p>Describe the method and instrument of measuring precipitation</p>	Multi-media Whiteboard, Internet link Materials, etc.	<p>Draw the mode of formation of precipitation</p> <p>Use instruments to measure different forms of precipitation and how they are used.</p>	<p>Guide the students to: draw the mode of formation of precipitation</p> <p>-use instruments to measure different forms of precipitation and how they are used.</p>	<p>Define Precipitation</p> <p>Describe the mode of precipitation formation</p>
General Objective 4.0: Understand the unit of hydrograph						

8-10	<p>4.1 Explain the different components of hydrograph and its application</p> <p>4.2 Explain the systematic unit of hydrograph</p> <p>4.3 Explain how the streamflow components can be separated</p>	<p>Explain the different components of hydrograph and its application</p> <ul style="list-style-type: none"> • Explain the systematic unit of hydrograph and how the stream flow components can be separated 	Multi-media Whiteboard, Internet link Materials, etc.	Identify the components of hydrograph and its applications	Guide students to identify the components of hydrograph and its applications	Explain the meaning of hydrograph.
General Objective 5.0: Understand the measurement of stream flow						
11	<p>5.1 List the different methods of measuring stream flow.</p> <p>5.2 Explain stage discharge rating curve and the procedures in establishing rating curves on logarithmic paper.</p> <p>5.3 Explain the relationship between slope stage discharges.</p> <p>5.4 Explain the relevance of keeping streamflow records (useful in evaluating total water supply, forecasting flooding events, designing hydraulics structures, computing sediments load of streams)</p>	<p>Explain the different methods of measuring stream flow and stage discharge rating curve and the procedures in establishing rating curves on logarithmic paper.</p> <p>Explain the relationship between slope stage discharges, the relevance of keeping stream flow records. Stressed the usefulness in evaluating total water supply, forecasting flooding events, designing hydraulics structures, computing</p>	Multi-media Whiteboard, Internet link Materials, Current meter Float Velocity rod	<p>Identify the methods of measuring streamflow</p> <p>Demonstrate the use of current meter, float and velocity rod in measuring stream flow.</p>	Guide students to demonstrate the use of current meter, float and velocity rod in measuring stream flow.	List the different types of gauges used in recording stream flow

	5.5 List the different types of gauges used in recording stream flow	sediments loads of streams.				
General Objective 6.0: Understand the various drilling technologies commonly used in the environmental and water well industries.						
12-13	6.1 Describe types of typical drilling methods used for water supply, rock coring and environmental site assessments	<ul style="list-style-type: none"> • Explain various drilling technologies. (The types of drilling methods will include: air rotary, mud rotary, cable tool, diamond drilling, Becker Hammer, direct push, solid-stem augers and hollow-stem augers). 	Multi-media Whiteboard, Internet link Materials, etc.	▪ --	▪ -	Explain various drilling technologies
General Objective 7.0: Understand flood estimation and control						
14	<p>7.1 Explain the meaning of flood</p> <p>7.2 List the different types of flood</p> <p>7.3 Explain the causes of flood</p> <p>7.4 Explain the approaches to floods and flood hazard management</p> <p>7.5 Explain soil conservation measures</p> <p>7.6 Explain flood control</p> <p>Approaches</p>	<p>Explain the meaning of flood</p> <ul style="list-style-type: none"> • Explain the socioeconomic impacts of flood as well as the methods of flood control 	Multi-media Whiteboard, Internet link Materials, etc.	<p>Identify flood sites</p> <p>Show the possible impacts of flood</p> <p>Determine the methods of flood control</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -identify flood sites -show the possible impacts of flood determine the methods of flood control 	Explain the socioeconomic impacts of flood as well as the methods of flood control
General Objective 8.0: Know how to interpret pumping test data and the reasons for completing pumping tests.						

	<p>8.1 Explain the following terminology associated with pumping tests such as: cone of depression, recharge boundaries, no-flow boundaries and vertical leakage.</p> <p>8.2 Explain the analyses of pumping test data.</p>	<p>Explain cone of depression, recharge boundaries, no-flow boundaries and vertical leakage.</p> <p>Explain the analyses of pumping test data.</p>	<p>Multi-media Whiteboard, Internet link Materials, etc.</p>	<p>-</p>	<p>-</p>	<p>Explain the terminology associated with pumping tests</p>
<p>General Objective 9.0: Know how to complete a detailed borehole log and well completion log.</p>						
	<p>9.1 State the types of information that is required on a borehole log and well completion log that are used during the drilling of boreholes and installation of monitoring wells and water supply wells.</p>	<p>List types of information that is required on a borehole log and well completion log that are used during the drilling of boreholes and installation of monitoring wells and</p> <ul style="list-style-type: none"> • water supply wells. 	<p>Multi-media Whiteboard, Internet link Materials, etc.</p>	<ul style="list-style-type: none"> ▪ - 	<ul style="list-style-type: none"> ▪ - 	<p>List types of information that is required on a borehole log and well completion</p>
<p>General Objective 10.0: Understand the various groundwater contaminants, their sources and transport processes</p>						
	<p>10.1 Explain the different types of common groundwater Contaminants and their sources.</p> <p>10.2 Describe Common groundwater contaminants such as:(light non-aqueous phase liquids (LNAPLs),</p>	<p>Explain groundwater Contaminants and their sources such as:</p> <ul style="list-style-type: none"> light non-aqueous phase liquids (LNAPLs), dense non-aqueous phase liquids phase (DNAPLs), 	<p>Multi-media Whiteboard, Internet link Materials, etc.</p>	<ul style="list-style-type: none"> ▪ - 	<ul style="list-style-type: none"> ▪ - 	<p>Explain the different types of common groundwater Contaminants and their sources.</p>

	<p>dense non- aqueous phase liquids phase (DNAPLs), hydrocarbons, petroleum hydrocarbons, chlorinated solvents, nitrates, metals, salt, coaltar, creosote, herbicides, pesticides, radionuclides, volatiles and semi-volatiles, coliform bacteria, E.coli, Giardia and Cryptosporidium.)</p> <p>10.3 Describe Common sources of groundwater Contamination such as: (landfills, service stations, bulk fuel facilities, septic tanks, mine tailings, salt storage yards, wood preserving facilities, manufacturing facilities, high technology industry.)</p> <p>10.4 Explain the fundamentals of contaminant transport and provide an overview on the processes involved, which include: advection, dispersion, diffusion and</p>	<p>hydrocarbons, petroleum hydrocarbons, chlorinated solvents, nitrates, metals, salt, coal tar, creosote, herbicides, pesticides, radionuclides, volatiles and semi-volatiles, coliform bacteria, E.coli, Giardia and Cryptosporidium.)</p> <p>Give examples of Common sources of groundwater contamination such as: (landfills, service stations, bulk fuel facilities, septic tanks, mine tailings, salt storage yards, wood preserving facilities, manufacturing facilities, high technology industry.)</p>				
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	retardation.					
ASSESSMENT: The continuous assessment; tests, quizzes, field works etc. will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.						

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Introduction to Geographic Communication	CODE: ESM 125	Credit Unit: 3.0	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course is designed to expose the students to an introduction to GIS technology required in the environmental field			
YEAR: ONE (1), SEMESTER: TWO (2)	PRE-REQUISITE: none	PRACTICAL: 1 HOUR/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <ol style="list-style-type: none"> 1.0 Know how to determine angles between set of points. 2.0 Understand the determination of Horizontal Distance and Vertical Difference between 2 points 3.0 Understand the determination of Coordinates of a point relative to another point 4.0 Understand the determination of topographic survey using a total station 5.0 Understand how to collect Mapping data using a handheld GPS Receiver. 6.0 Understand how to deliver a class presentation on a Specific GIS project that relates to Environmental Management Technology 7.0 Know how to Input various datasets in a GIS 8.0 Know how to Manage GIS data 9.0 Know how to Produce a GIS map using Mapping and Survey data 10.0 Know how to Produce a cartographic correct map using mapping and survey data 11.0 Know how to Produce a metadata file for the GIS Project 			

12.0 Know how to Interpret GIS data.

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
COURSE: Introduction to Geographic Communication			CODE: ESM 125	Credit Unit: 3.0		Contact Hours: 3
GOAL: This course is designed to expose the students to an introduction to GIS technology required in the environmental field						
Course Specification:			THEORETICAL CONTENT	PRACTICAL CONTENT		
General Objective 1.0: Know how to determine angles between set of points						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Describe parts of a total station 1.2 Describe how to set up and level a total station over a point 1.3 Explain how to measure horizontal angles by repetition 1.4 Describe how to record observations in standard field notes format	Explain in details Parts of a total station Measure horizontal angles using total station.	Lab Coat, coveralls	Identify the parts of a total station Set up and level a total station over a point Measure horizontal angles by repetition Record observations in standard field notes format	Guide students to: -identify the parts of a total station -set up and level a total station over a point -measure horizontal angles by repetition -record observations in standard field notes format	Describe parts of a total station
General Objective 2.0: Understand the determination of Horizontal Distance and Vertical Difference between 2 points						

4-5	<p>2.1 Explain EDM (electronic distance measurement) theory</p> <p>2.2 Describe how to use the total Station to measure the zenith angle and the slope distance between 2 points</p> <p>2.3 Describe how to record the observations in a standard field notes format</p> <p>2.4 Describe how to calculate the horizontal distance and vertical difference</p>	<ul style="list-style-type: none"> • Explain items 2.1-2.4 	EDM Equipment Total Station	<p>Use the total Station to measure the zenith angle and the slope distance between 2 points</p> <p>Record the observations in a standard field notes format</p> <p>Calculate the horizontal distance and vertical difference</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -use the total Station to measure the zenith angle and the slope distance between 2 points record the observations in a standard field notes format -calculate the horizontal distance and vertical difference 	Explain EDM theory
GENERAL OBJECTIVE: 3.0. Understand the determination of Coordinates of a point relative to another point						
6-7	<p>3.1 Describe procedure used to survey a close traverse</p> <p>3.2 Calculate directions from field angles</p> <p>3.3 Calculate latitudes and departures</p> <p>3.4 Calculate traverse precision and accuracy</p> <p>3.5 Perform traverse adjustment</p> <p>3.6 Calculate northings and</p>	<p>Explain procedure used to survey a close traverse</p> <ul style="list-style-type: none"> • Explain how to Calculate directions from field angles, latitudes and departures 	Theodolite Ranging Poles	<p>Perform traverse adjustment</p> <p>Perform a traverse survey</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -perform traverse adjustment <p>Perform a traverse survey</p>	Describe procedure used to survey a close traverse

	eastings 3.7 Perform a traverse survey					
GENERAL OBJECTIVE: 4.0. Understand the determination of topographic survey using a total station						
8-10	4.1 Describe trigonometric elevation determination 4.2 Describe the procedures for gathering topographical data 4.3 Measure and record horizontal angles, vertical angles and slope distance	Explain trigonometric elevation Explain procedure for gathering topographical data	Theodolite Ranging Poles	Measure and record horizontal angles, vertical angles and slope distance using theodolite	Guide students to measure and record horizontal angles, vertical angles and slope distance using theodolite	Describe the procedures for gathering topographical data
GENERAL OBJECTIVE: 5.0. Understand how to collect Mapping data using a handheld GPS Receivers						
11	5.1 Describe how to operate the receiver. 5.2 Describe how to use mapping coordinates to locate land features. 5.3 Explain how to collect mapping coordinates of land features. 5.4 Explain how to record the coordinates in a computer spreadsheet	Explain how to operate the receiver, use mapping coordinates to locate land features and Collect mapping coordinates of land features Explain how to record and coordinates in a computer spreadsheet	HandheldGPS Receivers	Operate the receiver Use mapping coordinates to locate land features Collect mapping coordinates of land features Record the coordinates in a computer spreadsheet	Guide students to:- operate the receiver -use mapping coordinates to locate land features -collect mapping coordinates of land features	Explain how to use mapping coordinates to locate land features

	5.5 Explain how to determine the accuracy of the data			Determine the accuracy of the data	record the coordinates in a computer spreadsheet	
GENERAL OBJECTIVE: 6.0. Understand how to deliver a Class Presentation on a Specific GIS project that relates to Environment Technology						
12-13	6.1 Explain how to Perform a research on a GIS project that relates to Environmental Technology. 6.2 Explain how to Perform a research that highlights the major components of the project. 6.3 Explain how to Present the results of a research	Explain how to perform a research on a GIS project that relates to Environmental Technology Explain how to perform a research that highlights the major components of the project Explain how to present the results of a research	Handheld GPS Receivers	Carry out a research on a GIS project that relates to Environmental Technology Carry out a research that highlights the major components of the project Present the results of a research	Guide students to: carry out a research on a GIS project that relates to Environmental Technology -carry out a research that highlights the major components of the project -present the results of a research	Explain how to perform a research on a GIS project that relates to Environmental Technology
GENERAL OBJECTIVE: 7.0. Know how to Input various data sets in a GIS						
14	7.1 Describe georeferenced maps, aerial photographs and orthophotos 7.2 Explain Import digital data in a GIS	• Explain items 7.1-7.3	Handheld GPS Receivers	Use georeferenced maps, aerial photographs and orthophotos.	Guide students to: -use georeference maps, aerial	Explain how to input non-spatial and spatial data (survey and GPS) in the standard fieldnotes format

	7.3 Explain Input non-spatial and spatial data (survey and GPS) in the standard field notes format			Import digital data in aGIS input non-spatial and spatial data (survey and GPS) in the standard fieldnotes format	photographs and orthophotos. -import digital data in a GIS -input non-spatialand spatial data (survey and GPS) in the standard field notes format	
GENERAL OBJECTIVE: 8.0. Know how to Manage GIS data						
	8.1 Explain how to transform GIS data between various map projections 8.2 Describe how to edit non-spatial and spatial GIS data 8.3 Explain how to manage GIS data	Explain data management Explain transformation ofGIS data between • various mapprojections	Handheld GPS Receivers	Transform GIS data between various map projections Edit non-spatial andspatial GIS data Manage GIS data	Guide students to: -transform GIS data between various map projections -edit non-spatialand spatial GIS data -manage GIS data	Explain data management

GENERAL OBJECTIVE: 9.0 Know how to Produce a GIS map using Mapping and Survey data						
	9.1 Explain GIS Data analysis 9.2 Explain how to Perform the analysis on the data	• Explain GIS data analysis	Handheld GPS Receivers	Carry out GIS data analysis Perform the analysis on the data	Guide students to: - carry out GIS data analysis - perform the analysis on the data	Explain GIS data analysis
GENERAL OBJECTIVE: 10.0. Know how to produce a cartographic correct map using mapping and survey data						
	10.1 Explain how to insert all map surround information 10.2 Explain how all points, lines, area and raster features on the map 10.3 Describe how to present on the map information that are cartographically correct 10.4 Explain how to Plot draft copy(ies) of the map 10.5 Explain how to Perform quality control of the map 10.6 Explain how to Produce the final	• Explain procedures of GIS data presentation	Handheld GPS Receivers	Plot draft copy(ies) of the map Perform quality control of the map Produce the final map	Guide students to: - plot draft copy(ies) of the map - perform quality control of the map produce the final map	Explain procedures of GIS data presentation

	map					
GENERAL OBJECTIVE: 11.0. Know how to Produce a metadata file for the GIS Project						
	11.1 Explain how to determine the accuracy of various map features 11.2 Describe how to compare the accuracy of the various mapping features and Produce the metadata records.	Explain the procedure for producing metadata of the •GIS project	HandheldGPS Receivers	Determine the accuracy of various map features Produce the metadata records.	Guide students to: determine the accuracy of various map features	Explain the procedure for producing metadata of the GIS
GENERAL OBJECTIVE:12.0 Interpret GIS data						
			HandheldGPS Receivers	12.1 Interpret GIS data for air monitoring and prediction. 12.2 Interpret GIS data for water monitoring and prediction. 12.3 Interpret GIS data for land monitoring and prediction. 12.4 Interpret GIS data for vegetation monitoring and	Guide students to carry out activities 12.1-12.4	Interpret GIS data for land monitoring and prediction.

				prediction.		
ASSESSMENT: The continuous assessment; tests, quizzes, field works etc. will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.						

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Environmental Sampling and Analysis	CODE: ESM 126	Credit Unit: 3.0	CONTACT HOURS: 3 HOURS/WEEK
Goal: This course is designed to expose the students to sampling techniques that are accurate, precise and maintain sample integrity.			
YEAR: ONE (1), SEMESTER: TWO (2)	PRE-REQUISITE: none	PRACTICAL: 1 HOUR/WEEK	
GENERAL OBJECTIVES			
On completion of this course, the Student should be able to:			
1.0 know how to evaluate the composition of complex sample matrices			
2.0 Know the properties of organic and inorganic pollutants			
3.0 Know the determination of appropriate sampling strategy to employ in a given situation.			
4.0 know how to develop a comprehensive sampling plan, given a particular scenario.			
5.0 know how to implement the correct preservation technique for a given sample			
6.0 know how to evaluate the general considerations of sampling surface and ground water.			
7.0 know how to evaluate general considerations for the sampling of soils.			
8.0 Understand the different categories of air pollutants and the collection of a representative air sample from a target population/environment			
9.0 Understand the principles of common field analyses.			
10.0 know how to incorporate correct quality assurance and quality control practices into action in the field during environmental sampling activities.			
11.0 know how to collect samples of air, water and soil that are defensible under legal scrutiny			
12.0 Understand the main principles of operation for different types of chemical instrumentation			

PROGRAMME: NATIONAL DIPLOMA ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY								
Course: Environmental Sampling and Analysis		Course Code: ESM 126		Credit Unit: 3.0		Contact Hours: 3		
GOAL: This course is designed to expose the students to sampling techniques that are accurate, precise and maintain sample integrity								
Course Specification: Theoretical Content: 2 hrs				Practical Content: 1 hr				
GENERAL OBJECTIVE 1.0: Know how to evaluate the composition of complex sample matrices.								
Course Specification:		THEORETICAL CONTENT			PRACTICAL CONTENT			
Week	Specific Outcome	Learning	Teachers' Activities	Learning Resources	Specific Outcome	Learning	Teachers' Activities	Evaluation
1-2	1.1 List the main components of the environment 1.2 Describe interdependency of the main components of the environment. 1.3 Describe the physical and chemical composition of various matrices encountered in the activity of environmental sampling and analysis		List out the components of the environment. Explain the physical/chemical composition of chosen samples • Explain interferences and their effects on analyses	Visual aids, calculator, marker, etc. .A bound laboratory notebook with numbered pages, a laboratory coat, disposable latex laboratory gloves Safety glasses and etc.	Identify types of interferences that are present in sample matrices collected from the environment and their effects on analyses		Guide students to identify types of interferences that are present in sample matrices collected from the environment and their effects on analyses	List the main component of the environment State the chemical component of various matrices Identify the type of interferences that are present in sample matrices

	1.4 Explain how to identify types of interferences that are present in sample matrices collected from the environment and their effects on analyses					
GENERAL OBJECTIVE 2.0: Know the properties of organic and inorganic pollutants						
3-4	2.1 Describe pathways, conditions and mechanisms that influence the migration path of a pollutant. 2.2 Explain with examples of organic and inorganic chemicals that are potentially hazardous to living Organisms	Give examples of various pollutants Explain the pathways of migration of pollutants Explain organic and inorganic chemicals and their potential hazard to living • organisms	Visual aids, chalks, chalkboard, magnetic Boards, markers, etc. Globe, darkroom mirrors, torchlight lens, plants, cork	▪	▪	List examples of organic and inorganic chemicals that are potential hazards

	2.3 Describe the concept and significance of bio magnification					
GENERAL OBJECTIVE 3.0: Know the determination of appropriate sampling strategy to employ in a given situation						
5-6	3.1 Describe the purpose of data quality objectives (DQA) 3.2 State example of a quantitative and a qualitative DQO Distinguish between the three types of sampling strategies 3.3 Explain the advantages of each.	Explain the purpose of data quality objectives (DQA) with example of a quantitative and a qualitative DQO Explain the advantages of each. Explain the best sampling strategy for a given situation	Visual aids, Gas chromatograph Mixtures Hydrocarbon Chromatogram, etc. Computer	Choose the best sampling strategy for a given situation	Guide students to choose the best sampling strategy for a given situation	Distinguish between the three types of sampling strategies
General Objectives 4.0: Know how to develop a comprehensive sampling plan, given a particular scenario						
7-9	4.1 Compare three types of sampling programs. 4.2 Determine the type of sampling plan required in a given situation. 4.3 Differentiate between local and area control sites. 4.4 Describe the types of samples commonly	Explain three types of sampling programs and differentiate between local and area control sites, the types of samples commonly collected and the benefits of grab versus automated sampling.	Magnetic Board, Markers Etc. IEC, Solvent Mixtures, IEC Chromatogram,	Determine the type of sampling plan required in a given situation	Guide students to determine the type of sampling plan required in a given situation	Differentiate between local and area control sites. List the types of samples commonly collected

	collected. 4.5 State the benefits of grab versus automated sampling.					
General Objective 5.0 Know how to implement the correct preservation technique for a given sample						
10-11	5.1 Describe the factors that affect an unpreserved sample 5.2 Select the correct preservation technique and holding time for given a water sample. 5.1 5.3 Select the correct preservation technique and holding time for a given a soil sample	Explain factors affecting • unpreserved sample with good illustration	Magnetic Boards,, Markers,etc.	Select the correct preservation technique and holding time for given a water sample. Select the correct preservation technique and holding time for a given a soil sample	Guide studentsto: -select the correct preservation technique and holding time for given a water sample. -select the correct preservation technique and holding time for a given a soil sample	List the factors that affect an unpreserved sample
General Objective 6.0 Know how to evaluate the general considerations of sampling surface waters and ground						
12-14	6.1 Discuss the unique properties of ground water and how they can interfere with the collection of a representative ground water sample. 6.2 Distinguish between the many types of	Explain properties of ground water and how they can interfere with the collection of a representative ground water sample.	Magnetic Boards,, Markers, etc.	Identify the unique properties of ground water and how they can interfere with the collection of a representative ground water sample. Identify the appropriate sampling	Guide students to: -identify the unique properties of ground water and how they can interfere with the collection of a representative ground water sample.	Distinguish between the many types of water samples that may be encountered and indicate the type of water to collect for a given situation.

<p>water samples that may be encountered and indicate the type of water to collect for a given situation.</p> <p>6.3 Describe the individual procedure steps and types of sampling equipment that are used for water sampling.</p> <p>6.10 Explain how to identify the appropriate sampling location for the collection of water.</p>	<p>Explain how to distinguish between the many types of water samples of water .</p> <p>Explain the individual procedure steps and types of sampling equipment that are used for water sampling. Identify the appropriate sampling location for the collection</p> <ul style="list-style-type: none"> • of water 		<p>location for the collection of water</p>	<p>identify the appropriate sampling location for the collection of water</p>	
<p>General Objective 7.0 Know how to evaluate general considerations for the sampling of soils</p>					
<p>7.1 Classify soils based on particle size.</p> <p>7.2 Explain the decisions that are made for a soil sampling program</p> <p>7.3 Explain how to choose the proper sampling equipment and containers to use for soil Sampling</p>	<ul style="list-style-type: none"> • Explain the classification of soils based on particle size. 	<p>Soil sample Soil sieve</p>	<p>Choose the proper sampling equipment and containers to use for soil sampling</p> <p>Perform soil analysis</p>	<p>Guide students to demonstrate use of soil sieve for soil particle size</p> <p>Guide Students to analyze soil samples</p>	<p>List physical characteristics of soil</p>

	7.4 Describe some physical characteristics of soil					
General Objective 8.0 Understand the different categories of air pollutants and the collection of a representative air sample from a target population/environment						
	<p>8.1 Explain the chemical composition of natural, unpolluted ambient air and concentration of individual chemical compounds present in ambient air.</p> <p>8.2 Explain examples of natural and anthropogenic sources of air pollution and some of the effects on the environment from air pollution.</p> <p>8.3 Describe the three components of an air pollution model and the relationships between each environment.</p> <p>8.4 Explain the four types of decisions that can be made from the study of air pollution and the environment</p> <p>8.5 List the four types of air samples collected in environmental studies</p>	<p>Explain the chemical composition of natural, unpolluted ambient air and concentration of individual chemical compounds present in ambient air.</p> <p>Give examples of natural and anthropogenic sources of air pollution and some of the effects on the environment from air pollution.</p> <p>state the three components of an air pollution model and the relationships between each.</p>	Whiteboard	<p>Identify examples of natural and anthropogenic sources of air pollution and some of the effects on the environment from air pollution.</p> <p>Identify the four types of decisions that can be made from the study of air pollution and the environment</p> <p>Identify different mechanisms of operations used in air sample collection equipment to collect individual air pollutants or categories from the environment</p>	<p>Guide students to:</p> <p>-identify examples of natural and anthropogenic sources of air pollution and some of the effects on the environment from air pollution.</p> <p>-identify the four types of decisions that can be made from the study of air pollution and the environment</p> <p>-identify different mechanisms of operations used in air sample collection</p>	<p>List examples of natural and anthropogenic sources of air</p> <p>State the component of an air pollution model</p> <p>List four types of air samples collected in environmental studies</p> <p>List the types of particulate matters.</p>

	<p>and categories of air pollutions that exist according to their vapour pressure</p> <p>8.6 Explain particulate matter (PM)</p> <p>8.7 Classify PM into the six different types and according to particle size</p> <p>8.8 Explain the different modes that are used for air sample collection including area, direct or indirect sampling and passive or active sampling</p> <p>8.9 List different mechanisms of operations used in air sample collection equipment to collect individual air pollutants or categories from the environment</p> <p>8.10 Describe the significance of environmental conditions on the collection of air samples</p> <p>8.11 Explain conditions that can interfere with the collection of a</p>	<p>Explain the four types of air samples collected in environmental studies and categories of air pollutions that exist according to their vapour pressure</p> <p>Explain particulate matter (PM)</p> <p>Classify PM into the six different types and according to particle size.</p> <p>Explain the different modes that are used for air sample collection including area, direct or indirect sampling and passive or active sampling</p> <p>Explain conditions</p>			<p>equipment to collect individual air pollutants or categories from the environment</p>	
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	<p>representative air sample in a given environment</p> <p>8.12 List examples of air sampling equipment</p> <p>8.13 Describe air sampling equipment and their method of operation and the mechanism employed to collect air pollutants</p> <p>8.14 Explain precautions to take in the handling and preservation of air samples</p>	<p>that can interfere with the collection of a representative air sample in a given environment</p> <p>List examples of air sampling equipment</p> <p>Describe air sampling equipment and their method of operation and the mechanism employed to collect air pollutants</p> <p>Explain precautions to take in the handling and</p> <ul style="list-style-type: none"> • preservation of air samples 				
General Objective 9.0 Understand the principles of common field analyses						
	<p>9.1 Give reasons for measuring some physical and chemical properties of environmental samples in the field</p>	<p>Explain reasons for measuring some physical and chemical properties of environmental samples in the field</p>	<p>Whiteboard</p> <p>Immunoassay kits</p>	<p>Measure the concentration of pollutant in a given environmental sample</p>	<p>Guide the students to measure the concentration of pollutant in a given environmental sample</p>	<p>Identify the purpose of turbidity, conductivity and residual chlorine measurement</p>

<p>9.2 Describe the model of immunoassay kits use to measure the presence and/or concentration of pollutant in environmental samples</p> <p>9.3 Explain the purpose of turbidity, conductivity and residual chlorine measurement.</p>	<p>Explain the model of immunoassay kits use to measure the presence and/or concentration of pollutant in</p> <ul style="list-style-type: none"> • environmental samples 				
<p>General Objective 10.0 Know how to incorporate correct quality assurance and quality control practices into action in the field during environmental sampling activities.</p>					
<p>10.1 Describe how to obtain quality in field activities and the collection of laboratory data.</p> <p>10.2 Distinguish between various terms that are used to identify aspects of quality assurance and quality control.</p> <p>10.3 Explain how to</p>	<p>Explain how to obtain quality in field activities and the collection of laboratory data.</p> <p>Explain ways to minimize the amount of error in measurements through the</p>	<p>Whiteboard</p>	<p>Minimize the amount of error in measurements through the application and execution of quality control practices.</p> <p>Acquire data that is valid and legally defensible</p>	<p>Guide students to:</p> <p>-minimize the amount of error in measurements through the application and execution of quality control practices.</p> <p>acquire data that is valid and legally</p>	<p>Distinguish between various terms that are used to identify aspects of quality assurance and quality control</p>

	<p>minimize the amount of error in measurements through the application and execution of quality control practices.</p> <p>10.4 Explain acquire data that is valid and legally defensible</p>	<p>application and execution of quality control practices.</p>			defensible	
General Objective 11.0 Know how to collect samples of air, water and soil that are defensible under legal scrutiny						
	<p>11.1 List the documentation required when obtaining samples for legal purposes</p> <p>11.2 Describe the special precaution that must be followed during the transport and storage of legal samples.</p> <p>11.3 Explain what a chain of custody is, its importance and the correct procedure that must be followed to correctly fill out a chain of custody report</p>	<p>Explain the documentation required when obtaining samples for legal purposes</p> <p>Describe the special precautions that must be followed during the transport and storage of legal samples.</p> <p>Explain what a chain of custody is, its importance and the correct procedure that must be followed to correctly fill</p>	Whiteboard	Identify what a chain of custody is	Guide students to identify what a chain of custody is	Define chain of custody

		out a chain of • custody report				
General Objective 12.0 Understand the main principles of operation for different types of chemical instrumentation						
	12.1 Compare the similarities and the differences between a gas chromatograph and an ion exchange chromatograph. 12.2 Explain the operation of a gas chromatograph, ion exchange 12.3 State the instrument that should be used to determine the presence and concentration of different chemicals in environmental samples.	Explain similarities and the differences between a gas chromatograph and an ion exchange chromatograph. List the instrument that should be used to determine the presence and concentration of different chemicals in environmental • Samples	Whiteboard	▪ -	▪ -	State the similarities between a gas chromatography and an ion exchange chromatography
ASSESSMENT: The continuous assessment; tests and quizzes will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.						

YEAR TWO, SEMESTER ONE COURSES

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Man And Environment	CODE: ESM 211	Credit Unit: 3.0	CONTACT HOURS: 2 HOURS/WEEK
GOAL: This course is designed to enable the student know the impact of man's activities on the environment.			
YEAR: TWO (2), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 0 HOURS/WEEK	

GENERAL OBJECTIVES

On completion of this course, the Student should be able to:

- 1.0 Understand man's impact on vegetation
- 2.0 Understand man's impact on animals
- 3.0 Understand man's impact on the soil
- 4.0 Understand man's impact on the waters

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
Course: Man and Environment			Course Code: ESM 211	Credit Unit: 2.0	Contact Hours: 2	
GOAL: This course is designed to enable the student know the impact of man's activities on the environment						
Course Specification:			THEORETICAL CONTENT	PRACTICAL CONTENT		
General Objective 1.0: Understand Man's Impact on Vegetation						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1: Define impact of man on environment. 1.2 Describe man's impact on vegetation 1.3 Describe the environmental impact of man's use of fire 1.5 Distinguish between natural and man-made fires 1.6 Describe the role of fire in suppressing vegetation 1.7 Explain some of the consequences of fire suppression of vegetation 1.8 Describe the role of grazing in suppression of vegetation 1.9 Describe the role of man in deforestation	Explain impact of man on: vegetation. Distinguish between natural and man-made fires, the role of fire in suppressing vegetation Explain some of the consequences of fire suppression of vegetation and the role of grazing in suppression of vegetation	-projection -textbooks - internet - lecture notes tutorial	▪ -	▪ -	Explains the meaning and significance of man activities on vegetation.

	<p>1.10 Describe the secondary rain-forest</p> <p>1.11 Describe the role of man in the creation and maintenance of savannah</p> <p>1.12 Explain the coastal forest problems</p> <p>1.13 Describe the effects of air pollution on plants</p> <p>1.14 Explain the role of man in vegetal decline</p> <p>1.15 Explain the role of man in changing the genetic diversity in plants</p>					
General Objective 2.0: Understand Man's Impact on Animals						
4-5	<p>2.1: Explain man's impact on animals</p> <p>2 Explain the environmental impact of man's domestication of animals</p> <p>2.3 Explain the environmental impact of man's dispersal of animal populations</p> <p>2.4 Explain the environmental impact of man's inversion of animal populations</p>	<p>Explains man's domestication of animals, the environmental impact of man's dispersal of animal populations, impact of man's inversion of animal populations</p> <p>And the role of man as an agent of animal population contractions, the role of man as an agent of</p>	<p>-projection</p> <p>-textbooks</p> <p>- internet</p> <p>- lecture notes</p> <p>tutorial</p>	<p>▪ -</p>	-	<p>Explains the meaning and significance of man activities on animals</p>

	<p>2.5 Describe the role of man as an agent of animal population contractions</p> <p>2.6 Describe the role of man as an agent of animal population decline</p> <p>2.7 Explain the expansion of animal populations under man's influence</p>	<p>animal population decline</p> <p>Explain the expansion of animal populations under man's influence</p>				
General Objective 3.0: Understand Man's Impact on The Soil						
6-7	<p>3.1 Explain man's impact on the soil</p> <p>3.2 List the natural sources of soil salinity</p> <p>3.3 Describe the sources of soil salinity brought by man</p> <p>3.4 Describe the spread of soil salinity</p> <p>3.5 Describe the methods of reclamation of salt-affected lands</p> <p>3.6 Explain the role of man in laterization of soil</p> <p>3.7 Explain the role of man in soil structure alteration</p> <p>3.8 Explain the role of man</p>	<p>Explains the meaning and significance of – man activities on soil.</p> <p>Explain soil salinity brought by man, how the spread of soil salinity occurs.</p> <p>Describe the methods of reclamation of salt-affected lands</p> <p>Explain the role of man in laterization of soil and explain the role of man in soil structure alteration and acidification of soil</p>	<p>-projection</p> <p>-textbooks</p> <p>- internet</p> <p>- lecture notes</p> <p>tutorial</p>	▪ -	▪ -	Explains the meaning and significance of man activities on soil

	<p>in acidification of soil</p> <p>3.9 Explain the impacts of soil drainage methods employed by man</p> <p>3.10 Describe the environmental impact of synthetic fertilizer on soil</p> <p>3.11 Describe the impact of man-made fire on the soil</p> <p>3.12 Explain the role of man in soil erosion</p> <p>3.13 Explain human attempts at soil and land conservation</p>	<ul style="list-style-type: none"> • Explain the impacts of soil drainage methods employed by man. 				
General Objective 4.0: Understand Man's Impact on The Soil						
8-10	<p>4.1 Explain the various aspect of man's deliberate modifications of rivers</p> <p>4.2 Describe the effects of urbanization on river flow</p> <p>4.3 Describe the effects of deforestation on river flow</p> <p>4.4 Explain the changes in lake levels brought about by man</p>	<p>Explains the various aspect of man's deliberate modifications of rivers, urbanization and flow</p> <p>deforestation on river flow</p> <p>Explain the role of man in water pollution</p> <p>Explain the</p>	<p>-projection</p> <p>-textbooks</p> <p>- internet</p> <p>- lecture notes</p> <p>tutorial</p>	<ul style="list-style-type: none"> ▪ - 	<ul style="list-style-type: none"> ▪ - 	<p>Explains the meaning and significance of man activities on water.</p>

	<p>4.5 Describe the changes in underground water conditions brought about by man</p> <p>4.6 Explain the role of man in water pollution</p> <p>4.7 Explain the process of chemical pollution by agriculture</p> <p>4.8 List other sources of chemical pollution of water by man</p> <p>4.9 Describe the effect of deforestation on water quality</p> <p>4.10 Explain the problem of thermal pollution of water by man</p>	<p>process of chemical pollution by agriculture</p> <p>List other sources of chemical pollution of water by man</p> <p>4.9 Describe the effect of deforestation on water quality</p> <p>4.10 Explain the problem of thermal pollution of water by man</p>				
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PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Environmental and Social Risk Communication	CODE: ESM 212	Credit Unit: 2.0	CONTACT HOURS: 2 HOURS/WEEK
GOAL: This course is designed to acquaint students to communication theory and principles, its application in various corporate stakeholders of communication setting			
YEAR: TWO (2), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 0 HOURS/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <ol style="list-style-type: none"> 1.0 Know risk communication process. 2.0 Understand the key principles, general communication process and elements of the risk communication relationship. 3.0 Understand the potential internal and external corporate environmental stakeholders and their potential influence on corporate activities 4.0 Understand the key element of stakeholder communication processes. 5.0 Understand how corporate environmental communications could be managed and the necessary systems that are required for it to be managed effectively 6.0 Know how to plan and prepare an oral technical presentation. 7.0 Understand the fundamentals of conflict management 8.0 Understand the key elements and strategies required to effectively engage the public during consultations. 9.0 Know of different types of ENGOs, and the roles they play in addressing corporate environmental issues and problems. 10.0 Know the new collection process from the viewpoint of different news media and the elements of a good story. 11.0 Understand successful engagement of a media representative in crisis or planned interviews. 12.0 Understand effective strategies for engaging regulatory or government representatives 			

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY								
COURSE: Environmental and Social Risk Communication			CODE: ESM 212		Credit Unit: 2.0	Contact Hours: 2		
GOAL: This course is designed to acquaint students to communication theory and principles, its application in various corporate stakeholders of communication setting								
Course Specification:				Theoretical Content: 2		Practical Content: 0 hrs		
GENERAL OBJECTIVE 1.0: Know risk communication process								
Course Specification:				THEORETICAL CONTENT		PRACTICAL CONTENT		
Week	Specific Outcome	Learning	Teachers' Activities	Learning Resources	Specific Outcome	Learning	Teachers' Activities	Evaluation
1-2	1.1 Describe the general process and elements of risk communication. 1.2 Describe, using examples, the three types of risk communication. 1.3 Explain the role of audiences in the risk communication process. 1.4 Describe the differences between scientific risk (i.e.,		Explain risk communication process with examples Compare and contrast scientific risk and • perceived risk	White board Multi-media	▪		▪	Describe the general process and elements of risk communication. State the 3 types of risk communication Explain the role of audience in risk communication

	hazards) versus perceived 1.1 risk (i.e., outrage).					
GENERAL OBJECTIVE 2.0: Understand the key principles and elements of the risk communication process.						
3-4	<p>2.1 List the components of community outrage.</p> <p>2.2. Describe the components of community outrage using examples.</p> <p>2.3 State the elements that could be implemented when trust is low.</p> <p>2.4 Describe the various means by which corporate trust and credibility can be damaged.</p> <p>2.5 Analyze a case study and describe why the results occurred and recommendations for improving the situation.</p> <p>2.5 Describe nonverbal communication in terms</p>	<p>Explain the components of community outrage its elements that could be implemented when trust is low.</p> <p>Describe the various means by which corporate trust and credibility can be damaged.</p> <p>Explain verbal and Nonverbal communication and the differences between verbal and nonverbal communication</p> <p>List out types of nonverbal communication; and</p> <ul style="list-style-type: none"> • role of nonverbal communication in 	Whiteboard Multi-media Chart	▪ -	▪ -	<p>Describe the components of community outrage with examples.</p> <p>Explain the various means by which corporate trust and credibility can be damaged</p> <p>Differentiate between verbal and nonverbal communication</p> <p>Describe role of nonverbal</p>

	<p>of: a definition; differences between verbal and nonverbal communication; types of nonverbal communication; and role of nonverbal communication in interpersonal communication.</p> <p>2.6 Define interpersonal communication.</p> <p>2.7 Define listening and hearing as they relate to the perception process</p>	interpersonal communication.				communication in interpersonal communication.
GENERAL OBJECTIVE 3.0: Understand the potential internal and external corporate environmental stakeholders and their potential influence on corporate activities						
5-6	<p>3.1 List the possible internal and external stakeholders of an organization.</p> <p>3.2 Describe the relationship of the internal and external stakeholders to the organization.</p>	<p>Give an overview of corporate Stakeholdersthe relationship of internal and external stakeholders to the organization. Describe the relationships of the internaland external</p>	<p>Whiteboard Multi-mediaChart</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Explain the relationship between internaland external stake holders to the organization</p> <p>Explain the</p>

	<p>3.3 Describe the relationships of the internal and external stakeholders to each other and how it influences overall and their relationship to the organization.</p> <p>3.4 Describe the role each stakeholder plays, using examples, in the risk communication process.</p> <p>3.5 Describe the potential influence each stakeholder has, using examples, on the activities of the organization</p>	<p>stakeholders to each other and how it influences overall and their relationship to the organization.</p> <p>Explain the role each stakeholder plays, using examples, in the risk communication process.</p>				<p>role stakeholders in risk Communication process</p>
GENERAL OBJECTIVE 4.0: Understand the key element of stakeholder communication processes.						
7-9	<p>4.1 Describe the process for determining communication purpose and objectives.</p> <p>4.2 Describe the factors that will influence the purpose and objectives.</p> <p>4.3 Explain how to prepare a communication purpose and</p>	<ul style="list-style-type: none"> • Explain the key element of stakeholder communication process 	<p>Whiteboard Multi-media Chart</p>	<ul style="list-style-type: none"> ▪ - 		<p>Explain the factors that will influence the purpose and Objectives of communication processes</p>

	Objectives of a given a scenario, 4.4 Describe the process of audience analysis. 4.5 Explain how to conduct an audience analysis of a given scenario.					
GENERAL OBJECTIVE 5.0: Understand how corporate environmental communications could be managed and the necessary systems that are required for it to be managed effectively						
10-11	5.1 Describe the elements of an effective communications plan. 5.2 Assess the communications plan and make recommendations for improvements of a given a scenario. 5.3 Describe the elements and interrelationships of an effective corporate environmental communications system. 5.4 Describe how an effective corporate	Explain the elements of an effective communications plan and assess the communications plan and make recommendation for improvements of a given a scenario. Describe the elements and interrelationships of an effective corporate environmental communications system.	Multi-media Magnetic Board	▪ -	▪	Explain the elements of an effective communication splan. Explain how an effective corporate environmental communications system should be implemented and improved upon

	<p>environmental communications systems should be implemented.</p> <p>5.5 Assess the corporate environmental communications system and make recommendations for improvements of a given a 5.2 scenario,</p>	<p>Discuss how an effective corporate environmental communications system should be implemented.</p> <p>5.5 Assess the corporate environmental communications system and make recommendation for improvements of a given a</p> <ul style="list-style-type: none"> • scenario 				
General Objective 6.0: Know how to plan and prepare an oral technical presentation.						
12-14	<p>6.1 Name three common types of oral presentation.</p> <p>6.2 Explain the rationale for choosing an oral presentation to convey information.</p> <p>6.3 Define topic, message, and objective as related to an oral presentation.</p> <p>6.4 Analyze the audience for knowledge and attitude.</p> <p>6.5 Critique an oral presentation to determine why it was or was not</p>	<ul style="list-style-type: none"> • Explain three common types of oral presentation. and the rationale for choosing an oral presentation to convey information 	Multi-media Magnetic Board	▪ -	▪ -	<p>Explain three common types of oral presentation.</p> <p>Assist students to plan a presentation</p> <p>Explain the basic delivery skills required for an oral presentation.</p>

	<p>effective.</p> <p>6.6 Plan a presentation with visual aids.</p> <p>6.7 Describe the basic delivery skills required for an oral presentation.</p> <p>6.8 Critique an oral presentation using a standard evaluation form</p>					
General Objective 7.0: Understand the fundamentals of conflict management						
	<p>7.1 Define conflict.</p> <p>7.2 Identify common causes of conflict in the workplace.</p> <p>7.3 List the benefits of conflict</p> <p>7.4 Describe defensiveness, its causes, types and effects.</p> <p>7.5 Describe five conflict resolution styles.</p> <p>7.6 Choose appropriate conflict resolution styles for a particular situation.</p>	<ul style="list-style-type: none"> • Explain the fundamentals of conflict management and negotiation 	<p>Whiteboard</p> <p>Multi-media</p> <p>Chart</p>	<ul style="list-style-type: none"> ▪ - 	<ul style="list-style-type: none"> ▪ - 	<p>Describe and explain the common causes of conflicts.</p> <p>Explain the benefits of conflicts</p> <p>Explain the appropriate conflict resolution styles</p>
General Objective 8.0: Understand the key elements and strategies required to effectively engage the public during consultations and interactions.						
	<p>8.1 Define consultation and interaction.</p>	<p>Explain meaning of consultation and</p>	<p>Multi-media</p> <p>Magnetic Board</p>	<ul style="list-style-type: none"> ▪ - 	<ul style="list-style-type: none"> ▪ - 	<p>Explain the methods of</p>

	<p>8.2 Recognize the different methods in which consultation and interactions with members of public can take place.</p> <p>8.3 Describe the methods by which a “snapshot” of people’s concerns can be achieved.</p> <p>8.4 List the types of questions that may be asked.</p> <p>8.5 Define data</p> <p>8.6 Describe the elements that must be explained in regards to risk data.</p> <p>8.7 Explain and illustrate how language must be simplified.</p> <p>8.8 Describe the process of dealing with uncertainty.</p> <p>8.9 Prepare a technical presentation to a general public audience.</p>	<p>interaction.</p> <p>Explain the different methods in which consultation and interactions with members of public can take place.</p> <p>Describe the methods by which a “snapshot” of people’s concerns can be achieved.</p> <p>List the types of questions that may be asked during consultations/interactions.</p> <p>Explain the elements that must be explained in regards to risk</p> <ul style="list-style-type: none"> • Data 				<p>interaction with the public</p> <p>Explain the elements that must be explained with regards to risk data.</p>
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General Objective 9.0: Know different types of ENGOs, and the roles they play in addressing corporate environmental issues and problems.						
	<p>9.1 Define an environmental non-governmental organization (ENGO).</p> <p>9.2 List the different types of ENGOs and provide examples of each.</p> <p>9.3 Describe the primary activities of each type of ENGO and provide examples of each.</p> <p>9.4 Compare and contrast the different types of ENGOs.</p> <p>9.5 Analyze a hypothetical situation and provide an idea of the ways different types of ENGOs might potentially respond.</p> <p>9.4 Describe methods by which ENGOs could be worked with.</p>	<p>Explain environmental and non-governmental organization (ENGO). List the different types of ENGOs and provide examples of each.</p> <ul style="list-style-type: none"> • Explain the primary activities of each type of ENGO and provide examples of each. 	<p>Whiteboard Multi-media Chart</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Explain the roles of ENGO</p> <p>Describe the primary activities of ENGO</p>
General Objective 10.0: Know the new collection process from the viewpoint of different news media and the elements of a good story.						
	<p>10.1 Describe the different types of news media (television, radio, newspapers, magazines,</p>	<ul style="list-style-type: none"> • Explain the different types of news media and the processes of 	<p>Multi-media Magnetic Board</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Describe the different types of news media (television,</p>

	<p>and internet) and the processes by which they collect and disseminate the news.</p> <p>10.2 List the elements of a good news story.</p> <p>10.3 Analyze elements of a given news story.</p>	<p>collection and dissemination of news.</p>				<p>radio, newspapers, magazines, and internet)</p> <p>Explain the importance of news media</p>
<p>General Objective 11.0: Understand successful engagement of a media representative in crisis or planned interviews.</p>						
	<p>11.1 Describe the differences between a crisis and a planned interview and the potential responses to these interviews</p> <p>11.2 List the key aspects necessary in helping reporters understand a technical story.</p> <p>11.3 Describe how a source can protect and maintain their credibility.</p> <p>11.4 Analyze potential media situations and recommend appropriate</p>	<p>Explain 11.1-11.4</p> <p>Given a simulated situation, guide the learner with 15 minutes of preparation time respond to questions in a mock interview situation.</p> <p>Given a simulated situation, guide the learner with 1</p>	<p>Whiteboard Multi-media Chart</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Explain differences between a crisis and a planned interview</p> <p>Explain how a source can protect and maintain their credibility.</p>

	communication techniques.	week's preparation time, respond to questions in a mock interview situation				
General Objective 12.0: Understand effective strategies for engaging regulatory or government representatives.						
	<p>12.1 Describe the role of regulatory agencies and government representatives in the environmental risk communication process.</p> <p>12.2 Describe the type of information regulatory agencies and government representatives require and why they require it.</p> <p>12.3 Describe the consequences of not providing this information or providing inadequate or misleading information.</p> <p>12.4 Describe the benefits of providing the necessary information.</p> <p>12.5 Describe strategies for working with regulatory and government</p>	<p>Explain the type of information regulatory agencies and government representatives require and why they require it.</p> <p>Explain the consequences of not providing this information or providing inadequate or misleading information.</p>	<p>Whiteboard</p> <p>Multi-media Chart</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Describe the role of regulatory agencies and government representatives in the environmental risk communication process.</p> <p>Describe the type of information regulatory agencies and government representatives require</p>

	representatives. 12.6 Analyze the situation and provide a strategy for addressing a given a scenario.					
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ASSESSMENT: The continuous assessment; tests and quizzes will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Environmental Law	CODE: ESM 213	Credit Unit: 2.0	CONTACT HOURS: 2 HOURS/WEEK
GOAL: This course is designed to provide students with basic knowledge of environmental laws that govern environmental practices			
YEAR: TWO (2), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 0 HOURS/WEEK	

GENERAL OBJECTIVES

On completion of this course, the Student should be able to:

- 1.0 Know the overview of the history and development of law in Nigeria and how law is administered
- 2.0 Understand the constitution that shaped the development of environmental law in Nigeria and the fundamentals of the Charter of Rights and Freedoms
- 3.0 Understand the development of Environmental Law and different types of regulatory offences in Nigeria.
- 4.0 Understand the background for the development of the current federal environmental legislation
- 5.0 Understand the NESREA Regulations and their applications.
- 6.0 Understand the federal jurisdictional responsibilities related to Nigerian oceans and inland waterways
- 7.0 Understand the federal agencies with legislation that provides for protection of the environment through monitoring toxic substances, regulating Nigerian energy sector and through the emergency management of hazardous substances/releases.
- 8.0 Understand the background for the current provincial environmental legislation and provide an overview of the general purpose of NESREA and its relationship to environmental protection.
- 9.0 Understand Environmental Impact Assessment and the principles and guidelines of the Water act and Regulations.
- 10.0 Know the basis for fair and consistent compliance and enforcement process, administrative roles and assessment of the development of environmental performance measures.
- 11.0** Understand the respective federal and state environmental enforcement programs and how these programs are administered.

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
COURSE: Environmental Law			Course Code: ESM 213	Credit Unit: 2.0	Contact Hours: 2-0-0	
GOAL: This course is designed to provide students with basic knowledge of environmental laws that govern environmental practices						
Course Specification:			THEORETICAL CONTENT	PRACTICAL CONTENT		
General Objective 1.0: Know the overview of the history and development of law in Nigeria and how law is administered						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	<p>1.1 Explain the history and development of law in Nigerian.</p> <p>1.2 Explain the development of Nigerian Law.</p> <p>1.3 Describe common law, constitutional law and statute law.</p> <p>1.4 Describe the legal process in civil and criminal proceedings.</p> <p>1.5 Describe the administration of law through the government and the courts.</p>	<p>Explain the history and development of law in Nigerian</p> <p>Explain common law, constitutional law and statute law.</p> <p>Explain the legal process in civil and criminal proceedings.</p> <p>Describe the administration of law through the government and the courts.</p>	<p>Whiteboard</p> <p>Multi-media Chart</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Explain the history and development of law in Nigerian</p>

General Objective 2.0: Understand the constitution that shaped the development of environmental law in Nigeria and the fundamentals of the Charter of Rights and Freedoms.						
4-5	<p>2.1 Explain the history and development of Nigerian constitution.</p> <p>2.2 Describe the division of powers between the federal and provincial governments.</p> <p>2.3 Explain the Charter of Rights and Freedoms.</p> <p>2.4 Describe how the constitution has shaped environmental law.</p>	<p>Explain the Nigerian constitution Vis-à-vis the environment.</p> <p>Explain the division of powers between the Federal, State and Local governments</p>	Whiteboard Multi-mediaChart	▪ -	-	Explain the history and development of law in Nigerian
General Objective 3.0: Understand the development of Environmental Law and different types of regulatory offences in Nigeria.						
6-7	<p>3.1 Describe the background and history of Nigeria environmental law.</p> <p>3.2 Describe the role of the federal government in the application of environmental law in Nigeria.</p> <p>3.3 Describe the role of the provincial government in the application of environmental law in Nigeria.</p> <p>3.4 Describe the role of local municipal governments in the application of</p>	<p>Narrate the history of Nigeria environmental law in Nigeria.</p> <p>Explain the role of the federal government and the role of the provincial government in the application of environmental law in Nigeria. Also describe the role of local municipal governments in the application of</p>	Whiteboard Multi-mediaChart	▪ -	▪ -	State the different common law remedies available as they apply to environmental matters

	<p>environmental law in Nigeria.</p> <p>3.5 State the different common law remedies available as they apply to environmental matters.</p> <p>3.6 List the three different classification of regulatory offences</p>	<p>environmentallaw in Nigeria.</p> <p>Exemplify common law remedies available as they apply to environmental matters.</p> <p>List the three different classification of regulatory offences</p>				
General Objective 4.0: Understand the background for the development of the current federal environmental legislations.						
8-10	<p>4.1 Explain the backgroundfor the development of NESREA</p> <p>4.2 Describe the basicpurpose of the ACT.</p> <p>4.3 Describe the differentparts of NESREA.</p>	<p>Define NESREA</p> <ul style="list-style-type: none"> • Explain items4.1 – 4.3 	Whiteboard Multi-mediaChart	▪ -	▪ -	Describe the basic purposeof the ACT
General Objective 5.0: Understand the NESREA Regulations and their application.						
11	<p>5.1 Develop an overview of federalregulations.</p> <p>5.2 Explain how theyare deriving and their statutory authority.</p> <p>5.3 Describe the NESREA powers related to the regulation of fuels, fuel</p>	<p>Explain overview of federal regulations, how they are derive and their statutory authority.</p> <p>Explain the NESREA</p>	WhiteboardMulti- mediaChart	▪ -	▪ -	Describe Nigeria’s environmentregulations related to thecontrol of toxic substances.

	<p>components and vehicle emissions.</p> <p>5.4 Describe Nigeria’s environment regulations related to the control of toxic substances.</p> <p>5.5 Describe the federal regulations related to the movement and identification hazards substances and waste throughout the country.</p> <p>5.6 Describe the federal regulations related to the authorized release of toxic substances from industrial activities</p>	<p>Describe the federal regulations related to the movement and identification Hazards substances and waste throughout the country.</p> <p>Describe the federal regulations related to the authorized release of toxic substances from industrial activities.</p>				
General Objective 6.0: Understand the federal jurisdictional responsibilities related to Nigerian oceans and inland waterways						
12-13	<p>6.1 Develop an overview of the legislative protection of Nigeria oceans and inland waterways.</p> <p>6.2 Describe the habitat protection provisions of the Fisheries Act.</p> <p>6.3 Describe the regulations associated with the Fisheries Act.</p> <p>6.4 Describe the miscellaneous federal legislation related to the environmental</p>	<p>Explain the geography of Nigeria and use sketch to show the oceans and sea ways</p> <ul style="list-style-type: none"> • Explain items 6.1 – 6.4 	Whiteboard Multi-media Chart	▪ -	▪ -	Describe the miscellaneous federal legislation related to the environmental protection of Nigerian waterways.

	protection of Nigerian waterways.					
General Objective 7.0: Understand the federal agencies with legislation that provides for protection of the environment through monitoring toxic substances, regulating Nigerian energy sector and through the emergency management of hazardous substances/releases.						
14	<p>7.1 Provide an overview of Nigerian health and its relationship to environmental protection.</p> <p>7.2 State the federally administered legislation related to the environment and the energy sector.</p> <p>7.3 Describe the federal legislation related to environmental emergencies and the movement of hazardous material.</p> <p>7.4 Describe some of the other federal legislation related to environmental protection</p>	<p>Explain Nigerian health and its relationship to environmental protection. by the federally administered legislation related to the environment and the energy sector.</p> <p>• Describe the federal legislation related to environmental emergencies and the movement of hazardous material.</p>	Whiteboard Multi-media Chart	▪ -	▪ -	Describe the federal legislation related to environmental emergencies and the movement of hazardous material.

General Objective 8.0: Understand the background for the current provincial environmental legislation and provide an overview of the general purpose of NESREA and its relationship to environmental protection.						
<p>8.1 Describe the history and development of the Nigerian Environmental protection and Enhancement Act.</p> <p>8.2 Explain the guiding principles of the Nigeria environmental protection and enhancement Act</p> <p>8.3 Describe the important concepts of the Nigerian environmental protection and enhancement Act.</p> <p>8.4 Describe an awareness of the Nigeria Environmental protection and enhancement Act.</p>	<p>Explain Environmental Protection and enforcement</p> <ul style="list-style-type: none"> act and its the guiding principles of the Nigeria environmental protection and enhancement Act. 	<p>Whiteboard Multi-media Chart</p>	<ul style="list-style-type: none"> - 	<ul style="list-style-type: none"> - 	<p>Describe the federal legislation related to environmental emergencies and the movement of hazardous material.</p>	
General Objective 9.0: Understand Environmental Impact Assessment and the principles and guidelines of the Water act and Regulations.						
<p>9.1 Explain the history and development of the EIA process.</p> <p>9.2 Describe the basic principles of conducting an EIA.</p> <p>9.3 Describe the federal EIA process.</p> <p>9.4 Describe the EIA</p>	<p>Explain Environmental Impact Assessment, the basic principles, and the process as it applies in Nigerian.</p> <p>Describe the history and development of Nigerian</p>	<p>Whiteboard Multi-media Chart</p>	<ul style="list-style-type: none"> - 	<ul style="list-style-type: none"> - 	<p>Describe the federal EIA process.</p>	

	<p>processes it applies in Nigerian.</p> <p>9.5 Describe the history and development of Nigerian Water Act</p> <p>9.6 Explain the principles and application of the Water Act.</p> <p>9.7 Explain how to obtain an awareness of the Water Act Regulations.</p>	<p>Water Act</p> <ul style="list-style-type: none"> • Explain the principles and application of the Water Act and Water Act Regulations 				
<p>General Objective 10.0: Know the basis for fair and consistent compliance and enforcement process, administrative roles and assessment of the development of environmental performance measures.</p>						
	<p>10.1 Describe the basis for compliance and enforcement of environmental laws.</p> <p>10.2 Describe the factors affecting compliance</p> <p>10.3 Obtain an understanding of development measures.</p>	<p>Explain environmental compliance and enforcement</p> <ul style="list-style-type: none"> • Explain items 10.1 – 10.3 	<p>Whiteboard Multi-media Chart</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Describe the factors affecting compliance</p>
<p>General Objective 11.0: Understand the respective federal and state environmental enforcement programs and how these programs are administered.</p>						
	<p>11.1 Describe the federal enforcement program for NESREA.</p> <p>11.2 Explain the provincial compliance the enforcement</p>	<p>Highlight Federal and state environmental Programmes in Nigeria</p> <p>List the various activities of states and NESREA in</p>	<p>Whiteboard Multi-media Chart</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Explain the provincial compliance the enforcement program for NESREA and the <i>Water Act</i>.</p>

	program for NESREA and the <i>Water Act</i> .	•Nigeria				
<p>ASSESSMENT: The continuous assessment; tests, quizzes, field works etc. will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.</p>						

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Environmental Pollution and Control	CODE: ESM 214	Credit Unit: 3.0	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course is designed to expose the students to the problems of pollution and the roles of organization and individuals in controlling it.			
YEAR: TWO (2), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 1 HOUR/WEEK	
<p>General Objectives:</p> <p>On completion of this course, the student should be able to:</p> <ol style="list-style-type: none"> 1.0 Understand the causes, sources and effects of Environmental Pollution 2.0 Understand roles of organization and individuals in preventing pollution 3.0 Understand the need for controlling pollution 4.0 Understand the different types of environmental pollution 5.0 Know the petroleum processes from petroleum exploration to refining 6.0 Understand the major area of environmental concern in the exploration, drilling and production phases of petroleum products. 7.0 know how to suggest mitigation measures for common petroleum related environmental concerns. 8.0 Understand the general processes carried out in typical exploration, mining and milling-smelting operations for base metal operations. 9.0 Understand the common sources of environmental concern in the exploration and mining industry 10.0 Know the basic measures for mitigation for some of the common environmental concerns associated with exploration and mining activities. 			

11.0 Know the basic environmental concerns from the agricultural industry, and have a general idea of why they are of concern.

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
COURSE: Environmental Pollution and Control			CODE: ESM 214	Credit Unit: 3.0	Contact Hours: 3	
GOAL: This course is designed to expose the students to the problems of pollution and the roles of organization and individuals in controlling it.						
Course Specification:			THEORETICAL CONTENT	PRACTICAL CONTENT		
General Objective 1.0: Understand the causes, sources and effects of Environmental Pollution.						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Define Environmental Pollution 1.2 Distinguish between point sources and non-point sources of pollution 1.3 Distinguish among degradable and non-degradable pollutants. 1.4 Explain the causes and effects of pollution 1.5 State control measures for pollution.	Explain Environmental Pollution, point sources and non-point sources of pollution among degradable and non-degradable pollutants, the causes and effects of pollution control measures for pollution. Define Environmental Pollution Distinguish between point sources and non-point sources of	Whiteboard Multi-media Chart	▪ -	▪ -	Define Environmental Pollution

		<p>pollution</p> <p>Distinguish among degradable and non-degradable pollutants.</p> <p>State control measures for pollution.</p>				
General Objective 2.0: Understand roles of organization and individuals in preventing pollution						
4-5	<p>2.1 Explain pollution control.</p> <p>2.2 State the benefits of controlling pollution such as Ecological balance, aesthetic value, food etc.</p>	<p>Explain the roles of organization and individuals in preventing environmental pollution</p> <ul style="list-style-type: none"> • Distinguish pollution prevention and pollution cleanup. 	<p>Whiteboard</p> <p>Multi-media Chart</p>	▪		<p>Distinguish pollution prevention and pollution clean-up.</p>
General Objective 3.0 Understand the need for controlling pollution						
6-7	<p>3.1 Explain the roles of organization and individuals in preventing environmental pollution</p> <p>3.2 Distinguish pollution prevention and pollution clean-up.</p> <p>3.3 Explain the limitations of pollution clean-up strategies.</p>	<p>Explain pollution and pollution control and the benefits of controlling pollution such as Ecological balance, aesthetic value, food</p>	<p>Whiteboard</p> <p>Multi-media Chart</p>	▪ -	▪	<p>State the benefits of controlling pollution.</p>

	3.4 Explain the pollution control in developing countries using Nigeria as an example.					
General Objective 4.0: Understand the different types of environmental pollution						
8-10	4.1 List types of environmental pollution e.g. Air, water bodies, soil, marine, noise, thermal, pollution, in-door pollution and nuclear hazard. 4.2 Describe types of environmental pollution stated 4.1 above.	<ul style="list-style-type: none"> • Explain items 4.1-4.3 	Whiteboard Multi-media Chart	Visit local polluted sites	Accompany student to visit local polluted sites	List types of environmental pollution
General Objective 5.0: Know the petroleum processes from petroleum exploration to refining.						
11	5.1 Explain the major constituents found in the raw oil and gas mixtures. 5.2 Describe the steps involved in the exploration for oil and gas deposits in Nigeria. 5.3 Describe the processes involved in the production of raw oil and gas mixture. 5.4 Describe the processes used at a gas plant and	Explain the raw oil and gas mixtures. Explain the process involved in the exploration of oil and gas deposits in Nigeria at a gas plant and fuel refinery to convert raw hydrocarbon mixtures into products.	Lab coat, coveralls, safety glasses with solid sideshields	Identify the major constituents found in the raw oil and gas mixtures.	Guide students to identify the major constituents found in the raw oil and gas mixtures.	Describe the steps involved in the exploration for oil and gas deposits in Nigeria.

	<p>fuel refinery to convert raw hydrocarbon mixtures into products.</p> <p>5.5 Describe the processes involved in the extraction of unconventional petroleum mixtures such as tar sands and its conversion into useable products</p>					
<p>General Objective 6.0: Understand the major area of environmental concern in the exploration, drilling and production phases of petroleum products.</p>						
12-13	<p>6.1 Describe the environmental problems associated with the exploration of oil and gas.</p> <p>6.2 Explain the environmental concerns associated with produced waters.</p> <p>6.3 Describe the major atmospheric contaminants associated with the processing of oil and gas and the burning of hydrocarbons.</p> <p>6.4 Explain the environmental concerns</p>	<p>Explain the environmental problems associated with the exploration of oil and gas. and the environmental concerns associated with</p> <ul style="list-style-type: none"> • produced waters, contaminants associated with the processing of oil and gas and the burning of hydrocarbons. 	<p>Lab coat, coveralls, safety glasses with solid sideshields</p>	<p>Identify videos on oil exploration, drilling and petroleum phase production</p>	<p>Demonstrate to student using videos on oil exploration, drilling and petroleum phase production</p>	<p>Describe the environmental problems associated with the exploration of oil and gas.</p>

	associated with solid wastes produced from refinery operations, gas plant operations and tarsands operations.					
General Objective 7.0: know how to suggest mitigation measures for common petroleum related environmental concerns.						
14	7.1 Explain the various industrial control measures used to control waster effluents. (This includes: catalytic converters, scrubbers, bag houses, cyclones, electrostatic precipitators, incinerators and stacks). 7.2 List methods for wastewater treatment used by industry. 7.3 Describe the processes used for the removal of sulfur from petroleum mixtures including the Claus Process for sulfur recovery from natural gas.	Explain the various industrial control measures used to control Waster effluents. (This includes: catalytic converters, scrubbers, bag houses, cyclones, electrostatic precipitators, incinerators and stacks).	Lab coat, coveralls, safety glasses with solid sideshields	▪ -	▪ -	List methods for wastewater treatment used by industry.
General Objective 8.0: Understand the general processes carried out in typical exploration, mining and milling-smelting operations for base metal operations.						
	8.1 List the types of ore mined in Nigeria and the base metals obtained from	Explain items 8.2 – 8.5	Lab coat, coveralls, safety glasses with solid sideshields	▪ -	▪ -	Describe the process of crushing, milling and

	<p>these ores.</p> <p>8.2 Describe the various ranks of coal found in Nigeria.</p> <p>8.3 Explain the various methods of ore extraction including underground and open-pit mining.</p> <p>8.4 Describe the process of crushing, milling and concentration in the mining process.</p> <p>8.5 Describe the various processes of extracting base metal from their ore, including the use of cyanide and the carbon-in-pulp process (CIP).</p>					<p>concentration in the mining process.</p>
<p>General Objective 9.0: Understand the common sources of environmental concern in the exploration and mining industry</p>						
	<p>9.1 Describe the environmental concerns arising from the extraction of ore and the abandonment of a mine site.</p> <p>9.2 State the problems associated with the processing of ore such as the problems of Acid Mine Drainage (AMD) and leaching.</p> <p>9.3 Explain some of the</p>	<p>Explain items 9.1 – 9.3</p>	<p>Lab coat, coveralls, safety glasses with solid sideshields</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Describe the environmental concerns arising from the extraction of ore and the abandonment of a mine site</p>

	problems associated with metals in the environment.					
General Objective 10.0: Know the basic measures for mitigation for some of the common environmental concerns associated with exploration and mining activity.						
	10.1 Describe methods used to contain mining wastes Such as dykes, holding ponds and lagoons. 10.2 Describe aspects of the reclamation of a mining site following abandonment. 10.3 Describe the environmental importance of recycling and the mining industry.	Explain items 10.0 - 10.3	Lab coat, coveralls, safety glasses with solid sideshields	▪ -	▪ -	List some reclaimed mining sites in Nigeria Explain the recycling process.
General Objective 11.0: Know the basic environmental concerns from the agriculture industry, and have a general idea of why they are a concern.						
	11.1 Describe the environmental problems associated with large-scale “Factory Farm” operations in Nigeria. 11.2 Describe the waste contaminants produced by agricultural practices and founding water, air, and soil. 11.3 Explain the health concerns associated with waste produced from the agricultural industry.	Explain items 11.1 – 11.5	Lab coat, coveralls, safety glasses with solid side shields	▪ -	▪ -	Explain environmental concerns in the agricultural industry

	<p>11.4 Describe the problems associated with the use of pesticides in the agricultural industry.</p> <p>11.5 Describe the problems associated with the use of fertilizers in the agricultural Industry</p>					
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PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: ENVIRONMENTAL ASSESSMENT	CODE: ESM 215	Credit Unit: 2.0	CONTACT HOURS: 2 HOURS/WEEK
GOAL: This course is designed to enable students have knowledge of the environmental assessment.			
YEAR: TWO (2), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 1 HOURS/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <ol style="list-style-type: none"> 1.0 Understand the Concept of Environmental Assessment 2.0 Understand Environmental Working Documents 3.0 Understand Public Participation 4.0 Understand Environmental Impacts and Resource Factors 5.0 Understand Assessment Preparation and Review 			

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY								
COURSE: ENVIRONMENTAL ASSESSMENT		CODE: ESM 215		Credit Unit: 2.0		Contact Hours: 2		
GOAL: This course is designed to enable students have knowledge of the environmental assessment.								
Course Specification: hr				Theoretical Content: 1		Practical Content: 1hr		
GENERAL OBJECTIVE 1.0: Understand the Concept of Environmental Assessment								
Course Specification:				THEORETICAL CONTENT		PRACTICAL CONTENT		
Week	Specific Outcome	Learning	Teachers' Activities	Learning Resources	Specific Outcome	Learning	Teachers' Activities	Evaluation
1-2	1.1 Define the term "Environmental Assessment". 1.2 Describe Environmental Assessment as contained in the national environmental Policy Act		Define the term Environmental assessment. Describe Environmental assessment as contained in the National Environmental • Policy act.	Board. Audio- Visual Systems.	▪ -		▪ -	Describe Environmental assessment as contained in the National Environmental Policy act.
GENERAL OBJECTIVE 2.0: Understand Environmental Working Documents								
3-4	2.1 Explain various types of environmental working documents such as Environmental Impact Assessment, Environmental Auditing.		Explain types of environmental working documents, legal conditions on preparing E.I.A.,	Board. Audio- Visual Systems.	Prepare samples of E.I.A., E.A. document formats.		Guide students to: -prepare samples of E.I.A., E.A. document formats.	Explain various types of environmental working documents such as Environmental

	<p>2.2 Explain the legal conditions and regulations on preparing E.I.A. E.A. etc.</p> <p>2.3 Prepare samples of E.I.A., E.A. document formats.</p> <p>2.4 Describe Environmental Contract Documents + legal and technical aspects.</p> <p>2.5 Prepare samples of environmental contract documents.</p> <p>2.6 Explain the general processing requirements: -</p> <ul style="list-style-type: none"> • Notice of Intent • Environmental Assessment • Draft E.I.S. • Finding of No. Significant impact. 	<p>E.A.</p> <ul style="list-style-type: none"> • Describe environmental contract documents and prepare same. Explain the general process requirements. 		<p>Prepare samples of environmental contract documents.</p>	<p>prepare samples of environmental contract documents.</p>	<p>Impact Assessment,</p>
GENERAL OBJECTIVE 3.0: Understand Public Participation						
5-6	<p>3.1 Explain the following:</p> <ul style="list-style-type: none"> - Effective public participation - Public information and involvement - Participation as a group member - Benefits from an effective public 	<p>Explain public participation public information and involvement benefits of effective public participation etc.</p> <ul style="list-style-type: none"> • Explain hindrance to public 	<p>Charts Public meetings and visual aids</p>	<p>Organise the following:</p> <ul style="list-style-type: none"> - Effective public participation - Public information and involvement - Participation as a group member 	<p>Guide students to organise the following:</p> <ul style="list-style-type: none"> - Effective public participation - Public information and 	<p>Explain hindrance to public participation, public participation.</p>

	<p>participation programme. 3.2 Explain hindrances to 3.1 above.</p> <p>3.3 Organise 3.1 above.</p> <p>3.4 Evaluate 3.1 above.</p>	<p>participation, public participation.</p>		<p>Benefits from an effective public participation programme</p>	<p>involvement - Participation as a group member Benefits from an effective public participation programme</p>	
GENERAL OBJECTIVE 4.0: Understand Environmental Impacts and Resource Factors						
7-9	<p>4.1 Classify the different types of impacts, viz: - direct impacts - indirect impacts - cumulative impacts</p> <p>4.2 Describe the various impacts</p> <p>4.3 Explain the measure of the various impact</p> <p>4.4 List examples of impacts</p> <p>4.5 Explain categories of resource factors namely: - atmosphere - water - land - biological environment - sound</p>	<p>Explain various impacts and their classes. Give examples and measures of various impacts</p> <p>Explain categories of resource factors such as water, atmosphere land human aspects etc.</p>	<p>Charts Public meetings and visual aids</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Identify the various impacts</p>

	human aspects Economic aspects					
GENERAL OBJECTIVE 5.0: Understand Assessment Preparation and Review						
10-11	<p>5.1 Define the scope of the environmental assessment project.</p> <p>5.2 Explain the need for the following: - Interdisciplinary team - Baseline studies - Scoping, i.e. identification of the important issues that require full analysis.</p> <p>5.3 Describe assessment methodologies.</p> <p>5.4 Prepare an environmental assessment (EA) document from results of the impact analysis.</p> <p>5.5 Explain document review e.g. Internal and inter Agency reviews.</p> <p>5.6 Prepare a document review of an environmental Assessment Project.</p>	<p>Specify the scope of the environmental assessment project and assessment methodologies.</p> <p>Explain the need for inter-disciplinary team, scoping and baseline studies.</p> <ul style="list-style-type: none"> • Prepare environmental assessment (EA) document from results of the impact analysis and review an environmental assessment project. 	Charts Graphsetc.	<p>Prepare an environmental assessment (EA) document from results of the impact analysis.</p> <p>Prepare a document review of an environmental Assessment Project.</p>	<p>Guide students to -prepare an environmental assessment (EA) document from results of the impact analysis.</p> <p>prepare a document review of an environmental Assessment Project.</p>	<p>Explain the need for inter-disciplinary team, scoping and baseline studies.</p>

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Environmental Monitoring	CODE: ESM 216	Credit Unit: 3.0	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course is designed to provide students with the fundamental knowledge of observing the environment, collection of data and deriving required knowledge on environmental pollution, effect of the pollution, the importance of environmental monitoring and control technologies			
YEAR: TWO (2), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 1 HOUR/WEEK	
GENERAL OBJECTIVES			
On completion of this course, the Student should be able to:			
1.0 Understand environmental monitoring, purpose of environmental monitoring. and the key environmental indicators			
2.0 Understand the fundamentals of environmental monitoring.			
3.0 Know the various sources of water, air and land pollution			
4.0 Know the effect of environmental monitoring on human health and ecosystem			
5.0 Understand environmental monitoring procedures			
6.0 Know the methods of preventing/controlling environmental pollution			
7.0 Know the roles of various agencies charged with pollution control / monitoring			
8.0 Understand the legislations governing pollution.			

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
COURSE: Environmental Monitoring			CODE: ESM 216	Credit Unit: 3.0	Contact Hours: 3	
GOAL: This course is designed to provide students with the fundamental knowledge of observing the environment, collection of data and deriving required knowledge on environmental pollution, effect of the pollution, the importance of environmental monitoring and control technologies						
Course Specification:			THEORETICAL CONTENT	PRACTICAL CONTENT		
General Objective 1.0: Understand environmental monitoring, purpose of environmental monitoring. and the key environmental indicators						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Define environmental monitoring 1.2 Describe the process and activities in 1.1 1.3 Explain the importance of monitoring 1.4 List the monitoring programmes (soil contamination monitoring, soil erosion monitoring, soil salinity monitoring, chemical , biological, radiological, microbiological, population 1.5 State the reason for environmental monitoring 1.6 Describe the 5 global –	Explain items 1.1 -1.6	projector -textbook -internet -lecture note -tutorial	▪ -	▪ -	Define environmental monitoring List the importance of monitoring

	<p>scale key environmental monitoring indicators:</p> <ul style="list-style-type: none"> • biological diversity • food production • average global surfacetemperature • carbon dioxide concentrationin the atmosphere • resource depletion 					
General Objective 2.0: Understand the Fundamentals in Environmental Monitoring						
4-5	<p>2.1 Define the following items</p> <ul style="list-style-type: none"> -Environmental Hazards -Environmental pollution/pollutants - Contamination/ contaminants - Environmental Media - Eutrophication - Eco System/ Eco Friendly <p>2.2State the importance of EnvironmentalMonitoring</p>	<ul style="list-style-type: none"> • Explain the meaning of wholesome water and unwholesome water 	<ul style="list-style-type: none"> -projector -textbook -internet -lecturenote -tutorial 	<ul style="list-style-type: none"> ▪ - 	-	State the importance of Environmental Monitoring
General Objective 3.0: Know the various sources of water, air and land pollution						
6-7	<p>3.1 Explain the sources of air, water and landpollution in municipal estate, institutional agricultural and industrial set up</p> <p>3.2 List sources of air, water and soil</p> <ul style="list-style-type: none"> - pollutions 	<p>Explain items 3.1-</p> <ul style="list-style-type: none"> • 3.5 	<p>projection</p> <ul style="list-style-type: none"> -textbooks - internet - lecturenotes <p>tutorial</p>	<p>Identify indicators of water pollution</p> <ul style="list-style-type: none"> - BOD 20°C - COD⁵ - nitrates -phosphates 	<p>Guide students to identify indicators of water pollution</p> <ul style="list-style-type: none"> - BOD 20°C - COD⁵ 	<p>Explain the sources of air, water andland pollution in municipal estate, institutional agricultural and industrialset up</p>

	<ul style="list-style-type: none"> -physical -chemical -biological -microbiological <p>3.3 Identify indicators of water pollution</p> <ul style="list-style-type: none"> - BOD 20°C - COD⁵ - nitrates -phosphates -total coliforms -faecal strep <p>3.4 Classify Environmental Hazard underphysical e.g. Noise, vibration, pressure, radiation, heat etc.</p> <p>3.5 Explain the types of hazards arising from:</p> <ul style="list-style-type: none"> - industries - automobiles - wastes and its disposal - farming activities - commercial activities 			<ul style="list-style-type: none"> -total coliforms faecal strep 	<ul style="list-style-type: none"> - nitrates -phosphates -total coliforms faecal strep 	
<p>General Objective 4.0: Know the effects of Environmental Monitoring on Human Health and Ecosystem</p>						

8-10	<p>4.1 Describe simple chemical and microbiological methods of measuring pollutants in air, water and land.</p> <p>4.2 Explain the relationship between environmental pollution, human health eco-system and the general environment.</p> <p>4.3 Explain the terms:</p> <ul style="list-style-type: none"> • ecological disruption • ecotoxicology • pathogen • carcinogen • mutagen • teratogen <p>4.4 Explain ionizing radiation</p> <p>4.5 Explain alpha and beta particles, x-ray and gamma rays</p> <p>4.6 Define non-ionizing radiation and list examples</p> <ul style="list-style-type: none"> • ultraviolet radiation (UV) • near UV • midrange UV • far UV • infrared rays (IR) 	<p>Explain items 4.1-4.8</p>	<p>Projection</p> <ul style="list-style-type: none"> -textbooks - internet - lecture notes <p>tutorial</p>	<ul style="list-style-type: none"> ▪ - 	<ul style="list-style-type: none"> ▪ - 	<p>State the relationship between environmental pollution, human health eco-system and the general environment</p>
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	<ul style="list-style-type: none"> • near infrared rays (IR) • Radio waves <p>4.7 Define and list particulate matter</p> <ul style="list-style-type: none"> • dust • mist • goot • smog • fume • smoke <p>4.8 State the effect of environmental pollution: nuisance and aesthetic insult property damage damage to plants and animals damage to human health damage to human genetic and reproductivesystems</p>					
GENERAL OBJECTIVES 5.0 Understand Environmental Monitoring Procedures						
11	<p>5.1 Describe why effective monitoring is important</p> <p>5.2 State keys to implementing an effective environmental monitoring</p> <p>5.3 Determine what the monitoring strategy will be such as: -Limits and acceptance</p>	<p>Explain items 5.1 -5.7</p>	<p>projection -textbooks - internet - lecture notes tutorial</p>	<p>Determine the following monitoring strategy: -Limits and acceptance level (often based on the products type) -Decide what specifically</p>	<p>Guide students to determine the following: -Limits and acceptance level (often based on the products type) Decide what specifically</p>	<p>Describe why effective monitoring is important</p>

	<p>level(oftenbased on the products type) -Decide what specifically should bemonitored Determine the frequency of monitoring -Discuss problem areas 5.3 Explain how to decide on the type of sampling precaution 5.4 Explain a thorough and procedural datadocumentation 5.5 Explain Validate monitoring procedure 5.6 Explain how to use result to minimize contamination</p>			<p>should be monitored -Evaluate the frequency of monitoring Identify problem areas</p>	<p>should be monitored Guide students to determine the frequency of monitoring Guide students to identify problem areas</p>	
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GENERAL OBJECTIVES 6.0 Understand Methods of Preventing/ Controlling Environmental Pollution						
12-13	<p>6.1 Explain how to carry out awareness campaigns on the effects of pollution.</p> <p>6.2 Explain how to carry out inspection visits (monitoring) to remind potential pollutants of their obligation to society.</p> <p>6.3 Explain the existence of air, water or soil pollution.</p> <p>6.4 Explain the best option in preventing or controlling air, water or soil pollution.</p> <p>6.5 Describe appropriate solutions to environmental pollution problems in urban and rural areas and in temporary settlement</p>	<p>Explain items awareness campaigns on the effects of pollution Carry out inspection visits (monitoring) to remind potential pollutants of their obligation to society and the existence of air, water or soil pollution</p> <p>Explain the best option in preventing or controlling air, water or soil pollution</p> <p>6.5 Describe appropriate solutions to environmental pollution problems in urban and rural areas</p> <ul style="list-style-type: none"> • and in temporary settlement 	<p>- projection</p> <p>-textbooks</p> <p>- internet</p> <p>lecture notes – tutorial</p>	<p>Carry out awareness campaigns on the effects of pollution</p> <p>Carry out inspection visits (monitoring) to remind potential pollutants of their obligation to society</p> <p>Identify the existence of air, water or soil pollution</p>	<p>Guide students to: carry out awareness campaigns on the effects of Pollution</p> <p>-carry out inspection visits (monitoring) to remind potential pollutants of their obligation to society</p> <p>-identify the existence of air, water or soil pollution</p>	<p>Explain the best option in preventing or controlling air, water or soil pollution</p>
GENERAL OBJECTIVE: 7.0 Know the roles of various agencies charged with pollution control / monitoring						
14	<p>7.1 list environmental pollution organizations and agencies at local, state,</p>	<p>list environmental pollution organizations and agencies at local,</p>	<p>projection</p> <p>-textbooks</p> <p>- internet</p>	<p>▪ -</p>	<p>▪ -</p>	<p>list environmental pollution organizations</p>

	<p>national and international levels.</p> <p>7.2 Explain the role of organizations in 5.1 above. Environmental pollution control e.g. National and State Environmental Protection Programme (UNEP)</p> <p>Agencies. United Nations Environmental</p>	<p>state, national and international levels. e.g. National and State Environmental Protection Agencies. United Nations Environmental Programme</p> <ul style="list-style-type: none"> •(UNEP) 	<p>- lecture notes tutorial</p>			<p>and agencies at local and state level</p>
<p>GENERAL OBJECTIVES: 8.0 Know the Legislation Governing Pollution</p>						
	<p>8.1 list environmental pollution control laws in Nigeria.</p> <p>8.2 Explain how to inform environmental pollution control laws regulation, guidelines and standards.</p>	<p>Explain environmental pollution control laws in Nigeria and how to inform environmental pollution control laws regulation, guidelines and standards.</p>	<p>projection</p> <ul style="list-style-type: none"> -textbooks - internet - lecture notes <p>tutorial</p>	<ul style="list-style-type: none"> ▪ - 	<ul style="list-style-type: none"> ▪ - 	<p>list environmental pollution control laws in Nigeria</p>

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Environmental Chemistry II	CODE: 217	Credit Unit: 3.0	CONTACT HOURS: 3 HOURS/WEEK
Goal: This course is designed to provide students with knowledge on how to apply stoichiometry, thermodynamics, and kinetics to physical and chemical changes that affect water quality, the toxicity of metals, as well as solid wastes and contaminated soils.			
YEAR: TWO (2), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 1 HOUR/WEEK	
GENERAL OBJECTIVES			
<p>On completion of this course, the Student should be able to:</p> <ol style="list-style-type: none"> 1.0 Know how to use Stoichiometry, thermodynamics and kinetics to describe the greenhouse effect and global warming 2.0 know how to use Stoichiometry, thermodynamics and kinetics to describe Carbon Dioxide Emission 3.0 Understand the Toxicity of heavy metals paying particular attention to the changes that occur as speciation changes. 4.0 Understand the basic chemistry of soil. 5.0 Understand the application of Chemistry to the solution of Environmental pollution. 			

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
Course: Environmental Chemistry II			Course Code: ESM 217	Credit Unit: 3.0	Contact Hours: 3	
GOAL: This course is designed to provide students with knowledge on how to apply stoichiometry, thermodynamics, and kinetics to physical and chemical changes that affect water quality, the toxicity of metals, as well as solid wastes and contaminated soils.						
Course Specification:			THEORETICAL CONTENT	PRACTICAL CONTENT		
General Objective 1.0: Know how to use Stoichiometry, thermodynamics and kinetics to describe the greenhouse effect and global warming						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Describe black body radiation. 1.2 Describe the earth's energy balance in terms of sources and sinks by comparing how the emission spectra of the sun and the earth are absorbed, reflected, or emitted by the earth's surface and its Atmosphere 1.3 Describe the greenhouse effect and the enhanced greenhouse effect in terms of energy transfer from the sun's input to the earth's output, thermal infra-ray (IR) scattering, and subsequent heating. 1.4 Describe sources and	Explain black body radiation. Describe the earth's energy balance in terms of sources. Describe the greenhouse effect and the enhanced greenhouse effect in terms of energy transfer from the sun's input to the earth's output, thermal infra-ray (IR) scattering, and subsequent heating. Describe sources and sinks of atmospheric CO ₂ (g) and H ₂ O (g). Explain sources and	White Board, Journals, Marker, Multimedia Projector, Laptop, Internet and Textbooks Lab Coat, coveralls safety Glasses with solid sideshields Audio Visual	Carryout experiment on 1.1 using black substances and some materials Visit greenhouse sites and record the effect of sun on the earth surface.	Guide students to: -carryout experiment on 1.1 using black substances and some materials visit greenhouse sites and record the effect of sun on the earth surface.	List the sources and sinks of atmospheric CO ₂ and H ₂ O (g)

	<p>sinks of atmospheric CO₂ (g) and H₂O (g).</p> <p>1.5 Describe sources and sinks of atmospheric gases contributing to the enhanced greenhouse effect.</p> <p>1.6 Compare the importance of atmospheric molecules that contribute to the green house and enhanced greenhouse effects.</p> <p>1.7 Describe sources and sinks of atmospheric aerosols.</p> <p>1.8 Describe the effect of 1.7 on global warming and compare their effect to the effects of greenhouse gases</p>	<p>sinks of atmospheric gases contributing to the enhanced greenhouse effect. and the importance of atmospheric molecules that contribute to the green house and enhanced greenhouse effects. Describe sources and sinks of atmospheric aerosols.</p> <p>Describe the effect of 1.7 on global warming and compare their effect to the effects of greenhouse gases</p>				
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GENERAL OBJECTIVE: 2.0 Understand the use of Stoichiometry, thermodynamics and kinetics to describe CarbonDioxide Emission						
4-5	<p>2.1 Define global warming</p> <p>2.2 List potential consequences of global warming.</p> <p>2.3 Quantify (using the value of Q) global energy use for developed and developing countries, compare proven and estimated energy reserves from different sources (including ethyl hydrates), and relate this information to estimates of global releases of carbon dioxide</p> <p>2.4 Describe variety of schemes for reducing the amount of carbon dioxide emitted.</p> <p>2.5 Explain advantages and disadvantages of each scheme stated in 2.3.</p> <p>2.6 Compare the various forms of solar energy currently contributing to the energy grid giving advantages and disadvantages of each Types</p>	<ul style="list-style-type: none"> • Explain the potential consequences of global warming. Quantify (using the value of Q) global energy use for developed and developing countries, compare proven and estimated energy reserves 	<p>White Board, Journals, Marker, Multimedia Projector, Laptop, Internet and Textbooks Audio Visual</p>	<p>Quantify (using the value of Q) global energy use for developed and developing countries, compare proven and estimated energy reserves from different sources (including ethyl hydrates), and relate this information To estimates of global releases of carbon dioxide</p>	<p>Guide students to Quantify (using the value of Q) global energy use for developed and developing countries, compare proven and estimated energy reserves from different sources (including ethyl hydrates), and relate this information to estimates of global releases of carbondioxide</p>	<p>State potential consequence of global warming</p> <p>List the advantages and disadvantages of hydrogen as a fuel</p> <p>List the advantages and disadvantages of radioactive materials as fuel.</p>

	<p>2.7 Describe the production and properties of the mixture called gasoline, explain why the different components are added to it</p> <p>2.8 Compare quantitatively and qualitatively the Advantages and disadvantages of gasoline, methane, CNG, and the fuel additives methanol, ethanol and their derivatives including synthetic pathways and the energy required to produce them.</p> <p>2.9 Explain the advantages and disadvantages of hydrogen as a fuel.</p> <p>2.10 Explain the advantages and disadvantages of radioactive materials as fuel.</p>					
GENERAL OBJECTIVE: 3.0. Understand the Toxicity of heavy metals paying particular attention to the changes that occur as speciation changes.						
6-7	3.1 Explain common features of the toxicity of heavy metals including speciation, transport, and bioaccumulation.	List heavy metals Explain their proportion and relate them to	White Board, Journals, Marker, Multimedia Projector, Laptop,	Identify hazardous wastes as ignitable, corrosive, toxic or radioactive.	Guide students to identify hazardous wastes as ignitable,	List common features of the toxicity of heavy metals

	<p>3.2 Explain the toxicity, sources, sinks and abatement of elemental mercury, mercury amalgams, mercury from the chloralkaline process, ionic mercury and methyl mercury.</p> <p>3.3 Explain the sources, sinks, abatement and health effects of lead in the 0, +2, and +4 oxidation states</p> <p>3.4 Explain the sources, sinks, abatement, and health effects of</p>	<p>their toxicity</p> <ul style="list-style-type: none"> • potentials 	<p>Internet and Textbooks Audio Visual</p>		<p>corrosive, toxic or radioactive.</p>	<p>List examples of hazardous waste under the following sections Ignitability, corrosivity, toxic or Radioactive</p>
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General Objectives: 4.0 Understand the basic chemistry of soil.						
8-10	<p>4.1 List the organic matter present in the soil.</p> <p>4.2 Explain factors affecting decomposition of organic matter in the soil.</p> <p>4.3 Explain the benefits of organic matter in the soil.</p> <p>4.4 Define cation exchange capacity of soil.</p> <p>4.5 Explain the origin of charges in the soil.</p> <p>4.6 Define Base Saturation of soil</p> <p>4.7 Explain the significance of Base Saturation of soil.</p> <p>4.8 Explain the origin and nature of soil acidity and alkalinity.</p> <p>4.9 List elements presents in the soil.</p> <p>4.10 Explain the benefits of elements listed in 4.9 above.</p> <p>4.11 Identify causes of deficiencies in the soil.</p> <p>4.12 Describe methods for remedying 4.11 above.</p> <p>4.13 Classify fertilizers in accordance with soil requirement, experimentally.</p>	<p>Explain organic matter present in the soil, factors affecting decomposition of organic matter in the soil.</p> <p>Explain the benefits of organic matter in the soil.</p> <p>Define cation exchange capacity of soil.</p> <p>the origin of charges in the soil.</p> <p>Define Base Saturation of soil</p> <p>Explain the significance of Base Saturation of soil.</p> <p>• Explain the origin and nature of soil acidity and alkalinity</p>	<p>White Board, Journals, Marker, Multimedia Projector, Laptop, Internet and Textbooks</p> <p>Audio Visual</p> <p>PH meter, colorimeter, flame Photometer, Atomic Absorption, Spectrophotometer.</p>	<p>Carry out a test of organic matter in the soil.</p> <p>Test soil samples for acidity, alkalinity and element.</p> <p>Determine soil elements e.g. Ca⁺⁺, P, K, Zn, Al³⁺ Na⁺⁺ etc.</p>	<p>Guide students to Carry out test of organic matter in the soil.</p> <p>Guide students to test soil samples for acidity, alkalinity and element.</p> <p>Determine soil elements e.g. Ca⁺⁺, P, K, Zn, Al³⁺ Na⁺⁺ etc</p>	<p>List the factors affecting decomposition of organic matter in the soil</p> <p>Identify the causes of deficiencies in the soil</p> <p>List elements present in the soil.</p>

	4.14 Describe method of applying fertilizers in the soil.					
General Objectives:5.0 Understand the application of Chemistry to the solution of Environmental pollution						
11	<p>5.1 Define the term environment.</p> <p>5.2 List the constituents of ecosystem.</p> <p>5.3 Describe the uses to which man puts water, air and land.</p> <p>5.4 Explain the effects of the activities of man on the quality of the environment.</p> <p>5.5 Explain the on-set (threshold) of environmental pollution.</p> <p>5.6 Define environmental pollution.</p> <p>5.7 List sources of environmental pollution</p> <p>5.8 Explain the uses to which the aquatic</p>	<p>Explain the term environment. Define: -ecosystem. -water, air and land.</p> <p>Explain the effects of the activities of man on the quality of the environment.</p> <p>Explain the on-set (threshold) of environmental pollution.</p> <p>Explain environmental pollution, sources of environmental pollution, water quality, water uses.</p> <p>Explain the parameters</p>	<p>White Board, Journals, Marker, Multimedia Projector, Laptop, Internet and Textbooks Audio Visual PH meter, TDS-meter, Dissolved oxygen meter. COD meter</p>	<p>Visit various ecological areas around the school. Report your findings with reference to pollution, effects of activities of man on the environment etc.</p> <p>Determine dissolved oxygen (DO), PH, Acidity and alkalinity of water.</p> <p>Determine pH, suspended solid, BOD etc.</p> <p>Carry out</p>	<p>Guide students to: -visit various ecological areas around the school. Report your findings with reference to pollution, effects of activities of man on the environment etc.</p> <p>-determine dissolved oxygen(DO), PH, Acidity and alkalinity of water.</p>	<p>List the constituents of ecosystem. List sources of environmental pollution</p> <p>List major sources of water pollution collect and identify water.</p>

	<p>environment is put by man and aquatic organisms.</p> <p>5.9 List sources of environmental pollution</p> <p>5.10 Explain water quality.</p> <p>5.11 Explain how water quality standard varies for the intended water uses.</p> <p>5.12 Describe parameters that are used to assess water quality e.g. dissolved Oxygen (DO), P^H, alkalinity/acidity, hardness, colour, turbidity, metals, etc.</p> <p>5.13 State the units for expressing values of the Parameters in 5.11 above.</p> <p>5.14 Explain the sanitary significance of Parameters determined in 5.12 above.</p> <p>5.15 Explain on-set of water pollution collect</p> <p>5.16 List major sources of water pollution collect and identify water.</p> <p>5.17 Describe natural purification/water assimilation capacity of a</p>	<p>that are used to assess water quality e.g. dissolved Oxygen(DO), P^H, alkalinity/ acidity, hardness, colour, turbidity, metals, etc.</p> <p>Explain on-set of water pollution collect</p> <p>List major sources of water pollution collect and identify water. Explain natural purification/water assimilation capacity of a natural body of water, eutrophication, acid mine drainage. Explain the occurrence of DO in the aquatic environment.</p> <p>Explain the term waste water, types and sources of waste water. effects of controlled discharge of water into the environment, e.g. into a water course.</p>		<p>BOD test and list important uses Of BOD test.</p>	<p>determine pH, suspended solid, BOD etc.</p> <p>-carry out BOD test</p>	
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<p>natural body of water.</p> <p>5.18 Explain eutrophication.</p> <p>5.19 Explain acid mine drainage</p> <p>5.20 List parameters used as water pollution index.</p> <p>5.21 Describe water</p> <ul style="list-style-type: none"> • pollution measures under theFollowing. Water pollution controlbody • Water quality standards • Municipal waste • watertreatment facilities. • Pretreatment of industrialwater <p>5.22 Discuss water pollutants.</p> <p>5.23 Explain the occurrence of DO in the aquatic environment.</p> <p>5.24 Explain the chemistry of DO measure.</p> <p>5.25 Explain the term waste water.</p> <p>5.26 List types and sources of waste water.</p> <p>5.27 Describe effects of controlled discharge of water into the environment, e.g. into</p>	<p>Explain parameters foranalyzing wastewater: e.g. PH, suspended solids,settle able solids,Biochemical oxygen demand (BOD), chemical oxygen demand (COD), etc.</p> <p>5.28 Define BOD(i.e Biochemical Oxygen demand (COD). Etc. Describe theprocedure for BOD test</p> <p>5.30 List important uses of</p>				
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	<p>a water course.</p> <p>5.28 List parameters for analyzing wastewater: e.g. PH, suspended solids, settle able solids, Biochemical oxygen demand(BOD), chemical oxygen demand (COD), etc.</p> <p>5.29 Define BOD (i.e Biochemical Oxygen demand (COD). Etc.</p> <p>5.30 Describe the procedure for BOD test</p> <p>5.31 List important uses of the BOD test. Apply chemical kineticsto the explanation of reactions.</p> <p>5.32 State the formulae for the calculation of BOD results</p> <p>5.33 Define COD (chemical oxygen demand).</p> <p>5.34 List applications of COD data.</p> <p>5.35 Calculate chemical oxygen demand (COD)</p> <p>5.36 Explain the chemistry of COD test</p> <p>5.37 State the formulae for the calculation of result.</p> <p>5.38 Correlate BOD/COD values for waste.</p>					
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	<p>5.39 Define ambient air. 5.40 Explain effects of high undesirable air pollutants on man's health.</p> <p>5.41 List sources of thermal pollution. 5.42 Define once-through cooling. 5.43 explain thermal shock. 5.44 Explain tolerance limit of temperature 5.45 Explain temperature inversion.</p>					
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PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Water and Wastewater Treatment	CODE: ESM 218	Credit Unit: 3.0	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course is designed to provide students with knowledge of basic laboratory water treatment course with emphasis on environmental applications			
YEAR: TWO (2), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 2HOURS/WEEK	

GENERAL OBJECTIVES

On completion of this course, the Student should be able to:

- 1.0 Know the qualities of water
- 2.0 Understand water quality parameters
- 3.0 Know the critical concepts of water chemistry and water treatment
- 4.0 Understand the basic water treatment processes
- 5.0 Know Water Analysis

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY								
COURSE: Water and Wastewater Treatment		Course Code: ESM 218		Credit Unit: 3.0		Contact Hours: 3		
GOAL: This course is designed to provide students with knowledge of basic laboratory water treatment course with emphasis on environmental applications								
Course Specification: hrs				Theoretical Content: 2		Practical Content: 1hr		
GENERAL OBJECTIVE 1.0: Know the qualities of water								
Course Specification:		THEORETICAL CONTENT			PRACTICAL CONTENT			
Week	Specific Outcome	Learning	Teachers' Activities	Learning Resources	Specific Outcome	Learning	Teachers' Activities	Evaluation
1-2	1.1 Define water 1.2 Explain the uses of water 1.3 Describe the different sources of water. 1.4 Explain the meaning of the following terms. <ul style="list-style-type: none"> • Quality • Quality control, • Standard Operating Procedure, <ul style="list-style-type: none"> • Quality Assurance. 1.5 Explain the important qualities of water		Explain water and its uses. List the different sources of water. Explain <ul style="list-style-type: none"> • Quality • Quality control, • Standard Operating Procedure, <ul style="list-style-type: none"> • Quality Assurance using water quality indicators, meaning of potable water 	Chalk and Chalkboard Felt-pen and Magnetic board, and Equipment	<ul style="list-style-type: none"> ▪ - 		<ul style="list-style-type: none"> ▪ - 	State the uses of water What is potable water State the WHO standard for potable water

	<p>1.6 Describe the water quality indicators</p> <p>1.7 Explain the meaning of potable water</p> <p>1.8 State the world health organization standard for Potable water.</p> <p>1.9 State the Federal Ministry of Environment Standard for potable water.</p> <p>1.10 Describe the water cycles.</p>	<p>Explain the world health organization standard for Potable water. State the Federal</p> <ul style="list-style-type: none"> • Ministry of Environment Standard for potable water 				
GENERAL OBJECTIVE: 2.0 Understand various methods of non-biological effluent waste treatment						
3-4	<p>2.1 List different types of insoluble / solid wastes and describe their effects on the environment and ecosystem.</p> <p>2.2 Estimate total organic matter waste and wastewater.</p> <p>2.3 Define Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Total Oxygen Carbon</p>	<p>Explain water quality, demand, usage and sources.</p> <p>Describe the various Chemical parameters used in water quality control and demonstrate their determination of such Parameters as BOD, COD,</p> <ul style="list-style-type: none"> • Acidity, Alkalinity, Water hardness colour etc. 	<p>Chalk and Chalkboard</p> <p>Felt-pen and Magnetic board, and Equipment</p>	▪ -	▪ -	List the chemical parameters used in water quality

	<p>(TOC).</p> <p>2.4 Explain methods of determining BOD, COD and TOC of wastes.</p> <p>2.5 List the possible chemical and biochemical toxic substances in effluents from food and other allied industries.</p> <p>2.6 Explain the principles of physical treatment of wastewater under the following: flocculation, sedimentation, centrifugation, floatation, adsorption, filtration, ultra filtration, and reverse osmosis, electro dialysis.</p> <p>2.7 Explain the principles of chemical treatment of wastewater under the following</p>	<p>Explain the Principles of chemical treatment of wastewater under the following methods: coagulation, emulsion breaking, neutralization, precipitation, chemical oxidation (using ozone, hydrogen peroxide, chlorine etc).</p> <p>Explain the advantages and limitations of each of the processes studied in 2.6 and 2.7 above.</p>				
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	<p>methods:coagulation, emulsion breaking, neutralization, precipitation, chemicaloxidation (using ozone, hydrogen peroxide,chlorine etc).</p> <p>2.8 Explain the advantagesand limitations of each of the processes studied in 2.6 and 2.7 above.</p>					
General Objectives 3.0: Know the critical concepts of water chemistry and water treatment.						
5-6	<p>3.1 Describe concepts of pH, P^{OH}, Kw, acidityand causticity</p> <p>3.2 Explain the concept of alkalinity and buffering</p> <p>3.3 Explain the concepts of temporary and permanent hardness</p> <p>3.4 Explain the concept ofturbidity and it units</p> <p>3.5 Differentiate</p>	<p>Explain conceptsof pH, P^{OH}, Kw, acidity and causticity, the concept of alkalinity and Buffering and the conceptsof temporary and permanent hardness.</p> <p>Use the concept of turbidity and itunits</p> <p>Differentiate</p>	<p>Samples of Water and waste water</p> <p>Conductivity Meter</p> <p>pH Meter</p>	<p>Use the concept of alkalinity and buffering</p> <p>Use the concepts of temporary and permanenthardness</p> <p>Use the concept of turbidity and it units</p> <p>Use the concepts of conductivity and resistively data for</p>	<p>Guide students to:</p> <p>-use the concept of alkalinity and buffering</p> <p>-use the concepts of temporary and permanent hardness</p> <p>-use the concept of turbidity and it units</p> <p>-use the concepts</p>	<p>Differentiate between solutions that contain dissolved and Suspended solids</p>

	<p>between dissolved and suspended solids</p> <p>3.6 Explain the concepts of conductivity and resistivity data for interpreting and predicting water problems</p> <p>3.7 Use the concept of color and its units</p> <p>3.8 Interpret scale deposition analysis</p> <p>3.9 Explain how to use Langelier and Stiff-Davis methods of scale predicting</p>	<p>between dissolved and suspended solids</p> <p>Explain the concepts of conductivity and resistivity data for</p> <ul style="list-style-type: none"> interpreting and predicting water 		<p>interpreting and predicting water problems</p> <p>Use the concept of color and its units</p> <p>Interpret scale deposition analysis</p> <p>Use Langelier and Stiff-Davis methods of scale predicting.</p>	<p>of conductivity and resistivity data for interpreting and predicting water problems</p> <p>-use the concept of color and its units</p> <p>-interpret scale deposition analysis</p> <p>-use Langelier and Stiff-Davis methods of scale predicting.</p>	
GENERAL OBJECTIVE: 4.0 Understand the basic water treatment processes.						
7-9	<p>4.1 Explain the desirable standards of water for domestic and other uses – WHO and other standards.</p> <p>4.2 Explain the reasons for establishing these standards sampling techniques.</p> <p>4.3 Explain methods of water analysis.</p> <p>4.4 Explain the effect of</p>	<p>Explain the WHO, NSDWQ standards for drinking water</p> <p>Explain sampling techniques</p> <p>Describe step by step treatment of water</p> <p>Explain chlorination showing residual</p>	<p>White board, marker, slides, charts and pictures</p> <p>Treatment plant, jar test apparatus, pH meter, DPD tablet, burette, pipette, Atomic absorption spectrophotometer (AAS), s</p>	<p>Collect effluent water samples from the sedimentation, coagulation, filter and chlorination tank and perform experiments on the water samples for colour, odour, taste, turbidity, acidity, alkalinity, hardness heavy metals, nitrate, Total suspended solids,</p>	<p>Guide students to Collect effluent water samples from the sedimentation, coagulation, filter and chlorination tank and perform</p>	<p>Distinguish between all essential water treatment processes and components</p>

	<p>pollutants in water.</p> <p>4.5 Explain municipal watertreatment process</p> <p>4.6 Describe surveillanc and</p>	<p>chlorine and breakpoint chlorination</p>	<p>and pectrophotometer, filter paper, etc.</p>	<p>total dissolved solids, total solids.</p>	<p>experiments on the water samples for colour, odor, taste, turbidity, acidity, alkalinity, hardness heavy metals, nitrate, Total suspended solids, total dissolved solids, total solids.</p> <p>Guide students to visit a water treatment plant</p>	
GENERAL OBJECTIVE: 5.0 Understand various methods of biological waste treatment, recycling and reuse						
10-11	<p>5.1 Explain the principles of biological treatment of wastewater.</p> <p>5.2 Describe the technology and operation of different aerobic biological Wastewater treatment processes:</p> <p>(a) activated sludge</p> <p>(b) aerated lagoon</p> <p>(c) stabilization ponds</p> <p>(d) trickling filters</p>	<p>Explain the principles of biological treatment ofwastewater. And the Technology and operation of different aerobic biological wastewater treatment processes:</p> <p>(a) activated sludge</p>	<p>-projection</p> <p>-Text Books</p> <p>- Internet</p> <p>-Lecture notes</p> <p>-Tutorials</p>	<p>Identify the various methods of water purification</p>	<p>Guide the student in identifying various methods of water purification</p>	<p>List water that may need purification</p>

	<p>(e) oxidation ditches 5.3 Describe the technology and operation of different anaerobic biological Wastewater treatment processes e.g. anaerobi</p>	<p>(b) aerated lagoon • stabilization ponds</p>				
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YEAR TWO, SEMESTER TWO COURSES

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Climate Change	CODE: ESM 221	Credit Unit: 3.0	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course is designed to enable students know the fundamentals of Climate Change			
YEAR: TWO (2), SEMESTER: TWO (2),	PRE-REQUISITE: none	PRACTICAL: 1 HOUR/WEEK	

GENERAL OBJECTIVES

On completion of this course, the Student should be able to:

- 1.0 Understand the Atmosphere
- 2.0 Understand the Concept of Global Warming
- 3.0 Understand Temperature and its Variation
- 4.0 Understand Air and its Variation
- 5.0 Understand Climatic Change and its relationship with the environment.

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
COURSE: Climate Change			Course Code: ESM 211	Credit Unit: 3.0	Contact Hours: 3	
GOAL: This course is designed to enable students know the fundamentals of Climate Change						
Course Specification:			THEORETICAL CONTENT	PRACTICAL CONTENT		
General Objective 1.0: Understand Atmosphere						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Define the atmosphere 1.2 Explain the major climatic factors and instruments for their Measurement 1.3 Describe the composition of the atmosphere 4 Explain the vertical divisions of the atmosphere 1.5 Explain the heat exchange processes of the atmosphere 1.6 Enumerate the effect of gravity on the atmosphere and air density.	Explain the atmosphere and the composition of the atmosphere Explain the vertical divisions of the atmosphere, the heat exchange processes of the atmosphere, Explain the effect of gravity on the atmosphere and air density.	Projector Text books Internet Barograph Thermometer Thermograph Hydrometer Rain gauge Anemometer	Take readings of atmospheric pressure using digital and analogue barograph Measure temperature using thermometer and thermograph Measure relative humidity using hydrometer Measure rainfall using rain gauge Measure wind speed and	Guide students to: -take readings of atmospheric pressure using digital and analogue barograph -measure temperature using thermometer and thermograph -measure relative humidity using hydrometer -measure rainfall using rain gauge	Describe the composition of the atmosphere Explain the heat exchange processes of the atmosphere

				direction using anemometer	-measure wind speed and direction using anemometer	
General Objective 2.0: Understand the concept of Global Warming						
4-5	<p>2.1 Define : Weather, Climate and Global Warming</p> <p>2.2 Explain the causes of global warming</p> <p>2.3 Explain how global warming is linked with extreme weather</p> <p>2.4 Explain carbon sequestration and carbon trading</p> <p>2.5 Explain the consequences and effects of global warming</p> <p>2.6 Explain measures to control global warming and changing environmental conditions</p>	<p>Describe the causes of globalwarming</p> <p>Explain the consequences and effects of global warming</p> <ul style="list-style-type: none"> • Explain how tocontrol global warming and changing environmental conditions 	<p>Projector</p> <p>Text books</p> <p>Internet</p> <p>Tutorial</p>	<ul style="list-style-type: none"> ▪ - 	-	<p>Define Global Warming</p> <p>Explain thecauses of global warming</p> <p>Explain how to control global warming and changing environmental conditions</p>
General Objective 3.0: Understand Temperature and its Variation						
6-7	<p>3.1 Define temperature and surface air temperature</p> <p>3.2 Explain temperature measuring instrument and its</p>	<p>Explain temperature and surface air temperature, the instrument used for</p>	<p>Projector Text books</p> <p>Internet Thermometer</p> <p>Thermograph</p>	<p>Measure temperature using different types of thermometers</p>	<p>Guide students to measure temperature usingdifferent</p>	<p>Define temperature and surfaceair temperature</p> <p>Explain thediurnal variation ofsurface air</p>

	<p>scale of conversion Explain the diurnal variation of surface air temperature</p> <p>3.4 Explain the physical processes used in thermometry.</p> <p>3.5 Describe the working principle of thermograph</p> <p>3.6 Explain the horizontal and vertical variations of air temperature</p>	<p>measuring temperature, temperature scale and its conversion</p> <p>Explain the diurnal variation of surface air temperature, the physical processes use in thermometry</p> <p>Explain the working principle of thermograph and the horizontal and vertical variations</p>			<p>types of thermometers</p>	<p>temperature</p> <p>Describe the working principle of thermograph and the horizontal and vertical variations</p>
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GENERAL OBJECTIVE: 4.0. Understand Air and its Variation						
8-10	<p>4.1 Define moist air</p> <p>4.2 Explain isobaric and adiabatic processes.</p> <p>4.3 Explain moisture indicators</p> <p>4.4 Describe the elementary theory of the wet-bulb thermometer</p> <p>4.5 Explain the working principles of the psychrometer and the hygrometer</p> <p>4.6 Explain the relationship between dry-bulb, wet-bulb and dew-point</p>	<p>Explain moist air</p> <p>Explain isobaric and adiabatic processes.</p> <ul style="list-style-type: none"> • Explain moisture indicators <p>Discuss the elementary theory of the wet-bulb</p>	<p>Projector Text</p> <p>books Internet</p> <p>Wet and dry bulb thermometer</p> <p>Psychrometer</p> <p>Hygrometer</p>	<p>Use wet and dry bulb thermometer to compute the relative humidity</p>	<p>Guide students to compute relative humidity</p>	<p>Explain isobaric and adiabatic processes.</p> <p>Explain the relationship between dry-bulb, wet-bulb and dew-point</p>
General Objective 5.0: Understand climatic change and its relationship with the environment						
11	<p>5.1 Explain Climate variability</p> <p>5.2. Explain Climate change</p> <p>5.3 Mention Natural and Anthropogenic causes of climate change</p> <p>5.4 Explain Greenhouse gases as major driver of climate change</p>	<p>Explain the causes of climate change</p> <p>Describe ocean currents and their effects upon world climate.</p> <p>Describe forests and their roles in climate regulation/mitigation.</p>	<p>Projector Text</p> <p>books Internet</p> <p>Audio visual</p> <p>Charts</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Explain Climate Change</p> <p>Mention causes of climate change</p> <p>Explain Ocean currents and their effects upon world climate</p>

	5 Explain Ocean currents and their effects upon world climate 5.6 Explain the environment and its relationship with climate change					
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PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Solid Waste Management	CODE: ESM 222	Credit Unit: 2	CONTACT HOURS: 2 HOURS/WEEK
GOAL: This course is designed to introduce students to waste management and how to provide a balance between evolution, management regulation technology and scientific aspects of the practical management of waste management			
YEAR: TWO (2), SEMESTER: TWO (2)	PRE-REQUISITE: none	PRACTICAL: 1HOUR/WEEK	
GENERAL OBJECTIVES			
On completion of this course, the Student should be able to:			
1.0 Know the general principle of Solid Wastes Management			
2.0 Understand the methods of on –site handling, storage and processing of solid waste.			
3.0 Know the methods of solid waste collection.			
4.0 Understand the methods of transfer and transportation of solid waste.			
5.0 Understand the methods and equipment for solid waste disposal.			
6.0 Understand the sources and utilization of various forms of energy from solid waste materials.			
7.0 Understand the principles of solid waste treatment/handling at home.			
8.0 Understand the processes of detection and abatement of health nuisances associated with poor waste management..			

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
COURSE: Solid Waste Management			Course Code: ESM 222	Credit Unit: 2.0	Contact Hours: 2	
GOAL: This course is designed to introduce students to waste management and how to provide a balance between evolution, management regulation technology and scientific aspects of the practical management of waste management						
Course Specification:			THEORETICAL CONTENT	PRACTICAL CONTENT		
General Objective 1.0: General Objective 1.0 Know the General principle of Solid Wastes Management						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 State the need for solid waste management. 1.2 Describe sources and types of solid waste. 1.3 Explain the composition of solid waste. 1.4 Describe the generation rates of 1.3 above. 1.5 Classify modes of measurement of 1.4 e.g i) measure of quantity. ii) Statistical analysis of generation rate. 1.6 List factors affecting generation rate.	Explain the need for solid waste management. Explain sources and types of solid waste. Explain the composition of solid waste. Describe the generation rates of solid waste. Classify the modes of measurement e.g.: measurement of quantity & statistical analysis of generation rate. List factors	Chalk and Chalkboard Magnetic board and felt pen	▪ -	▪ -	List the various sources and types of waste generated in your area

		affecting generation rate.				
General Objective 2.0: Understand the methods of on –site handling, storage and processing of solid waste						
4-5	<p>2.1 Explain public health and aesthetics.</p> <p>2.2 Describe the method of on-site handling for</p> <p>i) Residential premises.</p> <p>ii) Commercial premises.</p> <p>2.3 Describe the method of on-site storage.</p> <p>2.4 Describe the methods of on-site processing e.g. grinding, compaction, shredding, composting, etc.</p>	<p>Explain public health and aesthetics</p> <p>Describe the method of on – site handling for:</p> <p>(i) residential premises</p> <p>(ii) Commercial premises.</p> <p>Describe the methods of on – site processing e.g. grinding, compaction composting, etc.</p>	Magnetic board and felt pen	▪ -	-	Describe the method of on-site storage
General Objectives 3.0: Know the methods of solid waste collection.						
6-7	<p>3.1 Describe collection services.</p> <p>3.2 Describe collection systems, equipment and labour requirement.</p> <p>3.3 List collection systems e.g. hauled container</p>	<p>Describe collection services</p> <p>Describes collection systems equipment and labour requirement.</p>	Felt pen and magnetic board field trips etc.	<p>Analyse solid waste collection systems.</p> <p>Determine solid waste collection routes.</p>	<p>Guide students to:</p> <p>-analyse solid waste collection systems.</p> <p>determine solid waste collection routes.</p>	List the equipment used in the collection of waste-

	<p>system and stationary container system.</p> <p>3.4 Analyse collection systems.</p> <p>Determine collection routes.</p>	<ul style="list-style-type: none"> Analyse collection systems, and determine collection routes 				
General Objective 4.0: Understand the methods of transfer and transportation of solid waste						
8-10	<p>4.1 Explain the need for transfer operations.</p> <p>4.2 Describe transfer stations.</p> <p>4.3 Describe transport means and methods.</p> <p>4.4 Describe location of transfer stations.</p>	<p>Explain the need for transfer operations.</p> <p>Describe transfer stations.</p> <p>Describe location of transfer stations.</p> <p>Describe transportation incomes and methods.</p>	<p>Chalk and chalkboard felt pen and magnetic board field trips etc</p>	▪ -	▪ -	<p>Explain the need for transfer operations</p>
General Objectives 5.0: Understand the methods and equipment for solid waste disposal.						
11	<p>5.1 Explain solid waste disposal by sanitary landfill method.</p> <ul style="list-style-type: none"> Equipment Supervision Process <p>5.2 Dispose solid waste by incineration.</p> <p>5.3 Describe solid waste disposal by open dumps and its potential health</p>	<p>Describes solid wastes disposal by sanitary land fill method.</p> <ol style="list-style-type: none"> factors in choice of site equipment supervision process. <p>Describe solid waste disposal by incineration.</p>	<p>felt pen and magnetic board field trips etc</p>	▪ -	▪ -	<p>Describe how incinerator is used for waste disposal</p>

	<p>hazard.</p> <p>5.4 Describe deep well disposal.</p> <p>5.5 Describe disposal of radioactive waste.</p>	<p>Describe solid waste disposal by open dumps and its potential health hazards.</p> <p>Describe deep well disposal. Describe disposal of radioactive waste.</p>				
General Objective 6.0: Understand the sources and utilization of various forms of energy from solid waste materials						
12-13	<p>6.1 Explain the principles of conservation of energy.</p> <p>6.2 List the forms of energy available in solid wastes.</p> <p>6.3 Explain the process of energy conversions in 6.2 above.</p> <p>6.4 Explain how to identify materials that can be recycled e.g. waste paper, metal scraps, X-ray materials etc.</p> <p>6.5 Describe land reclamation process.</p>	<p>Review the principles of conservation of energy.</p> <p>List the forms of energy available in solid wastes.</p> <p>Explain the process of energy conversions in 6.2.</p> <p>Identify the materials that can be recycled e.g. waste paper, metal scraps, X-ray materials etc.</p> <p>Describe land reclamation process.</p>	felt pen and magnetic board and equipment	<p>Identify materials that can be recycled e.g. waste paper, metal scraps, X-ray materials etc.</p> <p>Design a solid waste utilization process</p>	<p>Guide students to:</p> <p>-identify materials that can be recycled e.g. waste paper, metal scraps, X-ray material etc.</p> <p>design a solid waste utilization process</p>	<p>List the types of energy that can be generated through waste</p> <p>Explain the processes involved in the recycling of waste</p>

	<p>6.6 Describe the processing and recovery system</p> <p>6.7 Explain the process of incineration with heat recovery.</p> <p>6.8 Explain pyrolysis in energy conversions.</p> <p>6.9 Design a solid waste utilization process</p>	<p>Describe the processing and recovery process.</p> <p>Explain the process of incineration with heat recovery.</p> <p>Describes pyrolysis in energy conversions.</p> <p>Design a solid waste utilization process</p>				
General Objective 7.0: Understand the principles of solid waste treatment/handling at home.						
14	<p>7.1 Describe various methods of waste treatment e.g.</p> <ul style="list-style-type: none"> ▪ Household grinding ▪ Pulverization ▪ Sorting ▪ Pyrolysis ▪ Feed to animal ▪ Shredding <p>7.2 Describe nuisances associated with solid waste treatment at home.</p>	<p>Describe how to sort waste</p> <p>List public health nuisance associated with poor solid waste management e.g. odour nuisance, fly infestation presence of vermin and rodent etc.</p> <p>Explain how to detect each of the nuisances.</p>	Felt pen and magnetic board and equipment	▪ -	▪ -	Describe how waste can be sorted before disposal
General Objectives 8.0: Understand the processes of detection and abatement of health nuisances associated with poor waste management.						

	<p>8.1 List common nuisances associated with poor waste management.</p> <p>8.2 Explain the process of detecting nuisances caused by 8.1.</p> <p>8.3 Describe the process of nuisance abatement.</p>	<p>• Describe and apply the process of abatement of such nuisances in a named situation.</p>	<p>felt pen and magnetic board and equipment</p>	<p>▪</p>	<p>▪ -</p>	<p>Explain the process of detecting nuisances</p>
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PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Renewable Energy and Sustainability	CODE: ESM 223	Credit Unit: 2.0	CONTACT HOURS: 2 HOURS/WEEK
GOAL: The Course is designed to acquaint students with the role of renewable energy in product and service sectors as well as its importance in the energy chain			
YEAR: TWO (2), SEMESTER: TWO (2)	PRE-REQUISITE: None	PRACTICAL: 0 HOURS/WEEK	

GENERAL OBJECTIVES

On completion of this course, the Student should be able to:

- 1.0 Understand the basic concept of Renewable energy and its various sources
- 2.0 Understand the difference between Renewable and Non-Renewable energy
- 3.0 Understand the Construction of Solar Cells and Fabrication of Solar Modules and their applications
- 4.0 Understand the chemistry of biodiesel
- 5.0 Understand the fundamentals of chemical energy conversion and storage
- 6.0 Understand how passive solar heating, hydro-power and wind power works
- 7.0 Understand the fundamentals of energy sustainability
- 8.0 Understand the main concepts of sustainable energy management

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
COURSE: Renewable Energy and Sustainability		Course Code: ESM 223		Credit Unit: 3.0		Contact Hours: 3	
GOAL: The Course is designed to acquaint students with the role of renewable energy in product and service sectors as well as its importance in the energy chain							
Course Specification: hrs				Theoretical Content: 2		Practical Content: 1 hr	
GENERAL OBJECTIVE 1.0: Understand the basic concept of Renewable energy and its various sources							
Course Specification:				THEORETICAL CONTENT		PRACTICAL CONTENT	
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation	
1-2	1.1 Define energy 1.2 Explain sources and uses of energy 1.3 Explain zero-carbon or low-carbon energy 1.4 State the six most common types of renewable energy sources; Solar, Wind, Hydro, Tidal etc.	Explain energy, sources and uses of energy Explain zero-carbon or low-carbon energy List out the six most common types of renewable energy sources; Solar, Wind, Hydro, Tidal	Laptop White board Text Books Internet Projector Lecture Notes	▪ -	▪ -	Define renewable energy	
GENERAL OBJECTIVE 2.0: Understand the difference between Renewable and Non-Renewable energy							
3-4	2.1 Define Renewable and Non-Renewable energy 2.2 State examples of common types of	Explain Renewable and Non-Renewable energy with examples of common types of	Laptop White board Text Books Internet Projector Lecture Notes	▪ -	▪ -	Differentiate between renewable and non-renewable energy	

	renewable and non- 2.3 renewable sources State the advantages and disadvantages of renewable and non- renewable energy 2.4 Differentiate between renewable and non- renewable energy	<ul style="list-style-type: none"> renewable and non- renewablesources 				
GENERAL OBJECTIVE: 3.0. Understand the Construction of Solar Cells and Fabrication of Solar Modules and their Applications						
5-6	3.1 Explain the concepts of Solar Cells 3.2 List Types of Solar Cells 3.3 Explain Generation of power from solar cells 3.4 Explain solar cells fabrication techniques 3.5 Explain solar module fabrication 3.6 List various types of solar modules	Explain concepts of Solar Cells, Types of Solar Cells, Generation of power from solar cells, solar cells fabrication techniques 3.7 Explain solar module fabrication List various types of solar modules	Laptop White board Text Books Internet Projector Lecture Notes	fabricate solar cells	Guide student to carry out practical to fabricate solar cells	List types of solar cells List various types of solar modules

GENERAL OBJECTIVE 4.0: Understand the chemistry of biodiesel						
7-9	<p>4.1 Define biodiesel</p> <p>4.2 Explain sources and processing of bio diesel (fatty acid methyl ester)</p> <p>4.3 Explain the nature of lipids especially fatty acids and glycerides</p> <p>4.4 Define fats and oil</p> <p>4.5 State the similarities and differences of fat and oil using the chemical formula and structural formula</p> <p>4.6 State sources and characteristics of lipids for use as biodiesel feedstock and conversion of feedstock into biodiesel (transesterification)</p> <p>4.7 Describe the use of vegetable oil (SVO) and waste vegetable oil (WVO)</p> <p>4.8 Describe the use of biodiesel</p> <p>4.9 Differentiate between Biodiesel and Petro diesel</p>	<p>Explain biodiesel</p> <p>Explain sources and processing of bio diesel (fatty acid methyl ester)</p> <p>Explain the nature of lipids especially fatty acids and glycerides</p> <p>Define fats and oil</p> <p>State the similarities and differences of fat and oil using the chemical formula and structural formula</p>	<p>Lecture notes</p> <p>Related Journals and Materials</p> <p>Internet.</p> <p>Reagents such as: potassium hydroxide, sodium hydroxide ethanol and sodium methoxide, biomass such as waste cooking oil, sugar cane jatropha curcas and mill for grinding the grains and seeds, Soxhlet extractor</p>	<p>Identify the various sources of lipids used for the production of Biodiesel</p> <p>Demonstrate Transesterification process for the conversion of biomass into biodiesel</p>	<p>Guide students to:</p> <p>-identify the various sources of lipids used for the production of biodiesel</p> <p>-demonstrate transesterification process for the conversion of biomass into biodiesel</p>	<p>Differentiate between Biodiesel and Petro Diesel</p> <p>Outline the use of biodiesel</p>

GENERAL OBJECTIVE 5.0: Understand the fundamentals of chemical energy conversion and storage						
10-11	5.1 Define battery 5.2 State the different types of batteries: - Primary batteries (zinc carbon cells, alkaline batteries, silver oxide batteries, zinc air lithium batteries, etc) - Secondary batteries (Lead acid batteries Nickel Cadmium batteries, Lithium ion batteries and lithium polymer batteries) 5.3 State the properties of Primary and secondary batteries and their uses 5.4 Describe Reduction and Oxidation reaction using equation (REDOX) 5.5 State the difference between super capacitor and capacitor 5.6 Define fuel cell 5.7 Describe different	Explain different types of batteries: -Primary batteries (zinc carbon cells, alkaline batteries, silver oxide batteries, zinc air lithium batteries, etc) Explain Secondary batteries (Lead acid batteries Nickel Cadmium batteries, Lithium ion batteries and lithium polymer batteries) Explain the properties of Primary and secondary batteries and their uses. Describe different types of fuel cells Proton exchange membrane fuel cell (PEMFC) Direct methanol fuel cells (DMFC)	Text books Lecture notes Related Journals and	construct a battery	Demonstrate to student how to construct a battery	Define fuelcell Differentiate between batteries and fuel

	<p>types of fuel cells Proton exchange membrane fuel cell (PEMFC) Direct methanol fuel cells (DMFC) Phosphoric acid fuel cells (PAFC) Solid oxide fuel cells (SOFC) Molten carbonate fuel cells (MCFC)</p> <p>5.8 Differentiate between batteries and fuel cells</p> <p>5.9 Define solar energy</p> <p>5.10 Describe the types of Solar cells Crystalline silicon (Poly silicon or mono silicon) Thin film solar cell Organic photovoltaic cell</p>	<p>Phosphoric acid fuel cells (PAFC) Solid oxide fuel cells (SOFC) Molten carbonate fuel cells (MCFC)</p> <p>Explain the differences between batteries and fuel cells</p> <p>Explain the types of Solar cells Crystalline silicon (Poly silicon or mono silicon) Thin film solar cell Organic photovoltaic cell</p>				
GENERAL OBJECTIVE 6.0: Understand how passive solar heating, hydro-power and wind power works						
12-14	<p>6.1 Explain the following- passive solar heating, hydro-power and wind power</p> <p>6.2 State how 6.1 works</p> <p>6.3 Describe the general characteristics of</p>	<p>Explain passive solar heating, hydro-power and wind power</p> <p>Describe the general characteristics of</p>	Text books Lecture notes Related Journals and materials Internet.	▪ -	▪ -	State the advantages of passive solar heating, hydro power and wind power

	<p>solar power, hydro-power and wind power</p> <p>6.4 List the advantages and disadvantages of passive solar heating, hydro-power and wind power</p>	<p>solar power, hydro-power and wind power</p> <p>List the advantages and disadvantages of passive solar heating, hydro-</p> <ul style="list-style-type: none"> • power and wind power 				
General Objective 7.0 Understand the fundamentals of energy sustainability						
	<p>7.1 Define energy</p> <p>7.2 Define the operation of renewable energy.</p> <p>7.3 Explain sustainability in terms of basic electrical and physical principles</p> <p>7.4 List three (3) factors that determine energy sustainability</p> <p>7.5 Describe how plant materials (Biomass) are renewable and sustainable in the following e.g;</p> <p>(a) The conversion of waste plant materials or animal manure to</p>	<p>Explain energy as the operation of renewable energy.</p> <p>Explain sustainability in terms of basic electrical and physical principles</p> <p>Explain three (3) factors that determine energy sustainability and how plant materials (Biomass) are renewable and sustainable in the</p>	<p>Journal, Audio visual,</p> <p>Related textbooks.</p>	<ul style="list-style-type: none"> ▪ - 	<ul style="list-style-type: none"> ▪ - 	<p>List three (3) factors that determine energy sustainability</p>

	<p>methane gas by anaerobic bacteria, and the methane gas is burned either for heat or to make electricity.</p> <p>(b) The conversion of grain such as corn to ethanol through sugar fermentation. And how the ethanol is mixed with gasoline or fossil fuel before being burned in an automobile.</p>	<p>following e.g;</p> <p>(a) The conversion of waste plant materials or animal manure to methane gas by anaerobic bacteria, and the methane gas is burned either for heat or to make electricity.</p> <p>(b) The conversion of grain such as corn to ethanol through sugar fermentation. And how the ethanol is mixed with gasoline or fossil fuel before being burned in an automobile.</p>				
General Objective 8.0 Understand the main concepts of sustainable energy management						
	<p>8.1 Explain sustainable energy management.</p> <p>8.2 Explain</p>	<p>Explain items 8.1-8.4</p>	<p>Journal, Audio visual, Related textbooks.</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Explain Energy management and environment</p>

	<p>Energy management and environment</p> <p>8.3 Differentiate between renewable and sustainable energy.</p> <p>8.4 Describe when is energy said to be sustainable</p>					
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PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Pests and Pest Control	CODE: ESM 224	Credit Unit: 3.0	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course is designed to enable students understand Pests and Pests' Control in environment			
YEAR: TWO (2), SEMESTER: TWO (2)	PRE-REQUISITE: none	PRACTICAL: 2 HOURS/WEEK	

GENERAL OBJECTIVES

On completion of this course, the Student should be able to:

- 1.0 Know the agents called pests and diseases spread by them in our environment
- 2.0 Know how to identify animals, crops, persons and environment suffering from pest infestations
- 3.0 Understand the menace and damage caused by pests
- 4.0 Understand the various ways of controlling pests and pests' diseases
- 5.0 Know agents and techniques of general pest control in special environments like airports, beaches and parks.
- 6.0 Understand safety precautions, protective equipment, recognition of the early signs and symptoms of poisoning, first aid resuscitation measures.

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
Course: Pests and Pest Control			Course Code: ESM 224	Credit Unit: 3.0	Contact Hours: 3	
GOAL: This course is designed to enable students understand Pests and Pests' Control in environment						
Course Specification:			THEORETICAL CONTENT	PRACTICAL CONTENT		
General Objective 1.0: Know the agents called pests and diseases spread by them in our environment						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Define Pests 1.2 List examples of pests and pests' diseases relevant to the environment 1.3 Explain internal and external pathogens e.g. bacteria; fungi; viruses. 1.4 Explain the role of mice, rodents, birds, snakes, roaches' pests as agents of diseases.	List examples of pests and pests' diseases relevant to the environment Explain internal and external pathogens e.g. bacteria; fungi; viruses. List pests of relevance in agriculture, recreational environment; homes and offices; airport and seaport etc	Text Books Internet Computer systems Projector Audio Visuals Live and preserved specimens. Hand lens Insect Box	Identify different types of environments. Examine the morphological features of different types of pests.	Guide students to: -identify different types of environments . examine the morphological features of different types of pests	List pests of relevance in agriculture, recreational environment; homes and offices; airport and seaports Explain internal and external pathogens e.g. bacteria; fungi; viruses.

General Objective 2.0 Know how to identify animals, crops, persons and environment suffering from pest infestations						
4-5	2.1 List types of pest infestation and diseases in crops and animals.	<ul style="list-style-type: none"> List types of pest infestation and diseases in crops and animals. 	Textbooks Internet Audio visuals Specimen of crops and animals afflicted with pest infestations and diseases. Farms, ponds	Identify types of infestations caused by pests in crops and animals Carry out a case study in an environment infested with pest transmitted diseases	Guide students to: -identify types of infestations caused by pests in crops and animals -carry out a case study in an environment infested with pest transmitted Diseases	Describe the appearance of pest infestation in animals
GENERAL OBJECTIVE 3.0: Understand the menace and damage caused by pests						
6-7	3.1 Describe the life cycles of pests. 3.2 Describe how knowledge of infective stages in the life cycles of pests is important in pest control.	<p>Explain the life cycles of pests.</p> <p>Explain which stage in life cycles is infective, and can cause damage to hosts.</p> <p>Explain the menace and damage caused by pests</p>	Audio Visuals Internet and computers Farms, ponds, projectors, animal treatment centres etc	Draw the life cycles of various pests	Guide students to draw the life cycles of various pests	Mention damages caused by pests of various types

	Describe the menace and damage caused by pests.	Mention damages caused by pests of various types				
GENERAL OBJECTIVE 4.0 Understand the various ways of controlling pests and pests' diseases						
8-10	<p>4.1 State the control techniques against pests.</p> <p>4.2 Describe how to carry out elimination of alternative host plants.</p> <p>4.3 Describe cultural methods adopted in control of various pests emphasizing their significance.</p> <p>4.4 Mention various factors considered in biological pests control method</p> <p>4.5 Describe integrated or mixed pest control management involving more than one method, named:</p> <ul style="list-style-type: none"> - biological method - cultural method -etc. 	<p>Explain control techniques against pests</p> <p>Describe how to carry out elimination of alternative host plants</p> <p>Explain the various factors considered in biological pests control method</p> <p>Explain various factors considered in biological pests control method.</p> <p>Describe biological pests control method</p> <ul style="list-style-type: none"> • e.g. vaccines and serum used in controlling pest and diseases 	<p>Crop fields, livestock and environments afflicted with infestation pest diseases</p> <p>Farms using cultural practices. Native varieties of crops/animals</p>	<p>Carry out elimination of alternative host using any one or combination of techniques in the control of pests</p> <p>Conduct elimination experiment in controlled environment of the Green House to verify the efficacy of technique.</p>	<p>Guide student to:</p> <ul style="list-style-type: none"> -carry out elimination of alternative host using any one or combination of techniques in the control of pests <p>conduct elimination experiment in controlled environment of the Green House to verify the efficacy of technique.</p>	<p>Mention various factors considered in biological pests control method</p>

GENERAL OBJECTIVE 5.0: Know agents and techniques of general pest control in special environments like airports, beaches and parks.						
11	<p>5.1 Describe the general treatment regimen and procedure for control of pest diseases in animals and plants</p> <p>5.2 Name fumigants and various pesticides used in disinfecting animals, humans and their habitations including churches, mosques, as they taxi on the tarmac, take off or land at the airports.</p> <p>5.3 Describe the types of dangers that pests and human trespassers cause at airports such as:</p> <p>physical damage to external body of aircrafts</p> <ul style="list-style-type: none"> • birds and insects are sucked into the engine • reduced visibility by large numbers of migratory birds and 	<p>Explain pest diseases control programs such as fumigation.</p> <p>Explain the general treatment regimen and procedure for control of pest diseases in animal and plants.</p> <p>Explain fumigants and various pesticides used in disinfecting animals, humans and their habitations</p> <p>Explain control techniques of pest and diseases in special environments like airports, harbours and recreational areas such as beaches and parks</p> <p>Explain various Vertebrate pests in aerodromes.</p>	<p>Videos, projectors and slides, text books, computer systems, internet</p> <p>Organic and inorganic fumigants, insecticides, herbicides, acaricides, used for pests of crops and animals</p>	<p>Practice use of the various techniques in pest control in air travelling</p> <p>Carry out spraying in specified environment using effective remedy for target pest</p>	<p>Guide student to:</p> <p>-practice use of the various techniques in pest control in air travelling</p> <p>carry out spraying in specified environment using effective remedy for target pest</p>	<p>Describe the general treatment regimen and procedure for control of pest diseases in animals and plants</p>

	<p>insects physical occupation of tarmac offices etc.</p> <p>5.4 Describe ways of controlling pest in special environments like airports, harbours and recreational areas such as beaches and parks</p> <p>5.5 Name vertebrate pests in aerodromes e.g. stray animals/livestock (cattle, goats and sheep, pets like cats and dogs and human trespassers) Others are rodents such as; avian pests (egrets, quela, hawks, kites, eagles, sparrows, vultures and reptilian pests i.e. all snakes</p> <p>5.6 Explain how animals and humans constitute huge menace to aeroplanes</p>	<p>Enumerate various types of pests and how they pose danger to aircrafts and personnel.</p>				
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General Objective 60: Understand safety precautions, protective equipment, recognition of the early signs and symptoms of poisoning, first aid resuscitation measures.

12-13	<p>6.1 Describe process of fumigation to adopt in any given environment.</p> <p>6.2 Explain choice of fumigant and safety measures put in place in event of misuse by staff</p> <p>6.3 Explain how mishandling of fumigants can be injurious to staff</p> <p>6.4 Enumerate the precautions necessary for safe use of pesticides.</p> <p>6.5 List the hazards of pesticide use, to man and environment.</p> <p>6.6 Explain the first aid procedures to be adopted in case of pesticide poisoning of humans.</p> <p>6.7 Describe the precautions to be taken in pesticide transportation and storage.</p> <p>6.8 Describe the maintenance of pesticide equipment</p>	<p>Explain process of fumigation to adopt in any given environment.</p> <p>Explain type of chemical and choice of preventive and control methods</p> <p>Explain various ways the choice of chemical in the prevention and control of pests and diseases can become injurious to handlers</p> <p>Explain process of fumigation to adopt in a given environment.</p> <ul style="list-style-type: none"> • Explain type of chemical and choice of preventive and control methods 	<p>Text books Computer systems Internet Projector Samples of fumigants Sprays, Blowers, Dusters, Bellows Samples pesticides formulation</p>	<p>Carry out fumigation of any given environment</p> <p>Carry out the maintenance of basic pesticides equipment.</p>	<p>Guide students to: -carry out fumigation of any given environment</p> <p>carry out the maintenance of basic pesticides equipment</p>	<p>Explain process of fumigation to adopt in a given environment.</p>
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PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Analytical Laboratory Skills II	CODE: ESM 225	Credit Unit: 3.0	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course is designed to expose the students to laboratory techniques that will enable the learner to become competent in the following areas: solubility test, filtration methods, extraction techniques and spectrophotometer analysis			
YEAR: TWO (2), SEMESTER: TWO (2)	PRE-REQUISITE: none	PRACTICAL: 3 HOURS/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <ol style="list-style-type: none"> 1.0 Demonstrate skills in separation techniques, solubility test, functional group analysis, and measurement of radioactivity using counters. 2.0 Select and use suitable filtration methods to separate solids from liquids, and carry out liquid - liquid extraction. 3.0 Demonstrate the separation of an unknown chemical solution mixture containing low and high boiling point impurities, and determination of the boiling points of the main chemical present in the mixture by measuring its boiling during a simple distillation.. 4.0 Prepare and label standard solutions for use in chemical analyses.. 5.0 Determine the concentration of a colored solution using Spectrophotometer. 			

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
COURSE: Analytical Laboratory Skills II			Course Code: ESM 225	Credit Unit: 3.0	Contact Hours: 3	
GOAL: This course is designed to expose the students to laboratory techniques that will enable the learner to become competent in the following areas: solubility test, filtration methods, extraction techniques and spectrophotometer analysis						
Course Specification:			THEORETICAL CONTENT	PRACTICAL CONTENT		
General Objective 1.0: Demonstrate skills in separation techniques, solubility test, functional group analysis, and measurement of radioactivity using counters						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2			Equipment Apparatus Polarimeter Lab coat Coverall Practical note, etc.	1.1 Carry out separation of mixtures for (Determination of total dissolved solids in water samples). 1.2 Identification of anions in solution. 1.2 Carry out solubility test and plot solubility curve. 1.4 Determine the level of hardness in water using Soap solution.	Guide student to conduct items 1.1-1.9	State how solubility test is been carried out State how to determine the concentration of optical active compounds using a polarimeter

				<p>1.5 Carry out acid/base titration.</p> <p>1.6 Carry out redox titration</p> <p>1.7 Determine the concentration of optically active compounds using a Polarimeter.</p> <p>1.8 Carry out functional group analysis (-OH, COOH, C=), sp, Sp², Sp³, etc)</p> <p>1.9 Carry out measurement of radioactivity using Counters</p>		
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General Objective 2.0 Select and use suitable filtration methods to separate solids from liquids, and carry out liquid - liquid extraction						
4-5		•	Equipment Lab coat, Coverall, Practical note etc.	<p>2.1 Carry out a vacuum filtration apparatus using a Buchner funnel.</p> <p>2.2 Filter and wash precipitates from solutions using vacuum filtration (Buchner funnel).</p> <p>2.3 Recognize gravity filtrations and syringe filters as being two commonly used methods for separating solids from liquids.</p> <p>2.4 Safely operate a separatory funnel.</p> <p>2.5 Choose the correct size of</p>	Guide student to conduct items 2.1-2.7	Describe vacuum filtration apparatus

				separatory funnel with respect to the volume of sample used. 2.6 Learn solvent extraction techniques. 2.7 Separate a 2- component mixture into two solid products.		
General Objective 3.0 Demonstrate the separation of an unknown chemical solution mixture containing low and high boiling point impurities, and determination of the boiling points of the main chemical present in the mixture by measuring its boiling during a simple distillation.						
6-7		•	Equipment Lab coat, Coverall, Practical notes etc.	3.1 Assemble laboratory glassware and operate a Simple distillation apparatus. 3.2 Determine the boiling point of the purified chemical present in an impure organic solution after Simple distillation.	Guide student to conduct items 3.1-3.5	Describe distillation apparatus State how to measure atmospheric pressure

				<p>3.3 Measure atmospheric pressure.</p> <p>3.4 Create a distillation graph from the data for the Simple distillation of an organic solution.</p> <p>3.5 Calculate the boiling point of an organic mixture measured by distillation to its equivalent boiling point at 760 mm Hg.</p>		
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General Objective 4.0: prepare and label standard solutions for use in chemical analyses.						
8-10		•	Practical notes	<p>4.1 Calculate the amount of chemicals required to prepare various standard solutions.</p> <p>4.2 Prepare weight/volume standard solutions by serial dilution.</p> <p>4.3 Prepare a % weight/volume standard solution from a primary standard grade chemical.</p> <p>4.4 Label all solutions prepared for use in the laboratory in accordance with WHMIS guidelines by completing a worksite label</p>	Guide student to conduct items 4.1-4.6	Calculate the weight/volume of a standard solution

				<p>for each solution prepared.</p> <p>4.5 Submit solutions for testing and store solutions for later use.</p> <p>4.5 Express the amount of a chemical present in a solution in common units of concentration.</p>		
General Objective 5.0: Determine the concentration of a colored solution using Spectrophotometer.						
11			Equipment Lab coat, Coverall, Practical note	<p>5.1 Operate a Spectronic 20D+ Spectrophotometer.</p> <p>5.2 Identify the proper care of cuvettes.</p> <p>5.3 Measure the %T of a solution.</p> <p>5.4 Calculate the Absorbance of</p>	Guide student to conduct items 5.1-5.6	Describe how to operate a spectronic 20D+ spectrophotometer

				<p>a solution from its measured %T value.</p> <p>5.5 Determine the concentration of unknown solutions using a Spectronic 20D+ instrument.</p> <p>5.6 Use back calculation to determine the mass of analyte in the original samples</p>		
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REQUIRED LABORATORIES/WORKSHOP/ MINIMUM EQUIPMENT FOR ND/HND ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY

S/N	Description of item	
A	WATER and WASTE-WATER LABORATORY	
	Toxic gas monitor with accessories for CO, NO,NO ₂ , H ₂ S	1 each
1	Sound level indicator with analogue display measuring 40-120Db	1
2	Spectrometer (student-type)	1
3	Environmental Multi-meter with accessories	1
4	Soil pH meter	1
5	General Purpose Soil auger	1
6	Soil conductivity meter	1
7	Hygrometer with graduated scales -5 to 150x 1 ⁰ C, 140mm length of scale, accuracy +5 to 20%	1
8	Portable anemometer for air speeds of 50 – 1000 m/m	1
9	Geiger Counter	1
10	Barometer with digital thermometer, range 945 to 1045 mbar, Accuracy 1 mbar, Temperature range – 20 to 60oC, Battery Operated	1
11	Meteorological station(equip with weatherequipment)	1
12	Bio-system kit covering experiments on respiration, Photosynthesis, transpiration, osmosis, enzymes, And gas analysis	1
13	Electric Clinostat, 220 – 240V, 50 - 60 Hz, SW.	2no.(each)
14	Toxic gas monitor with accessories for CO, NO,NO ₂ , H ₂ S	1no.each
15	Sound level indicator with analogue display measuring 40-120Db	2no
16	Water quality meter to measure p , conductivity/Salinity, dissolved oxygen, temperature and turbidity (Conductivitymeter)	1no.
17	Water quality field test kit covering thefollowing tests:- <ul style="list-style-type: none"> • Alkalinity, 0.5 – 8ppm • Chloride, 2 – 100 ppm 	2no

	Hardness, 2 – 100 ppm Sulphite, 2 - 50 ppm	
18	Water Colorimetric field test kit covering the following test:- 1.0 Ammonia/Nitrogen, 0.5 – 8 ppm 2.0 Chlorine (DFD), 0.1 – 8 ppm 3.0 Chromate, 5 – 40 ppm 4.0 Iron, 0.1 – 10 ppm 5.0 PH (wide range), 3 - 10 6.0 Phosphate, ortho, 0 – 4 ppm; 5 – 250 ppm Zinc, 0.5 – 10 ppm.	1 no.
19	Water titrimetric field test kit covering the following test:- • Alkalinity (total), 0 – 500 ppm • Colour, 0 – 100 units • Cyanide, 0 – 1 ppm • Hardness (low range), 0 – 10 ppm • Hardness (High range), 0 – 500 ppm • Dissolved oxygen, 0.04 – 20 ppm Sulphate, 1 – 750 ppm Turbidity, 5 – 100 JIM (AAS)	1 no.
B	<u>ENVIRONMENTAL BIOLOGY LABORATORY</u>	
	Description	__Qty Required
1.	Binocular Microscope -	15 No.
2	Prepared slides of Animal cells/tissues (various types)	50 No
3	Prepared slides of plants cells/tissues (various types)	50 No
4	Plain slides (plastic)	100 No
5	Petri-dishes (plastic/disposable)	200 No
6	Autoclave	2 No
7	Hot-Air Oven	1 No

8	Incubator	1No
9	Water-bath	2No
10	Vacuum pump	2No
11.	Inoculation needles (straight or loop)	10No
12.	Colony counter	2No
13.	Bunsen Burner	15No
14.	Hot Plate	2No
15.	Electronic Balance	2No
16.	Staining rack	2No
17.	pH meter	2No
18.	Bench top	Assorted.
19.	Electric blender	2No
20.	Refrigerator	1No
21.	Durham tubes	50No
22.	Measuring cylinder (various sizes)	Assorted
23.	Glassware (test-tubes, conical flasks, beakers, (of various sizes)	Assorted
24.	Pipettes/bulb pipettes (of various capacities)	Assorted
25.	Electric shaker	2No
26.	Electric/magnetic stirrers	2No
27.	Thermometer	20No
28.	Quad rat	10No
29.	Insect net	5 sets
30.	Pooter	2No
31.	Plankton net	2No
32.	Sprinker	5No
33.	First Aid Box	1

34.	Fire extinguisher	1
35.	Technologist office	1
36.	Preparatory room	1
37.	Store	1
C	<u>CHEMISTRY LABORATORY</u>	
S/NO.	Description	QTY
1	Column Chromatograph	2no.
2	Vacuum Desiccators	2no.
3	Bunsen Burner (general purpose)	10no.
4	High speed centrifuge	2no.
5	Water-still Mane-sty 220/240V	1no.
1.	Copper Voltammeters with electrodes	1no.
2.	Electrochemical cell	2no.
3.	Electrolysis cell, OHP	2no.
4.	Hoffman Voltammeter	1no.
5.	Muffle furnace	1no.
6.	Hot plates	2no.
7.	Glasswares	Various capacities(assorted)
8.	Deionizer	1
9.	First aid box	1
10.	Fire extinguisher	1
11.	Technologist office	1
12.	Preparatory Room	1
13.	Store	1
14.	CONSUMABLES	
D	<u>Hydrology Laboratory</u>	
	Description	Q TY
1	Evaporation gauge	1

2	Hydrology apparatus	1
3	Hydrometer	1
4	Stream guage	1
5	Rain guage	
6	Model Sedimentation tank (IMPROVISED)	1
7	Portable pressure meter	1
8	Digital indicator (hand type)	1

(1)WORKSHOPS

(A) SAFETY WORKSHOP

S/No.	Description	Qty
1.	Eye protection spectacles: - general purpose grade 2 impact	30NO
		15no.
2	Eye protection goggles: - grade 2 impact - chemical, type C - dust, type D - gas, type G molten metal, type M	15no.each

3	<p>Face shields:</p> <ul style="list-style-type: none"> -grade 2 impact, C resistance - grade 2 impact, C and M resistance -grade 1 impact, C and M resistance -Ultraviolet 	5 each
4	Eye wash assembly	2
5	<p>Fire extinguishers</p> <ul style="list-style-type: none"> - BCF dry powder - BCF 	3each
6	First aid kit (up to 30 persons)	3
7	Resuscitator (Brook airway)	5
8	Lifting manikin model	1
9	<p>Safety hand gloves:</p> <ul style="list-style-type: none"> - sterile types - non-sterile types Heat/cold resistance type 	Assorted (1stream of 30students)
10	<p>Hazard warning labels:</p> <ul style="list-style-type: none"> - Chemical (corrosive, flammable, irritant, toxic) - general (laser beam, radiation, radioactive, toxic) 	1no symboleach
11	<p>Protective coats:</p> <ul style="list-style-type: none"> - flame retardant chemical resistant 	(1steam of 30 students)
12	Dust/mist/fumes masks	5 each
13	<p>Respirators:</p> <ul style="list-style-type: none"> - dust/mist type - mercury vapour type - nuisance odor - organic vapour 	2pack 3 3

	acid gas	3 2
14	Safety caps (Hard hats)	30
15	Leather aprons	15
16	Fire buckets	5

B Surveying Equipment Store

S/No.	Description	Qty
1.	10 Second Total Station and Accessories	2no.
2.	Abney level	5no.
3.	Prismatic compass with tripods	3no.
4.	Hand held apparatus	5no.
5.	Clinometers	2no.
6.	Digital levelling instruments with accessories	2no.
7.	Pantograph (Small and big sets)	2each
8.	Telescopic Alidades (sighting rule)	2no.
9.	Ranging poles	3no.
10.	Pentium based computers with accessories	15no.
11.	Digital Theodolites	5no.
12.	Assorted relevant software	1no.
13.	Surveying Umbrella	5no.
14.	Staves	5no.
15.	Steel arrows	3no.
16.	Planimeters	5no.
17.	Pocket altimeter	5no.
18.	Tapes (30m, 50m, 100m)	5 each
19.	Optical square	5no.

(C) Remote Sensing Equipment

S/No.	Description	Qty
1.	Stereoscopes:- - Pocket Stereoscope - Mirror Stereoscope - Dual mirror Stereoscope Interpretoscope	1
2.	Densimeter`	1
3.	Slicer	1
4.	Scanner	1
5.	Aero-Sketchaster	1
6.	Photogrametric equipment	1
7.	Aerial photographs	1
8.	Satellite Imageries	1
9.	Global Positioning System	1
10.	Geographic Information System software (GIS)	1
11.	Computer Hardware and Software	1

Computer Studio

(2) WORKSHOPS

(A) SAFETY WORKSHOP

S/No.	Description	Qty
1.	Eye protection spectacles: - general purpose grade 2 impact	30NO

		15no.
2	<p>Eye protection goggles:</p> <ul style="list-style-type: none"> - grade 2 impact - chemical, type C - dust, type D - gas, type G <p>molten metal, type M</p>	15no.each
3	<p>Face shields:</p> <ul style="list-style-type: none"> -grade 2 impact, C resistance - grade 2 impact, C and M resistance -grade 1 impact, C and M resistance -Ultraviolet 	5 each
4	Eye wash assembly	2
5	<p>Fire extinguishers</p> <ul style="list-style-type: none"> - BCF dry powder <p>BCF</p>	3each
6	First aid kit (up to 30 persons)	3
7	Resuscitator (Brook airway)	5
8	Lifting manikin model	1
9	<p>Safety hand gloves:</p> <ul style="list-style-type: none"> - sterile types <p>non-sterile types Heat/cold resistance type</p>	Assorted (1stream of30students)
10	<p>Hazard warning labels:</p> <ul style="list-style-type: none"> - Chemical (corrosive, flammable, irritant, toxic) <p>general (laser beam, radiation, radioactive, toxic)</p>	1no symboleach
11	<p>Protective coats:</p> <ul style="list-style-type: none"> - flame retardant 	(1steam of 30students)

	chemical resistant	
12	Dust/mist/fumes masks	5 each
13	Respirators: <ul style="list-style-type: none"> - dust/mist type - mercury vapour type - nuisance odor - organic vapour acid gas	2pack3 3 3 2
14	Safety caps (Hard hats)	30
15	Leather aprons	15
16	Fire buckets	5

B Surveying Equipment Store

S/No.	Description	Qty
1.	10 Second Total Station and Accessories	2no.
2.	Abney level	5no.
3.	Prismatic compass with tripods	3no.
4.	Hand held apparatus	5no.
5.	Clinometers	2no.
6.	Digital levelling instruments with accessories	2no.
7.	Pantograph (Small and big sets)	2each
8.	Telescopic Alidades (sighting rule)	2no.
9.	Ranging poles	3no.
10.	Pentium based computers with accessories	15no.
11.	Digital Theodolites	5no.
12.	Assorted relevant software	1no.
13.	Surveying Umbrella	5no.
14.	Staves	5no.
15.	Steel arrows	3no.

16.	Planimeters	5no.
17.	Pocket altimeter	5no.
18.	Tapes (30m, 50m, 100m)	5 each
19.	Optical square	5no.

(C) Remote Sensing Equipment

S/No.	Description	Qty
1.	Stereoscopes:- - Pocket Stereoscope - Mirror Stereoscope Dual mirror Stereoscope Interpretoscope	1
2.	Densimeter`	1
3.	Slicer	1
4.	Scanner	1
5.	Aero-Sketchaster	1
6.	Photogrametric equipment	1
7.	Aerial photographs	1
8.	Satellite Imageries	1
9.	Global Positioning System	1
10.	Geographic Information System software (GIS)	1
11.	Computer Hardware and Software	1

(A) Computer Studio

S/No.	Description	Qty
1.	Computer (PC)	30
2.	Printer	2
3.	Scanner	2
4.	UPS	30

PRACTICAL GUIDE FOR ND I AND ND II ENVIRONMENTAL SCIENCE AND TECHNOLOGY	
COURSE: INTRODUCTION TO ECOLOGY COURSE CODE: ESM112	
SPECIFIC LEARNING OUTCOME	TEACHERS' ACTIVITIES
1. Identify short and long- life span organism	1. Guide student to carry out practical on the identification of short and long- life span organism
2. carry out practical on plant and animals' population density	2 Guide the student to carry out practical on plant and animals' population density
3 carry out practical to identify types of soil profile.	3. Guide student to carry out practical to identify types of soil profile
4 carry out practical to determine species diversity of a group of organisms using Simpson index	4. Guide student to carry out practical to determine species diversity of a group of organisms using Simpson index
5 Identify different ecological communities	5. Guide the student on how to identify different ecological communities
COURSE: INTRODUCTION TO GEOGRAPHY CODE: ESM 113	
6 Identify special features on igneous rocks.	6. Guide students to identify special features on igneous rocks
7 Identify special features on metamorphic rocks.	7. Guide students to identify special features on metamorphic
8. Identify special features on sedimentary rocks.	9. Guide students to identify special features on sedimentary rocks.
9 Determine porosity and permeability of rock	8 Guide students to determine porosity and permeability of rock
10 Identify recharge and discharge areas	10. Guide students to: - identify recharge and discharge areas

11. Determine water flow directions in confined and unconfined aquifer	11 determine water flow directions in confined and unconfined aquifer
12 Use a potentiometric surface to predict water	12. Use a potentiometric surface to predict water
13. Identify the different types of conformities.	13 Guide students to identify the different types of conformities
14. Identify and differentiate the different types of rock formation.	14 Guide students to identify and differentiate types of rock formations
15. Identify terrestrial, marine and transitional depositional environment	Guide students to identify terrestrial, marine and transitional depositional environment
SECOND SEMESTER YEAR ONE	
COURSE: ANALYTICAL LABORATORY SKILLS I CODE: ESM121	
1.8 Apply laboratory safety rules and procedures. 1.9 Locate safety equipment available in and outside of the laboratory. 1.10 Review WHMS requirements for labeling chemicals in the laboratory. 1.11 Dispose of chemical wastes in a safe and responsible manner. 1.12 illustrate the required emergency response procedures to follow. 1.13 Illustrate the safety Obligation Form to indicate the learner's agreement to follow 1.14 Apply the safety rules and chemical waste disposal practices as a student in the 16. Environmental Technology program.	Guide students to perform 1.1-1.6
2.2 Review storeroom and equipment checkout procedures. 2.4 Obtain tool checks.	Guide students to perform 2.1-2.4

<p>2.5 Take Inventory of assigned locker and drawer.</p> <p>2.6 Identify pieces of common laboratory equipment.</p>	
<p>3.7 Calibrate two different types of electronic analytical balances.</p> <p>3.8 Compare the ease and accuracy of weighing on analytical and top loading balances.</p> <p>3.9 Compare the weight of the same object measured on two different analytical balances.</p> <p>3.10 Weigh out a sample on an analytical balance using two different techniques: “weigh a sample by taring the container” and “weigh a sample in a weigh boat and quantitatively transfer to a container”.</p> <p>3.11 Demonstrate weight loss, over time, due to trace amounts of moisture on damp glassware. Observe the effects of temperature and static electricity on the weight of an object by measuring the weight of an object under different conditions.</p> <p>3.10 Identify when it is appropriate to use a “top loading” or “analytical” balance to</p>	<p>Guide students to perform 3.1-3.8</p>

<p>weigh objects or samples.</p> <p>3.11 Select the correct type of electronic balance to use for a weighing procedure and calculate the acceptable range of mass values for an individual sample weighed on an</p> <p>18. Electronic balance.</p>	
<p>4.4 Calibrate a conductivity meter.</p> <p>4.5 Measure the electrical conductivity of some solutions.</p> <p>4.6 Measure the conductance of brine water standards and graphically determine the NaCl concentration of an unknown sample.</p> <p>3.12 Determine The accuracy and precision of the Analyses</p>	<p>Guide students to perform 4.1-4.4</p>
<p>5.6 Estimate the pH of a solution using P^H paper.</p> <p>5.7 Measure the P^H of different solutions at different temperatures and observe the effect of temperature on the P^H value.</p> <p>5.8 Perform a “2-point calibration” to calibrate a pH meter using 2 buffer solutions, each with a different pH value.</p> <p>5.9 Titrate a solution that contains an unknown amount of hydrochloric acid to</p>	<p>Guide students to perform 5.1-5.5</p>

3. Carry out REDOX titration	Guide student to carry out REDOX titration
COURSE: OCCUPATIONAL SAFETY CODE: ESM 123	
1. carry out practical on proper procedures for the isolation of plant equipment	Guide student to carry out practical on proper procedures for the isolation of plant equipment
2. properly use PPE	Guide student on how to properly use PPE
3. Properly use mechanical and electrical equipment	Guide student on how to properly isolate mechanical and electrical equipment -
4. carry out practical on the use of hearing protection devices	Guide student to carry out practical on the use of hearing protection devices
5. produce electricity using static materials	Demonstrate to student how to produce electricity using static materials
6. Complete a material safety data sheet	Demonstrate how material safety data sheet is completed
7. carry out practical on how dispose Radio Active Material	Guide student to carry out practical on how dispose Radio Active Material
8. carry out CPR using mannequin	Demonstrate to student how to carry out CPR using mannequin
COURSE: INTRODUCTION TO HYDROLOGY CODE: ESM 124	
1. Demonstrate the role of the hydrologist in integrated development	Guide students to: -demonstrate the role of the hydrologist in integrated development
2. Show concept of contaminants hydrology	show concept of contaminants hydrology
3. Show the characteristics of estimating surface runoff and the factors affecting runoff.	Guide students to show the concept of surface runoff, its components and the factors affecting runoff and the method of surface runoff estimation.
4. Draw the mode of formation of precipitation	Guide the students to: draw the mode of formation of precipitation

5. Use instruments to measure different forms of precipitation and how they are used.	-use instruments to measure different forms of precipitation and how they are used.
6. Identify the components of hydrograph and its applications	Guide students to identify the components of hydrograph and its applications
7. Identify the methods of measuring streamflow	Guide students to demonstrate the use of current meter, float and velocity rod in measuring stream flow.
8. Demonstrate the use of current meter, float and velocity rod in measuring stream flow.	
9. Identify flood sites	Guide students to: -identify flood sites
10. Show the possible impacts of flood	-show the possible impacts of flood
11. Determine the methods of flood control	determine the methods of flood control
COURSE: INTRODUCTION TO GEOGRAPHIC CODE: ESM 125	
1. Identify the parts of a total station	Guide students to: -identify the parts of a total station
2. Set up and level a total station over a point	-set up and level a total station over a point -measure
3. Measure horizontal angles by repetition	horizontal angles by repetition -record
4. Record observations in standard field notes format	observations in standard field notes format
5. Use the total station to measure the zenith angle and the slope distance between 2 points	Guide students to: -use the total station to measure the zenith angle and the slope distance between 2 points record the observations in a standard field notes

6. Record the observations in a standard field notes format	format -calculate the horizontal distance and vertical difference
7. Calculate the horizontal distance and vertical difference	
8. Perform traverse adjustment	Guide students to: -perform traverse adjustment
9. Perform a traverse survey	Perform a traverse survey
10. Measure and record horizontal angles, vertical angles and slope distance using theodolite	Guide students to measure and record horizontal angles, vertical angles and slope distance using theodolite
11. Operate the receiver	Guide students to: - operate the receiver
12. Use mapping coordinates to locate land features	-use mapping coordinates to locate land features
13. Collect mapping coordinates of land features	-collect mapping coordinates of land features
14. Record the coordinates in a computer spreadsheet	record the coordinates in a computer spreadsheet
15. Determine the accuracy of the data	
16. Carry out a research on a GIS project that relates to	Guide students to: carry out a research on a GIS project that relates to
17. Environmental Technology	relates to Environmental Technology
18. Carry out a research that highlights the major components of the project	-carry out a research that highlights the major components of the project
19. Present the results of a research	-present the results of a research
20. Use georeferenced maps, aerial	Guide students to:

<p>photographs and orthophotos.</p> <p>21. Import digital data in aGIS</p> <p>22. input non-spatial and spatial data (survey and GPS) in the standard field notes format</p>	<p>-use georeferencedmaps, aerial photographs and orthophotos.</p> <p>-import digitaldata in a GIS</p> <p>-input non-spatialand spatial data (survey and GPS) in the standard field notes format</p>
<p>23. Transform GIS data between various map projections</p> <p>24. Edit non-spatial andspatial GIS data</p> <p>25. Manage GIS data</p>	<p>Guide students to:</p> <p>-transform GIS data betweenvarious map projections</p> <p>-edit non-spatialand spatial GIS data</p> <p>-manage GIS data</p>
<p>26. Carry out GIS dataanalysis</p> <p>27. Perform the analysis onthe data</p>	<p>Guide students to:</p> <p>-carry out GISdata analysis</p> <p>-perform the analysis on thedata</p>
<p>28. Plot draft copy(ies) of themap</p> <p>29. Perform quality control ofthe map</p> <p>30. Produce the final map</p>	<p>Guide students to:</p> <p>-plot draft copy(ies) of themap</p> <p>-perform quality control of the map</p> <p>produce the finalmap</p>
<p>31. Determine the accuracy ofvarious map features</p> <p>32. Produce the metadataarecords.</p>	<p>Guide students to:</p> <p>determine theaccuracy of various map features</p>
<p>33. Interpret GIS data for air monitoring andprediction.</p> <p>34. Interpret GIS data for water monitoring andprediction.</p>	<p>Guide students to carry out activities 33-37</p>

35. Interpret GIS data for land monitoring and prediction.	
36. Interpret GIS data for vegetation monitoring and prediction.	
COURSE: ENVIRONMENTAL SAMPLING AND ANALYSIS CODE: ESM 126	
1. Identify types of interferences that are present in sample matrices collected from the environment and their effects on analyses	Guide students to identify types of interferences that are present in sample matrices collected from the environment and their effects on analyses
2. Choose the best sampling strategy for a given situation	Guide students to choose the best sampling strategy for a given situation
3. Determine the type of sampling plan required in a given situation	Guide students to determine the type of sampling plan required in a given situation
4. Select the correct preservation technique and holding time for given a water sample. Select the correct preservation technique and holding time for a given a soil sample	Guide students to: -select the correct preservation technique and holding time for given a water sample. -select the correct preservation technique and holding time for a given a soil sample
5. Identify the unique properties of ground water and how they can interfere with the collection of a representative ground water sample.	Guide students to: -identify the unique properties of ground water and how they can interfere with the collection of a representative ground water sample.
6. Identify the appropriate sampling location for the collection of water	identify the appropriate sampling location for the collection of water
7. Choose the proper sampling equipment and containers to use for soil sampling	Guide students to demonstrate use of soil sieve for soil particle size Guide Students to analyze soil samples
8. Perform soil analysis	

9. Identify examples of natural and anthropogenic sources of air pollution and some of the effects on the environment from air pollution.	Guide students to: -identify examples of natural and anthropogenic sources of air pollution and some of the effects on the environment from air pollution.
10. Identify the four types of decisions that can be made from the study of air pollution and the environment	-identify the four types of decisions that can be made from the study of air pollution and the environment
11. Identify different mechanisms of operations used in air sample collection equipment to collect individual air pollutants or categories from the environment	-identify different mechanisms of operations used in air sample collection equipment to collect individual air pollutants or categories from the environment
12. Measure the concentration of pollutant in a given environmental sample	Guide the students to measure the concentration of pollutant in a given environmental sample
13. Minimize the amount of error in measurements through the application and execution of quality control practices.	Guide students to: -minimize the amount of error in measurements through the application and execution of quality control practices.
14. Acquire data that is valid and legally defensible	acquire data that is valid and legally defensible
15. Identify what a chain of custody is	Guide students to identify what a chain of custody is
FIRST SEMESTER YEAR TWO	
COURSE: ENVIRONMENTAL POLLUTION AND CONTROL CODE: ESM 214	
1. Visit local polluted sites	Accompany student to visit local polluted sites
2. Guide students to identify the major constituents found in the raw oil and gas mixtures.	Describe the steps involved in the exploration for oil and gas deposits in Nigeria.

3. Identify videos on oil exploration, drilling and petroleum phase production	Demonstrate to student using videos on oil exploration, drilling and petroleum phase production
COURSE: ENVIRONMENTAL ASSESSMENT CODE: ESM 215	
1.. Prepare samples of E.I.A., E.A. document formats.	Guide students to: -prepare samples of E.I.A., E.A. document formats.
2. Prepare samples of environmental contract documents.	prepare samples of environmental contract documents.
3. Organise the following: - Effective public participation - Public information and involvement - Participation as a group member	Guide students to organize the following: - Effective public participation - Public information and involvement - Participation as a group member
4. Benefits from an effective public participation programme	Benefits from an effective public participation programme
5. Prepare an environmental assessment (EA) document from results of the impact analysis.	Guide students to -prepare an environmental assessment (EA) document from results of the impact analysis.
6. Prepare a document review of an environmental Assessment Project.	prepare a document review of an environmental Assessment Project.
COURSE: Environmental Monitoring CODE: ESM 216	
1. Identify indicators of water pollution - BOD 20°C - COD ⁵ - nitrates - phosphates - total coliforms fecal strep	Guide students to identify indicators of water pollution - BOD 20°C - COD ⁵ - nitrates - phosphates - total coliforms fecal strep
2.. Determine the following monitoring	Guide students to determine the following:

dioxide	releases of carbondioxide
9. Identify hazardous wastes as ignitable, corrosive, toxic or radioactive.	Guide students to identify hazardous wastes as ignitable, corrosive, toxic or radioactive.
10. Carry out a test of organic matter in the soil.	Guide students to Carry out test of organic matter in the soil.
11. Test soil samples for acidity, alkalinity and element.	Guide students to test soil samples for acidity, alkalinity and element.
12. Determine soil elements e.g. Ca ⁺⁺ , P, K, Zn, Al ³⁺ Na ⁺⁺ etc.	Determine soil elements e.g. Ca ⁺⁺ , P, K, Zn, Al ³⁺ Na ⁺⁺ etc
13. Visit various ecological areas around the school. Report your findings with reference to pollution, effects of activities of man on the environment etc.	Guide students to: -visit various ecological areas around the school. Report your findings with reference to pollution, effects of activities of man on the environment etc.
14. Determine dissolved oxygen (DO), PH, Acidity and alkalinity of water.	-determine dissolved oxygen (DO), PH, Acidity and alkalinity of water.
15. Determine pH, suspended solid, BOD etc.	determine pH, suspended solid, BOD etc.
16. Carry out BOD test and list important uses of BOD test.	-carry out BOD test .
COURSE: WATER AND WASTEWATER TREATMENT	
CODE: ESM 218	
1. Use the concept of alkalinity and buffering	Guide students to: -use the concept of alkalinity and buffering
2. Use the concepts of temporary and permanent hardness	-use the concepts of temporary and permanent hardness
3. Use the concept of turbidity and its units	-use the concept of turbidity and its units

<p>4. Use the concepts of conductivity and resistivity data for interpreting and predicting water problems</p> <p>5. Use the concept of color and its units</p> <p>6. Interpret scale deposition analysis</p> <p>7. Use Langelier and Stiff-Davis methods of scale predicting.</p>	<p>-use the concepts of conductivity and resistivity data for interpreting and predicting water problems</p> <p>-use the concept of color and its units</p> <p>-interpret scale deposition analysis</p> <p>-use Langelier and Stiff-Davis methods of scale predicting.</p>
<p>8. Collect effluent water samples from the sedimentation, coagulation, filter and chlorination tank and perform experiments on the water samples for colour, odor, taste, turbidity, acidity, alkalinity, hardness heavy metals, nitrate, Total suspended solids, total dissolved solids, total solids.</p>	<p>Guide students to Collect effluent water samples from the sedimentation, coagulation, filter and chlorination tank and perform experiments on the water samples for colour, odor, taste, turbidity, acidity, alkalinity, hardness heavy metals, nitrate, Total suspended solids, total dissolved solids, total solids.</p> <p>Guide students to visit a water treatment plant</p>
<p>9. Identify the various methods of water purification</p>	<p>Guide the student in identifying various methods of water purification</p>
<p>YEAR TWO SEMESTER ONE</p>	
<p>COURSE: CLIMATE CHANGE 211 COURSE CODE: ESM</p>	
<p>1. Take readings of atmospheric pressure using digital and analogue barograph</p> <p>2. Measure temperature using thermometer and thermograph</p>	<p>Guide students to:</p> <p>-take readings of atmospheric pressure using digital and analogue barograph</p>

3. Measure relative humidity using hydrometer	-measure temperature using thermometer and thermograph
4. Measure rainfall using rain gauge	-measure relative humidity using hydrometer
5. Measure wind speed and direction using anemometer	-measure rainfall using rain gauge -measure wind speed and direction using anemometer
6. Measure temperature using different types of thermometers	Guide students to measure temperature using different types of thermometers
7. Use wet and dry bulb thermometer to compute the relative humidity	Guide students to compute relative humidity
COURSE: SOLID WASTE MANAGEMENT CODE: ESM 222	
1. Analyse solid waste collection systems.	Guide students to: -analyse solid waste collection systems.
2. Determine solid waste collection routes.	determine solid waste collection routes.
3. Identify materials that can be recycled e.g. waste paper, metal scraps, X-ray materials etc.	Guide students to: -identify materials that can be recycled e.g. waste paper, metal scraps, X-ray materials etc.
4. Design a solid waste utilization process	design a solid waste utilization process
COURSE: RENEWABLE ENERGY AND SUSTAINABILITY CODE: ESM 223	
5. fabricate solar cells	Guide student to carry out practical to fabricate solar cells
6. Identify the various sources of	Guide students to: -identify the

lipids used for the production of Biodiesel 7. Demonstrate Transesterification process for the 8. conversion of biomass into biodiesel	various sources of lipids used for the production of biodiesel -demonstrate transesterification process for the conversion of biomass into biodiesel
9. construct a battery	Demonstrate to student how to construct a battery
COURSE: Pests and Pest Control	CODE: ESM 224
1. Identify different types of environments.	Guide students to: -identify different types of environments.
2. Examine the morphological features of different types of pests.	examine the morphological features of different types of pests
3. Identify types of infestations caused by pests in crops and animals Carry out a case study in an environment infested with pest transmitted diseases	Guide students to: -identify types of infestations caused by pests in crops and animals -carry out a case study in an environment infested with pest transmitted Diseases
4. Draw the life cycles of various pests	Guide students to draw the life cycles of various pests
5. Carry out elimination of alternative host using any one or combination of techniques in the control of pests	Guide student to: -carry out elimination of alternative host using any one or combination of techniques in the control of pests

6. Conduct elimination experiment in controlled environment of the Green House to verify the efficacy of technique.	conduct elimination experiment in controlled environment of the Green House to verify the efficacy of technique.
7. Practice use of the various techniques in pest control in air travelling	Guide student to: -practice use of the various techniques in pest control in air travelling
8. Carry out spraying in specified environment using effective remedy for target pest	carry out spraying in specified environment using effective remedy for target pest
9. Carry out fumigation of any given environment	Guide students to: -carry out fumigation of any given environment
10. Carry out the maintenance of basic pesticides equipment.	carry out the maintenance of basic pesticides equipment
COURSE: ANALYTICAL LABORATORY SKILLS II CODE: ESM 225	
1.3 Carry out separation of mixtures for (Determination of total dissolved solids in water samples). 1.2 Identification of anions in solution.	Guide student to conduct items 1.1-1.9
1.4 Carry out solubility test and plot solubility curve.	
1.4 Determine the level of hardness in water using Soap solution.	
1.10 Carry out acid/base titration.	
1.11 Carry out redox titration	
1.12 Determine the	

<p>concentration of optically active compounds using a Polarimeter.</p> <p>1.13 Carry out functional group analysis (-OH, COOH, C=), sp, Sp², Sp³, etc)</p> <p>1.14 Carry out measurement of radioactivity using Counters</p>	
<p>2.3 Carry out a vacuum filtration apparatus using a Buchner funnel.</p> <p>4 Filter and wash precipitates from solutions using vacuum filtration (Buchner funnel).</p> <p>2.3 Recognize gravity filtrations and syringe filters as being two commonly used methods for separating solids from liquids.</p> <p>2.4 Safely operate a separatory funnel.</p> <p>2.5 Choose the correct size of separatory funnel with respect to the volume of sample used.</p> <p>2.6 Learn solvent extraction techniques.</p> <p>2.7 Separate a 2- component mixture into two solid products.</p>	<p>Guide student to conduct items 2.1-2.7</p>
<p>3.3 Assemble laboratory glassware and operate a Simple distillation apparatus.</p> <p>3.4 Determine the boiling point of the purified chemical present in an impure organic solution after Simple distillation.</p>	<p>Guide student to conduct items 3.1-3.5</p>

<p>3.3 Measure atmospheric pressure.</p> <p>3.4 Create a distillation graph from the data for the Simple distillation of an organic solution.</p> <p>3.5 Calculate the boiling point of an organic mixture measured by distillation to its equivalent boiling point at 760 mm Hg.</p>	
<p>4.1 Calculate the amount of chemicals required to prepare various standard solutions.</p> <p>4.4 Prepare weight/volume standard solutions by serial dilution.</p> <p>4.5 Prepare a % weight/volume standard solution from a primary standard grade chemical.</p> <p>4.4 Label all solutions prepared for use in the laboratory in accordance with WHMIS guidelines by completing a worksite label for each solution prepared.</p> <p>4.5 Submit solutions for testing and store solutions for later use.</p> <p>4.5 Express the amount of a chemical present in a solution in common units of concentration.</p>	<p>Guide student to conduct items 4.1-4.6</p>
<p>5.2 Operate a Spectronic 20D+ Spectrophotometer.</p> <p>5.2 Identify the proper care of cuvettes.</p> <p>5.5 Measure the %T of a solution.</p>	<p>Guide student to conduct items 5.1-5.6</p>

<p>5.6 Calculate the Absorbance of a solution from its measured %T value.</p> <p>5. 5 Determine the concentration of unknown solutions using a Spectronic 20D+ instrument.</p> <p>5.6 Use back calculation to determine the mass of analyte in the original samples</p>	
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**CURRICULUM DEVELOPMENT HELD AT NBTE SECRETARIAT, KADUNA FROM 27TH
SEPTEMBER TO 3RD OCTOBER, 2020**

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NATIONAL BOARD FOR TECHNICAL EDUCATION, KADUNA

CURRICULUM AND COURSE SPECIFICATIONS

FOR

HIGHER NATIONAL DIPLOMA (ND)

IN

ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY

September, 2022

FOREWORD

The Higher National Diploma in Environmental science and management curriculum is designed to be used by training institutions to produce manpower for the health sector nationwide.

The shortage of professionally-trained manpower in the health sector in Nigeria as well as the need to produce professional practitioners with good ethics and career progression, through the acquisition of desirable knowledge and skills, necessitated the production of this national curriculum.

It is my belief that this curriculum and course specifications which is the minimum required to produce health practitioners with sound knowledge and skills in Environmental science and management if properly implemented with the required resources (qualified teaching staff in adequate number and mix, adequate consumables, training materials, teaching aids), and qualified candidates are admitted into the programme will lead to the production of competent and skilled practitioners required in the sector.

I wish to express my deep appreciation to those that made the review of this curriculum possible especially the invaluable contributions of all the members of the committee and resource persons during the national review workshop are appreciated.

I hope that the curriculum would be properly implemented, so as to produce the required Work Force of our dream.

Prof. Idris M. Bugaje
EXECUTIVE SECRETARY,
NBTE KADUNA.

GENERAL INFORMATION

1.0 TITLE AND CERTIFICATION OF THE PROGRAMME: The title of the programme is Higher National Diploma in Environmental Science and management Technology

2.0 GOAL AND OBJECTIVES:

2.1 GOAL The programme is designed to produce skilled technologists who should be able to manage the environment.

2.2 OBJECTIVES

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

- vii. Operate environmental equipment used in industries.
- viii. Maintain environmental equipment.
- ix. Collect, collate and analyse environmental data
- x. Undertake quality control tests in environment.
- xi. Participate in Environmental Impact Assessment, Environmental Management, etc.
- xii. Set up and manage an enterprise in the areas of environmental management and other disciplines

5.1 MANPOWER REQUIREMENTS:

5.2 Headship of The Department

The HOD should be at least a Senior lecturer who has a minimum of second Degree in any of the Basic Science courses or related discipline.

He should have at least 10 years cognate experience and must be registered with relevant professional body.

5.3 Teaching Staff

At the point of entry Assistant Lecturers should first degrees (BSc, BTech.or HND+PGD) in any of the Basic Science courses.

The Instructor should have HND (upper credit) in any of the Basic Science courses or related discipline.

5.3.1 Lecturer/Instructor Cadre

5.3.2 Technologist Cadre

5.3.2.1 Technologist

Technologist should have HND (upper credit) in any Basic Science programme or Environmental Science and Management Technology or related discipline

5.3.3 Technician Cadre

Technicians should have ND (lower credit) as stated in 2.1

5.4 Criteria for appointment of ND External Examiners

6.0 CAREER PROSPECTS

- xi) Environmental and Safety Health Management Sector
- xii) Pest Control Management
- xiii) Small and medium Scale Business Owners/Manager
- xiv) Data Processor (Environmental and Safety)
- xv) Research and Academic Laboratories
- xvi) Ministries of Environment at Federal and State levels
- xvii) Regulatory and Enforcement Agencies at the Federal and State level
- xviii) Waste Management Authorities
- xix) Emergency Management Agencies
- xx) Industrial Sector

7.0 CURRICULUM

7.1 The curriculum of all ND programmes consists of the following four (4) main components:

- v. General Studies/Education
- vi. Foundation courses

- vii. Professional courses
- viii. Supervised Industrial Work Experience Scheme (SIWES)

7.2 The General Education Components shall include courses in:

English Language, Communication, Industrial Management and Engineer in Society, The General Education component shall account for not more than 15% of the total contact hours for the programme.

7.3 Foundation Courses include courses in Mathematics, the number of hours for the programme may account for about 10-15% of the total contact hours.

7.4 Professional Courses are courses of the programme which give the student the theory and professional skills he needs to practice his field of calling at the technician/technologist level. These may account for between 60-70% of the contact hours.

7.5 Curriculum Structure:

The structure of the National Diploma programme consists of four semesters of classroom, laboratory and workshop activities in the college. Each semester shall be of 17 weeks duration made up as follows:

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

8.0 Mandatory Skills Qualification (MSQ) for Higher National Diploma (HND) Programmes.

MSQ is a four (4) credit unit course spanning across two semesters of a programme totaling (8) which requires the student to learn a hands-on skill qualification either relevant or related to his area of study.

It is mandatory for HND graduates to acquire certification from appropriate awarding body of Nigerian Skills Qualification or any equivalent proprietary bodies. This policy of the Board requires that student should not be allowed to graduate without obtaining certification in the skill area they chose as a compulsory graduating requirement.

The MSQ is aimed to add value to all TVET graduates towards dual certification by way of obtaining a HND certificate and additional skills qualification to meet local and global demand for skilled labour

9.0 PROJECT

Final year students in this programme are expected to carry out a project work. This could be on individual basis or group work; but reporting must be undertaken individually. The project should, as much as possible incorporate basic element of design, drawing and complete fabrication of a marketable item or something that can be put to use. Project reports should be well presented and should be properly supervised.

The departments should make their own arrangement of schedules for project work.

10.0 ACCREDITATION

The programme shall be accredited by the National Board for Technical Education before the diplomates can be awarded the Higher National Diploma certificates. Details about the process of accrediting a programme for the award of the Higher National Diploma are available from the office of the Executive Secretary, National Board for Technical Education, Plot “B”, Bida Road, P.M.B. 2239, Kaduna, Nigeria.

10.1 Conditions for the Award of ND:

Conditions for the award of Higher National Diploma include the following:

- e. Satisfactory performance in all prescribed course work which may include class work, tests, quizzes.
- f. Workshop practice, laboratory work and field work.

g. Satisfactory performance at all semester examinations.

h. Satisfactory completion of final year project work.

Normally, continuous assessment contributes 30%, project work 10% while semester examinations are weighted 60% to make a total of 100%.

iii. 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

iv. 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 2.50-2.99
Pass	-	CGPA 2.00-2.49

11. Guidance Notes for Teachers of the Programme:

11.1 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/she is transferring.

11.2 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.

11.3 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.

11.4 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.

CURRICULUM TABLE

HND I SEMESTER I

S/N	COURSE CODE	COURSE TITLE	L	P	CU	CH
1	GNS 301	Use of English III	2	0	2	2
2	STM 323	Environmental Microbiology	2	1	3	3
3	ESM 311	House Keeping Emergency Preparedness/Contingency Response	2	1	3	3
4	ESM 312	Environmental Biotechnology	1	1	2	2
5	ESM 313	Water Supply and Wastewater Treatment	2	1	3	3
6	ESM 314	Environmental and Health Risk Assessment	2	1	3	3
7	ESM 315	Fundamentals of Geo-informatics	1	2	3	3
8	ESM 316	Environmental Economics	2	0	2	2
TOTAL			14	7	21	21

HND I SEMESTER II

S/N	COURSE CODE	COURSE TITLE	L	P	CU	CH
1	GNS 302	Communication in English III	2	-	2	2
2	GNS 302	Technical Report Writing	2	-	2	2
3	ENT 326	Practice of Entrepreneurship I	2	2	2	4
4	STV 315	Research Methodology and Biostatistics	2	-	2	2
5	ESM 321	Environmental Auditing and Management Systems	2	1	3	3
6	ESM 322	Ergonomics	1	1	2	2
7	ESM 325	Instrumentation and Laboratory Analysis	1	2	3	3
8	ESM 326	Waste Utilization	1	2	3	3
9	ESM 327	Remote Sensing Application	1	2	3	3
10	ESM 328	Mandatory Skills Qualification I	0	4	4	4
Total			15	13	28	28

HND II SEMESTER I

S/N	COURSE CODE	COURSE TITLE	L	P	CU	CH
1	GNS 401	Use of English IV	2	-	2	2
2	ENT 416	Practice of Entrepreneurship II	2	2	4	4
3	ESM 411	Mandatory Skills Qualification I	0	4	4	4
4	ESM 412	Environmental Legislation, Enforcement and Compliance	2	-	2	2
5	ESM 413	Advanced Environmental Assessment	2	1	3	3
6	ESM 414	Sanitation and Waste Management	2	1	3	3
7	ESM 415	Seminar	2	-	2	2
8	ESM 416	Environmental Project Management	2	-	2	2
9	ESM 417	Advanced Man and Environment	2	-	2	2
10	ESM 418	Environmental Toxicology	2	1	3	3
11	ESM 419	Construction, Machine and Tools Safety	2	1	3	3
Total			20	10	30	30

HND II SEMESTER II

S/N	COURSE CODE	COURSE TITLE	L	P	CU	CH
1	GNS 402	Literary and Oral Appreciation	2	0	2	2
2	ESM 421	Ecological Disaster, Prevention and Control	2	1	3	3
3	ESM 422	Environmental Performance	2	0	2	2
4	ESM 423	Sampling Methods for Polluted Sites	1	2	3	3
5	ESM 424	Polluted Site Investigation and Remediation	2	1	3	3
6	ESM 425	Research Project	0	4	4	4
TOTAL			9	8	17	17

NOTE: Borrowed/Foundation/General Courses in *italics* above are to be obtained from the respective programme curricula.

KEY: L= Lecture hours, T= Tutorial hours, P= Practical hours, CU= Credit Units, CH= Contact Hour

YEAR ONE, SEMESTER ONE COURSES

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: House Keeping Emergency Preparedness/ Contingency Response	CODE: ESM 311	Credit Unit: 3	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course is designed to provide the student.			
YEAR: ONE (1), SEMESTER: ONE (1)	PRE-REQUISITE: None	PRACTICAL: 1 HOUR/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <ol style="list-style-type: none"> 1.0 Understand house keeping 2.0 Know emergency response strategy 3.0 Know contingency plan 4.0 Understand safety/healthcare management strategy 5.0 Understand unsafe condition and act, auditing and reporting 			

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
Course: House Keeping Emergency Preparedness/ Contingency Response		Course Code: 311		Credit Unit: 3.0		Contact Hours: 3
GOAL: This course is designed to enable students know the fundamentals of Housekeeping /Emergency/Contingency response as well as Safety/Health care Strategies.						
Course Specification: h			Theoretical Content: 2		Practical Content: 1hr	
GENERAL OBJECTIVE 1.0: Understand Housekeeping						
Course Specification: CONTENT			THEORETICAL		PRACTICAL CONTENT	
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Define: (i)Housekeeping (ii)House cleaning/sanitation (iii)House keeper 1.2 Define workplace housekeeping checklist. 1.3 Describe each component of work place housekeeping checklist.	Distinguish between housekeeping and house cleansing Explain where housekeeping is done Describe the importance of work place housekeeping checklist Give example of	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts Workplace, Checklist and PPE	Identify work areas/ work space and the areas needing housekeeping Identify types of dirt, litter, garbage etc Identify tools/equipment's inhousekeeping	Guide students to: -identify work areas/ work space and the areas needing housekeeping -identify types of dirt, litter, garbage etc -identify tools/ equipment's in housekeeping	Distinguish between housekeeping and house cleansing Describe the role of the housekeeping department in a work place. Explain the use of a checklist

	<p>1.4 Explain the importance of house cleaning.</p> <p>1.5 Describe factors that enhances housekeeping in workplace.</p> <p>1.6 Mention some of the tools used in house cleaning. List some of the product/ tools used in cleaning: (i) House. ESM(ii) Factories/ industries (iii) Offices (iv) Labs/ Workshops (iv) Surroundings</p> <p>1.8 Explain the significance of dirt and litter removal in house cleaning,</p>	<p>work place housekeeping checklist</p> <p>Mention the implement used for house cleaning purposes Describe the type of dirty and litters commonly found in house hold</p> <ul style="list-style-type: none"> • Explain the effect of using house hold chemicals on food stuff, kitchen utensils etc. 	<p>Projector Text books Internet Tutorial</p>	<p>Identify potential hazards in workplace</p>	<p>-identify potential hazards in Workplace</p>	<p>Explain housekeeping auditing and reporting.</p>
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	<p>1.9 Describe house hold chemical.</p> <p>1.10 Explain the effect of exposure to potentially household chemicals.</p> <p>1.11 Describe household chores.</p> <p>1.12 Explain unsafe condition auditing.</p> <p>Explain housekeeping auditing and reporting.</p>					
GENERAL OBJECTIVE 2.0: Know Emergency Response Strategy						
3-4	<p>2.1 Explain emergency response plan regarding fire and evacuation.</p> <p>2.2 Describe the action plan for firefighting and evacuation. List out different types of evacuation</p>	<p>Describe the steps to be taken for evacuation when fire outbreak occurs.</p> <p>Describe the action plan for firefighting and evacuation.</p>	<p>Projector Text books</p> <p>Internet Tutorial</p> <p>Lecture note</p>	<p>Identify escape route and places of assembly point.</p> <p>Demonstrate the use to radios during emergency situations.</p> <p>Identify firefighting</p>	<p>Guide students to:</p> <p>: identify escape route and assembly points.</p> <p>- demonstrate the use to radios during emergency situations.</p>	<p>Explain the importance of safety signs in places such as factory, school, high way, offices etc</p> <p>Explain the importance the importance of safety drills in</p>

	<p>strategy.</p> <p>2.4 Explain the importance of fire alarm in a fire outbreak.</p> <p>2.5 Identify escape route and places of assembly point.</p> <p>2.6 Describe five escape plan and personal emergency evacuation plan (PEEP).</p> <p>2.7 Describe five firefighting training procedure;</p> <p>2.8 List out the firefighting equipment.</p> <p>2.9 State the importance of radio communication in an emergency.</p> <p>2.10 Enumerate the necessary facilities</p>	<p>Explain the importance of safety signs in places such as factory, school, high way, offices etc.</p> <p>Describe five escape plan and personal emergency evacuation plan (PEEP).</p> <p>Describe the role and responsibility of a safety officer in emergency response.</p> <p>Describe different ways of communication used in an emergency</p> <p>Describe response action in case of spill</p>		<p>equipment's.</p> <p>Simulate a safety evacuation drill</p>	<p>- identify firefighting equipment's.</p> <p>-simulate a safety evacuation d</p>	<p>workplace</p> <p>Describe the role and responsibility of a safety officer in emergency response</p>
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	<p>required for medical emergency.</p> <p>2.11 Explain response action in case of spill emergencies.</p> <p>2.12 State the purpose of emergency response drill. Describe the procedure / process steps for emergency response drills.</p> <p>2.14 List out the personal protective equipment/safety wears needed in an emergency response</p>	<p>emergencies. Describe the procedure / process / steps for emergency response drills.</p> <p>List out the personal protective equipment / safety wears needed in an emergency response.</p>				
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GENERAL OBJECTIVE 3.0: Know contingency plan						
5-6	3.1 Defined contingency plan. 3.2 Describe how to develop a contingency plan. 3.3 Describe contingency plan process 3.4 State the benefit derived from the preparation of a contingency response plan.	Define a contingency plan Describe how to develop a contingency plan State the usefulness of a contingency plan in the industry	Projector Text books Internet Tutorial Lecture note	Carryout a contingency plan for a workplace	Guide students to develop and Organize a contingency plan for a work place	State the usefulness of a contingency plan in the industry

GENERAL OBJECTIVE 4.0: Understand Safety/Healthcare Management Strategy						
7-9	<p>4.1 Explain safety and healthcare management system.</p> <p>4.2 Describe the general environmental and safety guide line for industries in terms of Environmental</p> <ul style="list-style-type: none"> • Occupational Health and Safety • Community health and safety • Construction and Decommissioning 	<p>Describe the component of safety and management system</p> <p>Explain environmental and safety guideline use in the industries</p> <p>Distinguish between construction commissioning and decommissioning</p>	<p>Projector Text books Internet Tutorial Lecture note</p>	<p>Identify safety and healthcare systems</p> <p>Identify the general environmental and safety guide line for industries interms of:</p> <ul style="list-style-type: none"> • Environmental • Occupational Health and Safety • Community health and safety • Construction and Decommissioning 	<p>Guide students to:</p> <p>-prepare a safety and healthcare plan</p> <p>- identify the general environmental and safety guide line for industries in terms of: Environmental, Occupational Health and Safety Community health and safety, Construction and Decommissioning</p>	<p>Describe a safety and healthcare management system</p> <p>Describe the general safety guide line for Occupational Health and Safety</p>
GENERAL OBJECTIVE 5.0: Understand unsafe condition and act, auditing and reporting.						

10-11	<p>5.4 Describe an unsafe condition</p> <p>5.5 Explain unsafe act.</p> <p>5.6 Explain safety auditing</p> <p>5.7 Explain safety/accident report</p>	<p>Explain an unsafe condition</p> <p>Explain unsafe act</p> <p>Explain safety auditing</p> <p>Explain the steps in carrying out an safety audit</p> <p>Explain steps in writing an accident report</p>	<p>Workplace, Checklist template, Accident report template and PPE</p>	<p>Identify an unsafe condition in work place.</p> <p>Identify an unsafe act</p> <p>Identify the main factor to be investigated in an unsafe condition</p>	<p>Guide students to carry out a safety audit for a case study.</p> <p>Guide students to prepare an accident report for a case study.</p>	<p>Describe an unsafe condition</p> <p>Explain safety auditing</p> <p>Explain safety/accident report</p>
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ASSESSMENT: The continuous assessment; tests and quizzes will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE			
COURSE: BIOTECHNOLOGY	ENVIRONMENTAL	CODE: ESM 312	Credit Unit: 2. CONTACT HOURS: 2 HOURS/WEEK
GOAL: This course is designed to provide the student with indept knowledge in environmental biotechnology as it relate to importance and the working principle of environmental management technology.			
YEAR: ONE (1), SEMESTER: ONE (1)		PRE-REQUISITE:	PRACTICAL: 1 HOURS/WEEK
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the student should be able to:</p> <p>8.0 Understand the significance of environmental Biotechnology</p> <p>9.0 Understand the fundamental principles, functions and application of industrial product.</p> <p>10.0 Understand environmental biotechnology interventions</p> <p>11.0 Understand waste treatment strategies</p>			

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE TECHNOLOGY							
COURSE: ENVIRONMENTAL BIOTECHNOLOGY		Course Code: 312		Credit Unit: 2.0		Contact Hours: 2	
GOAL: This course is designed to provide the student with in dept knowledge in environmental biotechnology as it relates to importance and the working principle of environmental management technology.							
Course Specification: 1hr				Theoretical Content:		Practical Content: 1 hr	
12.0 GENERAL OBJECTIVE 1.0: Understand the significance of environmental Biotechnology							
Course Specification:		THEORETICAL CONTENT			PRACTICAL CONTENT		
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation	
1-2	1.3 Define Biotechnology 1.4 Explain environmental Biotechnology 1.5 explain the basic component of the environment 1.6 Discuss the concept of biotic and abiotic components of the eco system	• Explain the 1.1 – 1.4	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts etc.			Narrate the historical background	
GENERAL OBJECTIVE 2.0: Understand the fundamental principles, functions and application of industrial product							

3-4	<p>2.1 Explain Biological Processes in relation to biotechnology</p> <p>2.2 Explain the industrial fundamental principle:</p> <ul style="list-style-type: none"> • Biological processes • Quality control • Safety • Regulations and compliance <p>2.3 Discuss the functions and application of industrial product to environmental biotechnology</p>	Explain 2.1 – 2.3		▪	▪	
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13.0 **GENERAL OBJECTIVE 3.0:** Understand environmental biotechnology interventions

5-6	<p>3.1 Explain sustainable remediation of contamination in different environment</p> <p>3.2 Explain biodegradation</p> <p>3.3 explain environmental impact and their assessment using bio indicators, biomarkers. biosensor</p> <p>3.4 Explain biodegradation and bio-remediation</p>	•		<p>conduct a practical on biodegradation xenobiotic compounds (hydrocarbons, detergent, dyes and pesticide)</p> <p>Carry out practical on phyto- remediation</p>	<p>Guide student to conduct a practical on biodegradation xenobiotic compounds (hydrocarbons, detergent, dyes and pesticide)</p> <p>Guide student to Carry out practical on phyto-remediation</p> <p>Carry out practical on air, water and soil toxicity testing</p>	
GENERAL OBJECTIVE 4.0: Understand waste treatment strategies						
7-9	<p>4.1 discuss the principle and mechanism of waste treatment</p> <p>4.2 explain characterization of waste</p> <p>4.3 discuss the classification of waste</p>	•		<p>carry out practical on anaerobic aerobic digestion</p> <p>carry out treatment on waste water.</p>	<p>Guide student to carry out practical on anaerobic aerobic digestion</p> <p>Guide student to carry out treatment on waste water.</p>	

	4.4 explain the economics and special aspect of waste treatment					
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PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL AND SAFETY MANAGEMENT TECHNOLOGY			
COURSE: Water Supply and Wastewater Treatment	CODE: ESM 313	Credit Unit: 3.0	CONTACT HOURS: 3HOURS/WEEK
GOAL: This course is designed to enable the students understand municipal and industrial wastewater and water treatment techniques			
YEAR: ONE (1), SEMESTER: ONE (1)	PRE-REQUISITE:	PRACTICAL: 1 HOUR/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <ol style="list-style-type: none"> 1.0 Know the wholesome water. 2.0 Know various sources of water supply in a community. 3.0 Understand various methods of water purification. 4.0 Know Industrial Wastewater Treatment 5.0 Know Municipal Wastewater Treatment 6.0 Know Drinking Water Treatment 7.0 Know water analysis 			

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL AND SAFETY MANAGEMENT TECHNOLOGY						
Course: Water Supply and Wastewater Treatment		Course Code: 313		Credit Unit: 3.0		Contact Hours: 3
GOAL: This course is designed to enable the students understand municipal and industrial wastewater and water treatment techniques						
Course Specification:			THEORETICAL		PRACTICAL CONTENT	
CONTENT						
General Objective 1.0: Know the wholesome water.						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Define the terms wholesome water and unwholesome water 1.2 Differentiate between wholesome water and unwholesome water 1.3 State the characteristic of wholesome water and unwholesome water such as: turbidity, - colour, - taste, odour, - pathogens 1.4 List water pollutant toxic chemicals, radioactive substances, pathogens, and solid waste. 1.5 Explain sources of water pollutant in : <ul style="list-style-type: none"> • Industry • Sewage 	Explain 1.1 – 1.5	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts, Policy documents, etc.	Identify the wholesome water and unwholesome water	Guide the students in identifying wholesome water and unwholesome water	Differentiate between wholesome water and unwholesome water

	<ul style="list-style-type: none"> • Agricultural activities <p>Institutions like hospitals, School.</p> <ul style="list-style-type: none"> - Transportation <p>Automobile fumes, maritime activity</p>					
General Objective 2.0: know various source of water supply in a community						
4-5	<p>2.1. List possible sources of water supply in a community such as :</p> <ul style="list-style-type: none"> • Rain water • Driven wells • Bored tube well • jetted tube well • springs • Hand dug wells • Bore holes • pipe borne water • Steam water <p>2,2 Describe the hydrologic cycle.</p> <p>2.3 Classify the source of water listed on 2.1 above on three categories:</p>	<p>Explain water supply in a community such as :</p> <ul style="list-style-type: none"> • Rain water • Driven wells • Bored tube well • jetted tube well • springs • Hand dug wells • Bore holes • pipe borne water • Steam water <p>Explain how to protect the various sources of water from</p>	<ul style="list-style-type: none"> -projection -Text Books - Internet -Lecture notes -Tutorials -Disinfectants 	<p>Identify possible sources of water supply to community.</p> <p>Disinfect well</p>	<p>Guide the students in identifying various sources of water supply to community.</p> <p>Guide students to disinfect well</p>	<p>Describe the hydrologic cycle</p>

	<p>- Surface water - Underground water Rain water</p> <p>2.3 Describe the characteristics of a community sanitary well.</p> <p>2.5 Explain how to protect the various sources of water from contaminations</p> <p>2.6 Explain the terms shallow well and deep well</p> <p>2.7 .list the disadvantages of shallow well and deep well. Describe how to disinfect wells. categories: - Surface water - Underground water Rain water</p> <p>2.8 Explain the characteristics of a community sanitary well.</p>	<p>contaminations: shallow well and deep well</p> <p>Give the disadvantages of shallow well and deep well.</p> <p>2.8 Describe how to disinfect wells</p>				
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General Objective 3.0: Understand various methods of water purification

6-7	<p>3.1 Explain how to improvise water filters for the home</p> <p>3.2 Explain how to disinfect and Sediment water for domestic and rural use.</p> <p>3.3 Explain how to store domestic water to reduce/prevent contamination</p> <p>3.4 Describe the outlay of a water treatment plant</p> <p>3.5 Explain the various steps in water treatment in a conventional plant:</p> <ul style="list-style-type: none"> • -Source • -Aeration • -Sedimentation • -Screening • -Coagulation • -Disinfection • -Filtration 	<p>Explain the various steps in water treatment in a conventional plant:</p> <ul style="list-style-type: none"> -Source -Aeration -Sedimentation -Screening -Coagulation -Disinfection -Filtration -Storage -Distribution 		<p>Visit a conventional water treatment plant</p>	<p>Guide student to identify the characteristics of a water treatment plant area.</p> <p>-Visit a conventional water treatment plant</p>	<p>Explain the objective of water purification</p>
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	<ul style="list-style-type: none"> -Storage -Distribution <p>3.6 Explain the characteristics of a watertreatment Condiment plant area.</p> <p>3.7 Explain Biological Oxygen Demand (BOD)</p>					
General Objective 4.0: know industrial wastewater treatment						
8-10	<p>4.1 Explain how the regulatory requirements impact industrial wastewatertreatment and municipal facilities</p> <p>4.2 Explain the impact of the key industrial wastewater contaminants (heavy metals, other inorganic constituents, synthetic organic compounds, etc) on the receiving environment,</p> <p>4.3 State the techniquesof industrial wastewater survey.</p>	<p>Explain how the regulatory requirements impact industrial wastewater treatment and municipal facilities</p> <p>Explain the impact of the key industrial wastewater contaminants (heavy metals, other inorganic constituents, synthetic organic compounds, etc) onthe receiving environment.</p>	<p>-projection -Text Books - Internet -Lecture notes -Tutorials Water sampleChemicals</p>	<p>Visit industrial wastewater treatment plant.</p> <p>Design chemical feed systems that will allow the estimation of chemical sludge production.</p>	<p>Guide student to visit industrial wastewater treatment plant.</p> <p>Guide students to design chemical feed systems thatwill allow the estimation of</p>	<p>Explain the principles of chemical coagulation andprecipitation forthe removal of suspended solids and heavy metals and phosphorus.</p>

	<p>4.4 Assess the economic benefits of waste minimization by evaluating industrial wastewater treatment options Explain the need for quality equalization, neutralization, and oil-water separation.</p> <p>4.6 Explain the key design parameters to size equalization, neutralization, and oil-water separation facilities.</p> <p>4.7 Explain the principles of chemical coagulation and precipitation for the removal of suspended solids and heavy metals and phosphorus.</p> <p>4.8 Describe key design criteria for sizing treatment system components.</p> <p>4.9 Design chemical feed systems that</p>	<p>Explain the principles of chemical coagulation and precipitation for the removal of suspended solids and heavy metals and phosphorus. Explain the key design criteria for sizing treatment system components. And Design chemical feed systems that will allow the estimation of chemical sludge production.</p> <p>Explain the principal of ion exchange.</p> <p>Describe how to Plot adsorption isotherms and breakthrough curves (adsorption and ion exchange).</p> <p>Take students through the calculation of</p>		<p>Plot adsorption isotherms and breakthrough curves (adsorption and ion exchange)</p>	<p>chemical sludge production.</p> <p>Guide students to plot adsorption isotherms and breakthrough curves (adsorption and ion exchange)</p>	
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	<p>will allow the estimation of chemical sludge production.</p> <p>4.10 Explain the principal of ion exchange.</p> <p>4.11 Plot adsorption isotherms and breakthrough curves (adsorption and ion exchange). Calculate adsorption and ion exchange capabilities.</p> <p>4.13 Categorize the principles of membrane processes.</p> <p>4.14 Describe the concepts of breakpoint chlorination based on chemical oxidation and how it impacts ammonia removal.</p> <p>4.15 Explain the principles of gas transfer and its application in air</p>	<p>adsorption and ion exchange capabilities and categorize the principles of membrane processes.</p> <p>Explain the concepts of breakpoint chlorination based on chemical oxidation and how it impacts ammonia removal.</p>				
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	stripping.					
General Objective 5.0: know municipal wastewater treatment						
11	<p>5.1 Quantify the municipal wastewater problem based on the analysis of various sources of municipal wastewater and factors that affect wastewater flow and the comparison between types of sewer system.</p> <p>5.2 Explain how to measure municipal wastewater strength based on the physical and chemical characteristics of the wastewater.</p> <p>5.3 Explain the need for wastewater treatment as defined in provincial and/or federal legislation taking into consideration the effect of discharging wastewater into the environment.</p> <p>5.4 Describe municipal</p>	<p>Explain how to quantify the municipal wastewater problem based on the analysis of various sources of municipal wastewater and factors that affect wastewater flow and the comparison between types of sewer system,</p> <p>measure municipal wastewater strength based on the physical and chemical characteristics of the wastewater.</p> <p>Explain the need for wastewater treatment as defined in provincial and/or federal legislation taking into</p>	<p>-projection -Text Books - Internet -Lecture notes -Tutorials Water sample Chemicals</p>	<p>Visit municipal wastewater treatment plant.</p> <p>Measure municipal wastewater strength based on the physical and chemical characteristics of the wastewater.</p>	<p>Guide student to visit municipal wastewater treatment plant.</p> <p>Guide students to measure municipal wastewater strength based on the physical and chemical characteristics of the wastewater.</p>	<p>Describe municipal wastewater treatment unit operations including onsite disposal (septic tanks) system and central collection treatment systems.</p>

	<p>wastewater treatment unit operations including onsite disposal (septic tanks) system and central collection treatment systems.</p> <p>5.5 Describe preliminary treatment processes including screening, comminution (grinding) and grit removal.</p> <p>5.6 Analyze the design of primary wastewater treatment with focus on the principles of</p> <p>5.7 primary sedimentation Explain the basic fundamentals of five-day biochemical oxygen demand (BOD5), the BOD5 test and limitation.</p> <p>5.8 Analyze the design of suspended growth systems such as activated sludge and its variants and their application to secondary wastewater</p>	<p>consideration the effect of discharging wastewater into the environment.</p> <p>Explain municipal wastewater treatment unit operations including onsite disposal (septic tanks) system and central collection treatment systems</p> <p>Explain the preliminary treatment processes including screening, comminution (grinding) and grit removal.</p> <p>Explain how to analyze the design of primary wastewater treatment with focus on the principles of primary sedimentation.</p>				
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	<p>treatment, including the basic kinetics of suspended growth biological treatment.</p> <p>5.9 Analyze secondary clarification in biological treatment systems</p> <p>5.10 Evaluate wastewater disinfection alternatives.</p> <p>5.3 Evaluate sludge processing options for a given application, considering the cost effectiveness of the processing techniques.</p>					
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General Objective 6.0: know drinking water treatment

12-13	<p>6.1 Discuss the significance of water demand (based on water consumption statistics) and the characterization of water quality in relation to treatment system design.</p> <p>6.2 Explain how to assess key bacteriological water quality parameters to ensure the production of potable water according to criteria established under the Guidelines for Nigerian Drinking Water Quality and the Nigerian Safe Drinking Water Regulation.</p> <p>6.3 Compare the water treatment philosophies practiced in Africa and other parts of the world, including explanation of standards set by the WHO and AU.</p> <p>6.4 Explain the significance of source water protection to minimize water quality</p>	<p>Explain the significance of water demand (based on water consumption statistics) and the characterization of water quality in relation to treatment system design and assess key bacteriological water quality parameters to ensure the production of potable water according to criteria established under the Guidelines for Nigerian Drinking Water Quality and the Nigerian Safe Drinking Water Regulation. Explain the principles of coagulation /flocculation, the principles of filtration and the principles of</p>	<p>-projection -Text Books - Internet -Lecture notes -Tutorials Water sample Chemicals</p>	<p>Visit drinking water treatment plant.</p> <p>Measure key bacteriological water quality parameters</p>	<p>Guide student to visit drinking water treatment plant.</p> <p>Guide students to measure the key bacteriological water quality parameters</p>	<p>Explain the significance of source water protection to minimize water quality risks.</p>
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	<p>risks</p> <p>6.5 Explain the principles of coagulation /flocculation as they pertain to water treatment plant design.</p> <p>6.6 Explain the principles of clarification as they pertain to water treatment design.</p> <p>6.7 Describe the principles of filtration as they pertain to water treatment plant design.</p> <p>6.8 Describe conventional, direct, diatomaceous earth, slow sand and membrane processes.</p> <p>6.9 Explain filter operation, defining the concept of headloss and the relationship to backwash requirements and media types.</p> <p>6.10 Explain the principles of water softening to the removal of hardness from</p>	<p>clarification as they pertain to water treatment plant design and analyze the</p> <p>Describe conventional, direct, diatomaceous earth, slow sand and membrane processes.</p> <p>Explain filter operation, defining the concept of headloss and the relationship to backwash requirements and media types.</p> <p>Explain the application of the principles of water softening to the removal of hardness from scale forming waters, including the calculation of dosage requirements for various water softening scenarios.</p>				
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	<p>scale forming waters, including the calculation of dosage requirements for various water softening scenarios.</p> <p>6.11 Explain the principles of corrosion control as they pertain to water treatment process design.</p> <p>6.12 Explain the principles of primary and secondary disinfection as they pertain to water treatment process design.</p> <p>6.13 Explain chlorine-based treatment and other alternative technologies including ozone and ultraviolet light.</p> <p>6.14 Explain the formation potential of disinfection by-product and microbial regrowth in distribution systems and their associated exposure risks</p>	<p>Explain the principles of corrosion control and the principles of primary and secondary disinfection as they pertain to water treatment process design.</p> <p>Explain chlorine-based treatment and other alternative technologies including ozone and ultraviolet light.</p> <p>Explain the formation potential of disinfection by-product and microbial regrowth in distribution systems and the risk of their associated exposure.</p>				
General Objective 7.0: know water analysis						

14	<p>7.1 Explain the appropriate materials for collecting water samples</p> <p>7.2 Prepare sampling bottles for water collection</p> <p>7.3 Explain how to collect water samples</p> <p>7.4 Explain how to dispatch sample bottles to the laboratory for analysis</p> <p>7.5 Explain how to package and label sample bottles for transportation</p> <p>7.6 Explain Indicator Organisms</p> <p>7.7 Explain how to culture water samples for Indicator organism</p> <p>7.8 Explain how to identify other organism e.g. protozoa etc. In water samples from under the microscope</p> <p>7.9 Explain how to identify hard water by its characteristics</p>	Explain 7.1 – 7.11	<p>-projection</p> <p>-Text Books</p> <p>- Internet</p> <p>-Lecture notes</p> <p>-Tutorials Water sample</p> <p>Chemicals</p>	<p>Identify appropriate materials for collecting water samples</p> <p>Prepare sampling bottles for water collection</p> <p>Collect water samples</p> <p>Dispatch sample bottles to the laboratory for analysis</p> <p>Package and label sample bottles for transportation</p> <p>Culture water samples for Indicator</p>	<p>Guide student to:</p> <p>-identify appropriate materials for collecting water samples</p> <p>-prepare sampling bottles for water collection</p> <p>-collect water samples</p> <p>-dispatch sample bottles to the laboratory for analysis</p> <p>-package and</p>	Explain Indicator Organisms
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	<p>7.10 Explain how to remove water hardness</p> <p>7.11 Explain how to treat water for odour</p>			<p>organism</p> <p>Identify other organism e.g. protozoa etc. In water samples from under the microscope</p> <p>Identify hard water by its characteristics Remove water hardness Treat water for Odour</p>	<p>label sample bottles for transportation Culture water samples for Indicator organism</p> <p>-identify other organism e.g. protozoa etc. In water samples from under the microscope</p> <p>-identify hard water by its characteristics -remove water</p>	
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					hardness -treat water for Odour	
ASSESSMENT: The continuous assessment; tests, quizzes, field works etc. will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.						

PROGRAMME: Higher National Diploma in Environmental Science and Management Technology			
COURSE: Environmental and Health Risk Assessment	CODE: 314	Credit Unit: 3.0	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course is designed to provide students with knowledge of basic risk concepts that apply to health and environment..			
YEAR: ONE (1), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 1 HOUR/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the student should be able to:</p> <ol style="list-style-type: none"> 1.0 Know various terms associated with risk assessment 2.0 Know Hazard Identification (Step 1) of the Risk Assessment Process. 3.0 Understand the principles and Calculation of Exposure including the two main principle activities 4.0 Know dose-response assessment 5.0 Understand the basic principles of toxicology 6.0 Understand the basic principles of epidemiology 7.0 Understand the Transport and Fate of Contaminants on Ecosystems 8.0 Know how Risks are estimated. 9.0 Understand the Process of risk management 10.0 Understand the Risk Assessment Phases using the class examples as a guide 11.0 Understand the advantages of cost benefit analysis 			

PROGRAMME: Higher National Diploma in Environmental Science and Management Technology						
Course: Environmental And Health Risk Assessment		Course Code: 314		Credit Unit: 3.0		Contact Hours: 3
GOAL: This course is designed to provide students with knowledge of basic risk concepts that apply to health and environment						
Course Specification: 2hr			Theoretical Content:		Practical Content: 1 hr	
GENERAL OBJECTIVE 1.0: Know various terms associated with risk assessment						
Course Specification: CONTENT			THEORETICAL		PRACTICAL CONTENT	
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 State the difference between environment risk assessment, health risk assessment, risk management, risk communication, and comparative risk assessment. 1.2 List the four steps to risk assessment. 1.3 Explain the four steps of risk assessment. 1.4 Explain the	Explain the differences between environment risk assessment, health risk assessment, risk management, risk communication, and comparative risk assessment, voluntary and involuntary risk, risks posed by chemicals and those posed by microorganisms	Whiteboard Text books Journals Internet	Identify risks associated with different development activities.	Guide students to identify Risk assessment in activities such as mining.	Explain the interaction between the environment and development activities-

	<p>concept of risk assessment.</p> <p>1.5 Describe why environmental and health requirements must be considered in risk assessment.</p> <p>1.6 Explain why we use safety factors in risk assessment.</p> <p>1.7 Explain with examples the difference between avoluntary and involuntary risk.</p> <p>1.8 List the differences between risks posed by chemicals and those posed by microorganisms</p>					
GENERAL OBJECTIVE 2.0: Know Hazard Identification (Step 1) of the Risk Assessment Process.						
3-4	<p>2.1 Explain the benefits of eliminating hazards.</p> <p>2.2 Explain why a process hazard safety</p>	List the benefits of eliminating hazards and why a process hazard safety management program	Whiteboard Text books Journals Internet			Explain why a process hazard safety management program is

	<p>management program is important to a facility.</p> <p>2.3 Describe the 14 elements of process safety management</p> <p>2.4 Explain the use of performance measurements</p>	<p>is important to a facility.</p> <p>Describe the 14 elements of process safety management</p> <p>Explain the use of performance measurements</p>				important to a facility
GENERAL OBJECTIVE 3.0: Understand the principles and Calculation of Exposure including the two main principle activities						
	<p>3.1 Describe common exposure pathways.</p> <p>3.2 Explain the need to consider Bioaccumulation in exposure</p> <p>3.3 Calculate exposure pathways</p>	Explain exposure pathways.	Whiteboard Text books Internet			Explain Exposure pathways
General Objective 4.0: Know dose-response assessment						
	<p>4.1 Explain the importance of selection of the dose-response curve in risk management</p> <p>4.2 Describe what is</p>	<p>Explain the importance of selection of the dose-response curve in risk management and what is meant by</p>				Explain Dose Response Assessment

	<p>meant by “the most conservative dose-response curve.</p> <p>4.3 Describe what a threshold dose-response curve is and give examples of the types of toxicants that have a threshold dose- response curve</p> <p>4.4 Identify the four steps in a formal health-risk assessment.</p> <p>4.5 Explain why some chemicals are more likely to bioaccumulate than others</p> <p>4.6 Identify the types of dose-response curves that best reflect pathogen exposure.</p>	<p>“the most conservative dose-response curve”?</p> <p>Explain what a threshold dose-response curve is and give students examples of the types of toxicants that have a threshold dose-response curve.</p> <p>Explain the four steps in a formal health-risk assessment and why some chemicals are more likely to bioaccumulate than others.</p>				
General Objective 5.0: Understand the basic principles of toxicology						
	<p>5.1 Define toxicity.</p> <p>5.2 Give reasons for the use of small</p>	<p>Explain why small animals are used in laboratory tests</p>	<p>Whiteboard Text books Internet</p>			<p>Describe how the safety of chemical substances is</p>

	<p>animals in laboratory tests involving toxic materials.</p> <p>5.3 Describe how the safety of chemical substances is defined with respect to exposure.</p> <p>5.4 Differentiate between exposure concentration and exposure dose including how they are related to one another.</p> <p>5.5 Define LD50 and how it is used.</p> <p>5.6 List the advantages of short-term toxicity testing.</p> <p>5.7 State reasons why some compounds are highly toxic when injected,</p>	<p>involving toxic materials.</p> <p>Give reasons why or why not chemical substances should be exposed.</p> <p>Differentiate between exposure concentration and exposure dose including how they are related to one another.</p> <p>Explain how LD50 is used.</p> <p>List the advantages of short-term toxicity testing.</p> <p>State reasons why some compounds are highly toxic when injected, but innocuous when ingested.</p>				defined with respect to exposure
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	but innocuous when ingested.					
General Objective 6.0: Understand the basic principles of epidemiology						
	<p>6.1 Define the following related terms of epidemiology:</p> <ul style="list-style-type: none"> • relative risk • absolute risk • confounding factors • protective factors; <p>6.2 Define the following term pairs: risk and proactive factors; retrospective and prospective studies</p> <p>6.3 Describe epidemiological studies and how it is linked to diseases</p> <p>6.4 Explain the expression “rate of occurrence</p> <p>6.5 Describe the</p>	<p>Explain the principles of Epidemiology as it relates to:</p> <p>-relative risk, absolute risk, confounding factors protective factors; retrospective and prospective studies</p> <p>Describe epidemiological studies and how it is linked to diseases.</p> <p>Explain the expression “rate of occurrence.</p> <p>Describe the limitations in using epidemiological studies to assess the</p>	<p>Whiteboard Text books Internet</p>	<p>Determine if an epidemiological study prove can be linked to diseases.</p>	<p>Guide students to determine if an epidemiological study prove can be linked to diseases</p>	<p>Explain the principles of Epidemiology</p>

	<p>limitations in using epidemiological studies to assess the toxicity or carcinogenicity of a chemical.</p> <p>6.6 Recognize the negative effect of substance that is carcinogen.</p>	<p>toxicity or carcinogenicity of a chemical.</p>				
General Objective 7.0: Understand the Transport and Fate of Contaminants on Ecosystems						
	<p>7.1 State What are the different kinds of stressors to which an ecosystem might be exposed to.</p>	<p>Explain 7.1 fully.</p>	<p>White board Text books Internet</p>			<p>State What are the different kinds of stressors to which an ecosystem might be exposed to</p>
General Objective 8.0: Know how Risks are estimated						
	<p>8.1 Determine the risk (carcinogenic) of working in an environment for 70 years that results in a chronic oral intake of 0.50 mg/(kg-day) of benzene.</p> <p>8.2 Determine the chemical specific risk</p>	<p>Explain how to calculate carcinogenic risks in an environment for 70 years that results in a chronic oral intake of 0.50 mg/(kg-day) of benzene.</p> <p>Explain how to</p>	<p>Whiteboard Text books Internet</p>	<p>Determine the risk (carcinogenic) of working in an environment for 70 years that results in a chronic oral intake of 0.50 mg/(kg-day) of benzene.</p>	<p>Guide the students to conduct:</p> <p>-determine the risk (carcinogenic) of working in an environment</p>	<p>Calculate carcinogenic risks</p>

	for an intake of 0.00025 mg/(kg-day) of benzene via ingestion with Water. 8.3 Determine the non-carcinogenic risk for an intake of 1mg/(kg-day) of phenol via ingestion with water	determine the chemical specific risk for an intake of 0.00025 mg/(kg-day) of benzene via ingestion with Water and the non carcinogenic risk for an intake of 1mg/(kg-day) of phenol via ingestion with water		Determine the chemical specific risk for an intake of 0.00025 mg/(kg-day) of benzene via ingestion with Water.	for 70 years that results in a chronic oral intake of 0.50 mg/(kg-day) of benzene. -determine the chemical specific risk for an intake of 0.00025 mg/(kg-day)	
General Objective 9.0: Understand the Process of risk management						
	9.1 Explain the process of risk management. 9.2 Calculate how to effectively lower risks by reducing one or more of the major components of severity, exposure and likelihood.	Explain how to Calculate the lower risks by reducing one or more of the major components of severity, exposure and likelihood in risk management	Whiteboard Text books Internet			Explain the process of risk management.
General Objective 10.0: Understand the Risk Assessment Phases using the class examples as a guide.						
	10.1 List the steps that would need to be	Lead students into the calculation of the steps it takes to assess the	Whiteboard Calculators	Identify steps needed to assess the copper site.	Guide students to identify needed to	List the steps required to assess the DDT site of a

	<p>taken to assess the copper site if a former municipal landfill exists from which copper is leaching into a large pond down gradient of the site.</p> <p>10.2 List the steps required to assess the DDT site of a former chemical production facility that spilled DDT, which has been transported into a nearby stream by surface water runoff,</p> <p>10.3 List the steps to assess the PCB site of a former waste-oil recycling facility that disposed of PCBs in a lagoon</p>	<p>copper site if a former municipal landfill exists from which copper is leaching into a large pond down gradient of the site and the steps required to assess the DDT site of a former chemical production facility that spilled DDT, which has been transported into a nearby stream by surface water runoff.</p> <p>Also calculate the steps to assess the PCB site of a former waste-oil recycling facility that disposed of PCBs in a lagoon from which extensive soil contamination had resulted</p>			<p>assess the copper site.</p>	<p>former chemical production facility that spilled DDT, which has been transported into a nearby stream by surface water runoff,</p>
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	from which extensive soil contamination had resulted					
General Objective 11.0: Understand the advantages of cost benefit analysis						
	<p>11.1 Define cost benefit analysis is.</p> <p>11.2 List the 11 steps of C-B analysis.</p> <p>11.3 Create a table to compare the different types of costs.</p> <p>11.4 List the methods to analysis a C-B study and identify the best overall method.</p> <p>11.5 Describe this best overall method from the previous objective.</p>	<p>Explain cost benefit analysis</p> <p>Create a table for comparing different types of cost benefits</p>	Whiteboard Calculators			List the methods to analysis a C-B study and identify the best overall method

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: FUNDAMENTALS OF GEO-INFORMATICS	CODE: ESM 315	Credit Unit: 2.0	CONTACT HOURS: 2 HOURS/WEEK
GOAL: The course is designed to give students an understanding of principles of surveying and undertaking field surveying required for environmental and safety management projects.			
YEAR: ONE (1), SEMESTER: ONE (1)	PRE-REQUISITE:	PRACTICAL: 0 HOURS/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <ul style="list-style-type: none"> 1.0 Know the Fundamental Concepts of Surveying 2.0 Understand Surveying 3.0 Know Survey Drawing Techniques 4.0 Understand leveling 5.0 Know traversing 6.0 Know triangulation 7.0 Know tacheometry 			

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
Course: fundamentals of geo-informatics		Course Code: 315		Credit Unit: 3.0		Contact Hours: 3
GOAL: The student on completion of this course should have a sound understanding of principles of surveying and be able to undertake field surveying required for environmental and safety management projects						
Course Specification: hrs			Theoretical Content: 2		Practical Content: 1hrs	
GENERAL OBJECTIVE 1.0: Know the Fundamental Concepts of Surveying						
Course Specification: CONTENT			THEORETICAL		PRACTICAL CONTENT	
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Define Surveying 1.2 Distinguish between the following major divisions of surveying: (i) geodetic surveying (ii) plane surveying 1.3 State the uses of plane surveying (e.g. maps and plans, geographical, geological engineering, military purpose etc.). 1.4 Explain the	Develop instructional manual for teaching this Course. Explain the fundamental concepts of surveying. Explain the relevance of surveying to mining industry and the various professions	Instructional Manual. Recommended textbooks, e- books, lecture notes, Whiteboard, PowerPoint Projector, Screen, Magnetic Board, flip charts, etc.			State the uses of plane surveying.

	<p>threestages of surveying process.</p> <ul style="list-style-type: none"> • Reconnaissance • Observational and Measurements • Presentation <p>1.5 Explain the basic principles of surveying measurements (linear and angular)</p> <p>1.6 State the branches of surveying in mineral exploration and exploitation</p>	<p>where surveying is significant</p>				
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General Objective 2.0: Understand Surveying						
3-4	<p>2.1 Review trigonometric ratios of common angles</p> <p>2.1 Solve problems involving triangles (sine rule, cosine rule, area of triangle, Napier's tangent rule).</p>	<ul style="list-style-type: none"> Revise trigonometric ratios and solve problems involving triangles 	<p>Instructional manual</p> <p>Recommended textbooks</p> <p>eBooks, lecture note, whiteboard</p> <p>PowerPoint Projector, screen magnet board</p> <p>flip charts etc</p>	<ul style="list-style-type: none"> - 	<ul style="list-style-type: none"> - 	<p>Solve problems involving triangles</p> <p>(sine rule, cosine rule, area of triangle, Napier's tangent rule).</p>
General Objective 3.0: Know Survey Drawing Techniques						
5-6	<p>3.1 Explain the use of scales and handling of other drawing instruments</p>	<p>Explain the use of basic survey drawing techniques</p>	<p>PowerPoint Projector, Screen Magnetic Board, flip charts, etc</p>	<p>Identify all the drawing instruments (compasses, dividers, protractors, set squares, pencil, etc.)</p> <p>Demonstrate the procedure for ink-</p>	<p>Guide students to:</p> <p>-Identify all the drawing instruments (compasses, dividers, protractors, set squares, pencil, etc.)</p>	<p>Explain the use of scales and handling of other drawing instruments</p>

				drawing and lettering techniques	Guide students to demonstrate the procedure for ink-drawing and lettering techniques	
GENERAL OBJECTIVE 4.0: Understand leveling						
7-9	<p>4.1 Define leveling</p> <p>4.2 Explain the following terms related to leveling: datum; level surface, line of collimation, mean sea level, bench mark</p> <p>4.3 Describe the basic principle of leveling</p> <p>4.4 Explain the following leveling procedure</p> <ul style="list-style-type: none"> • compound leveling • flying level 	<p>Explain the terms related to leveling: datum; level surface, line of collimation, mean sea level, bench mark and the following leveling procedure</p> <ul style="list-style-type: none"> • compound leveling • flying level • profile leveling. <p>Explain the effect of each curvature and atmospheric</p>	<p>PowerPoint</p> <p>Projector, Screen, Magnetic Board, flip charts, etc</p> <p>Practical Manual.</p> <p>Theodolite, ranging rods, ranging staff, survey record book</p>	<p>Measure horizontal and vertical angles using theodolite.</p>	<p>Guide students to measure horizontal and vertical angles using theodolite</p>	<p>Describe the effect of each curvature and Atmospheric refraction on Leveling.</p>

	<ul style="list-style-type: none"> • profile leveling • reciprocal leveling. <p>4.5 Explain the reduction of leveling results by</p> <ul style="list-style-type: none"> • rise and fall method, and • height of collimation method <p>4.6 Describe the effect of each curvature and atmospheric refraction on leveling.</p> <p>4.7 State typical errors that may occur in leveling.</p>	<p>refraction on leveling.</p> <p>Enumerate errors that may occur in leveling.</p>				
GENERAL OBJECTIVE 5.0: Know traversing						
10-11	<p>5.1 Define Traversing</p> <p>5.2 Describe the principle of traversing</p>	<p>Explain the concept of traversing</p>	<p>Whiteboard PowerPoint Projector, Screen, Magnetic Board, flip charts, etc</p>	<p>Perform calculations of bearings, distances and co-ordinates from traverse surveys</p>	<p>Guide students to perform calculations of bearings, distances</p>	<p>Explain the concept of traversing</p>

	<p>5.3 Explain the methods of Adjustment of closed Traverses Bowditch method and transit method</p> <p>5.4 Perform calculations of bearings, distances and Co-Ordinates from traverse surveys</p>	Solve problems of bearings, distances and coordinates from traverse surveys			and co-ordinates from traverse surveys	
GENERAL OBJECTIVE 6.0: Know triangulation						
12-14	<p>6.1 Define triangulation</p> <p>6.2 Describe the principle of Triangulation</p> <p>6.3 State application of Triangulation</p> <p>6.4 Enumerate other parameters of triangulation such as selection, beaconing numbering of triangulation stations baseline azimuth determination, extension of connected</p>	Describe the triangulation principles and its methods of measurement	Whiteboard PowerPoint Projector, ScreenMagnetic Board, flip charts, etc. lecture notes			Describe the triangulation principles and its methods of measurement

	<p>triangles, angular repetition, reciprocal observations, angular misclosure field measurement checks etc</p> <p>6.5 Explain methods of measurement of triangulation angles (re-iteration and repetition methods)</p> <p>6.6 Explain method of adjusting values of triangulation angles (triangle Braised quadrilateral and polygonal adjustments).</p> <p>6.7 Write angular observations in conventional forms</p>					
<p>General Objective 7.0: Know tacheometry</p>						
	<p>7.1 Define tachometry</p> <p>7.2 Describe the</p>	<p>Explain the concepttachometry and the</p>	<p>Whiteboard PowerPoint Projector, Screen,Magnetic board flip charts, etc.</p>	<p>Conduct a tachometric exercise.</p> <p>Determine</p>	<p>Guide students to: -conduct a tachometric exercise.</p>	<p>Explain tachometric methods for plotting contours</p>

	<p>principle of the stadia-system (fixed-hair and sub tenses tachometers)</p> <p>7.3 Describe the determination of tachometric constant</p> <p>7.4 Describe the sub tenses system Outline the optical wedge system.</p> <p>7.5 Explain tachometric methods for plotting contours</p> <p>7.5 Observe small vertical angles precisely by repetition</p> <p>7.6 Determine horizontal distance using vertical stage and tachometry</p> <p>7.7 Explain the special characteristics and use of self-reducing tachometers Measure distances using a</p>	<p>determination of tachometric constants.</p> <p>Describe sub tenses System Asses with good examples activities in 1.1 to 1.5 and ask the students to solve problems on them.</p>	<p>Engineer's level Field book drawing paper, pencil, rules, eraser Practical Manual. Theodolite tachometers Staff</p> <p>Ranging Poles</p>	<p>tachometric constants from field measurement.</p> <p>Plot contours from tachometric measurements Carry out compass traversing of a closed figure</p>	<p>-determine tachometric constants from field measurement.</p> <p>-plot contours from tachometric measurements carry out compass traversing of a closed figure</p>	
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	theodolites as tacheometer 7.8 Determine spot heights and survey detail by tacheometry					
ASSESSMENT: The continuous assessment; tests and quizzes will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.						

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: ENVIRONMENTAL ECONOMICS	CODE: ESM 316	Credit Unit: 2.0	CONTACT HOURS: 2 HOURS/WEEK
GOAL: This course is designed to expose students to the economic ways of harnessing environmental resources in a suitable way			
YEAR: ONE (1), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 0 HOURS/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the student should be able to:</p> <ol style="list-style-type: none"> 1.0 Understand the scope and concept of environmental economics 2.0 Understand the impact of excessive exploitation of environmental resources 3.0 Understand the implication of economic projects on the environment. 4.0 Understand the cost-benefits of conservation. 5.0 Understand the implication of economic globalization and market system on the conservation of nature. 6.0 Understand the ecotourism potentials of the Nigerian environment. 			

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY

Course: Introduction to **Course Code:** 316 **Credit Unit:** 2.0 **Contact Hours:** 2

GOAL: This course is designed to expose students to the economic ways of harnessing environmental resources in a suitable way.

Course Specification: **THEORETICAL** **PRACTICAL CONTENT: 0**
CONTENT

General Objective 1.0: Understand the scope and concept of environmental economics

Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Define environmental economics. 1.2 Describe the relationship between environment and economics. 1.3 Explain the major economic indicators in environmental economics. 1.4 Explain the concept of environmental sustainability. 1.5 List factors militating against environmental sustainability e.g. overutilization, over exploitation of natural resources e.t.c.	Explain environmental economics and relationship between environment and economics. Explain the major economic indicators in environmental economics and the concept of environmental sustainability.	Multimedia. Projector, ScreenMagnetic Board,	-	-	State factors militating against environmental sustainability

General Objective 2.0: Understand the impact of excessive exploitation of environmental resources						
4-5	<p>2.1 Define environmental resources.</p> <p>2.1 Explain the concept of use, overutilization and overexploitation of natural resources.</p> <p>2.3 Explain the impacts of excessive exploitation of natural resources on the environment.</p>	<p>Explain the factors militating against Environmental sustainability e.g. overutilization, over exploitation of natural resources</p>	<p>Multimedia, Projector, Screen Magnetic Board.</p>		-	<p>List the impacts of excessive exploitation of</p>
General Objective 3.0: Understand the implication of economic projects on the environment.						
6-7	<p>3.1 List the characteristics of economic projects.</p> <p>3.2 List examples of economic and environmental projects in Nigeria.</p> <p>3.3 List the implications of economic projects on the environment.</p>	<p>Explain the characteristics of economic projects.</p> <p>Explain the examples of economic and environmental projects in Nigeria.</p> <p>Explain the implications of economic projects on the environment.</p>	<p>Multimedia, Projector, Screen Magnetic Board.</p>			<p>List the characteristics of economic projects and their implications for the environment.</p>
General Objective 4.0: Understand the cost-benefits of conservation.						

8-10	<p>4.1 Define environmental conservation.</p> <p>4.2 Explain the concept of cost-benefit analysis.</p> <p>4.3 Explain cost-benefit of projects under:-</p> <ul style="list-style-type: none"> • External and internal costs • The cost of environmental regulation • The benefit of environmental regulation 	Explain items 4.1 –4.3	Multimedia, Projector, Screen Magnetic Board.			Outline cost- benefit of environmental projects.
General Objective 5.0: Understand the implication of economic globalization and market system on the conservation of nature						
11	<p>5.1 Define economic globalization and market system.</p> <p>5.2 Describe the impacts of economic globalization and market system on nature conservation.</p>	Explain the impacts of economic globalization and market system on nature conservation	Multimedia, Projector, Screen Magnetic Board.			Explain the impacts of economic globalization and market system on nature conservation.
General Objective 6.0: Understand the ecotourism potentials of the Nigerian environment.						

12-13	6.1 Define ecotourism 6.2 State some of the major ecotourism sites such as parks, lakes, waterfalls etc across the different geo-political zones of Nigeria.	Explain ecotourism And give some of the major ecotourism sites such as parks, lakes, waterfalls etc across the different geo-political zones of Nigeria.	Multimedia, Projector, ScreenMagnetic Board.	-	-	Describe the economic potentials of ecotourism site in any geo- political zone of Nigeria..
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ASSESSMENT: The continuous assessment; tests, quizzes, field works etc. will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.

YEAR ONE, SEMESTER TWO COURSES

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Environmental Auditing and Management Systems	CODE: 321	Credit Unit: 3	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course is designed to provide students with the skills and knowledge required to develop Environmental Management System and Auditing			
YEAR: ONE (1), SEMESTER: two (2)	PRE-REQUISITE: none	PRACTICAL: 1HOURS/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <ol style="list-style-type: none"> 1.0 Understand the introduction to environmental systems and organization 2.0 Understand Environmental Management Planning, Leadership and Support system 3.0 Understand Emergency Preparedness and Response System 4.0 Know the Environmental Management System Audit 5.0 Understand EMS Auditing Tools and Techniques 6.0 Know the elements of Environmental Audit 7.0 Understand the need for resource efficiency 8.0 Understand the benefits of Auditing 			

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
Course: Environmental Auditing and Management Systems		Course Code: ESM 321		Credit Unit: 3		Contact Hours: 3
GOAL: This course is designed to provide students with the skills and knowledge required to develop Environmental Management System and Auditing						
Course Specification:			THEORETICAL		PRACTICAL CONTENT	
CONTENT						
General Objective 1.0: Understand the Introduction to Environmental Systems and Organization						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Explain Environmental Management System (EMS) 1.2 Explain the scope of Environmental Management System 1.3 Define the organization and its context 1.4 Explain what the International Organization for Standardization (ISO) is. 1.5 Explain why the ISO is developing the ISO 14000 standards series. 1.6 Describe the process leading up to the	Explain the term environmental management system Explain the full meaning of International Organization for Standardization (ISO) families and their objectives and functions. Explain the relationship of ISO and Sustainable Development Goal (SDG).	-projector -textbook -internet -lecture note -tutorial	Identify the different types of ISO family	Guide the student to identify different types of ISO	Explain the scope of Environmental Management System

	<p>development of the standard.</p> <p>1.7 Explain what the ISO/TC207 is and its purpose.</p> <p>1.8 List the primary potential benefits of an EMS</p> <p>1.9 Explain using examples, benefits of an EMS</p> <p>1.10 Explain ISO 14001 and the ISO 14000 family (Families)</p> <p>1.11 Compare and contrast the ISO 14001 and ISO 14004</p>					
<p>General Objective 2.0: Understand Environmental Management Planning, Leadership and Support system</p>						

4-5	<p>2.1 Explain the role of leadership and commitment</p> <p>2.2 State the environmental policies</p> <p>2.3 Explain organization roles, responsibilities and authorities</p> <p>2.4 List the actions to be taken to address risks and opportunities</p> <p>2.5 Explain environmental aspects</p> <p>Explain environmental compliance and obligations</p> <p>2.7 Explain environmental objectives and planning</p> <p>2.8 Explain the following:</p> <ul style="list-style-type: none"> • Environmental resources • competence • awareness • communication • Documented information 	<p>Explain leadership</p> <p>State the various environmental policies</p> <p>Explain environmental policies</p> <ul style="list-style-type: none"> • Explain environmental compliance and obligations 	<p>-projection</p> <p>-textbooks</p> <p>- internet</p> <p>- lecture notes</p> <p>tutorial</p>	<p>Identify possible leadership qualities that can make an industry grow</p>	<p>Guide the student to identify possible leadership qualities that can make an industry grow</p>	<p>Explain environmental compliance and obligations</p>
<p>General Objective 3.0: Understand Emergency Preparedness and Response System</p>						

6-7	<p>3.1 Explain emergency management of industrial system</p> <p>3.2 Explain Emergency Planning Ideals and Implementation</p> <p>3.3 Compare and contrast Communication and incident assessment</p> <p>3.4 Distinguish between operational planning and control measures</p> <p>3.5 Compare and contrast Preparedness phase and response measures</p> <p>3.6 List International emergency management society</p> <p>Explain Incident Stabilization</p>	<p>Explain Emergency planning Ideals and implementation</p> <p>Explain preparedness phase and response</p>	<p>-projection</p> <p>-textbooks</p> <p>- internet</p> <p>- lecture notes</p> <p>tutorial</p>	<p>Identify steps for developing the emergency response plan</p>	<p>Guide the students in identifying various emergency response plans.</p>	<p>Explain Emergency planning Ideals and implementation</p>
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General Objective 4.0: Know the Environmental Management System Audit						
8-10	4.1 Explain Management system audit 4.2 List the types of environmental audits (e.g , site, compliance, social) 4.3 List key process of elements of environmental audits. (List the key elements of environmental audit) 4.4 Explain the significance of environmental audit 4.5 Explain management review 4.6 List Audit tools and Technology used in Environmental Audit 4.7 Describe Environmental compliance audit 4.8 Describe Discuss Evaluation of Compliance 4.9 Describe the scope of the ISO 14012 standard. 4.10 List personal attributes and skills an auditor should possess	Explain the different types and forms of environmental audit List the audit tools and technology	-projection -textbooks - internet - lecture notes tutorial	Carry out a specific environmental audit	Guide the studentsto carry out an environmental audit	Explain the different typesand forms of environmentalaudit

	<p>4.11 Describe the key elements of the ISO 14010</p> <p>4.12 Give a case study or examples; analyze it using the ISO 14010 standard</p>					
General Objective 5.0: Understand EMS Auditing Tools and Techniques						
11	<p>5.1 List the key elements of the ISO 14011 standard.</p> <p>5.2 Analyze key elements of the ISO 14011 standard.</p> <p>5.3 List the seven EMS audit techniques and tools that can be used to make audit more efficient and effective.</p> <p>5.4 Describe the EMS audit techniques or tool.</p> <p>5.5 Explain the benefits to the EMS Auditor of using the EMS audit tool.</p>	<p>Explain the key elements of the ISO 14011 standard.</p> <p>State the seven EMS audit techniques and tools that can be used to make audit more efficient and effective.</p> <p>Explain the EMS audit techniques or tool.</p>	<p>-projection</p> <p>-textbooks</p> <p>- internet</p> <p>- lecture notes tutorial</p>			<p>List the seven EMS audit techniques and tools that can be used to make audit more efficient and effective.</p>

		Explain the benefits to the EMS Auditor of using the EMS audit tool.				
General Objective 6.0: know the element of environmental audit						
12-13	6.1 Describe the basic aim of environmental auditing 6.2 Explain the foundational element of environmental Audit 6.3 explain the types of environmental audit 6.3 describe the main component of environmental audit 6.4 Explain the steps involve in an environmental audit 6.5 Explain the principle of environmental audit	Explain 6.1 -6.6 with detailed note	Marker, marker board, projector. Charts.			Describe the basic aim of environmental auditing explain the types of environmental audit
General Objective 7.0: Understand the need for resource efficiency						

14	7.1 Differentiate between environmental and resource efficiency 7.2 Explain the importance of resource efficiency in environmental auditing 7.3. Describe the steps involve in identifying resource efficiency issues	Explain 7.1 -7.3 with detailed note	Marker, marker board, projector. Charts	▪	▪	Differentiate between environmental and resource efficiency
GENERAL OBJECTIVE 8.0: Understand the benefit of audit						
	8.1 explain the benefit of audit 8.2 What are the benefit of environmental Audit to industries 8.3 explain the important role of an environmental auditor 8.4 Explain the objectives of environmental Audit	Explain 8.1- 8.4	Marker, marker board, projector. Charts			explain the benefit of audit What are the benefit of environmental Audit to industries

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: ERGONOMICS	CODE: 322	Credit Unit: 2.0	CONTACT HOURS: 2 HOURS/WEEK
GOAL: This course is designed to enable the student know the purpose of Ergonomics in the work place			
YEAR: ONE (1), SEMESTER: TWO (2)	PRE-REQUISITE: None	PRACTICAL: 0 HOURS/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <ol style="list-style-type: none"> 1.0 Know the Meaning and Significance of Ergonomics in Industrial Safety 2.0 Understand Human Biological Systems Essential to Ergonomics 3.0 Understand Ergonomics in Physical Effort Tasks 4.0 Know the Effects of Environment on Performance in Physical Work 5.0 Understand Ergonomics in Psychomotor Tasks 6.0 Understand Ergonomics in Visual Inspection Tasks 7.0 Know Workplace Design in Ergonomics 			

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
Course: ERGONOMICS			Course Code: ESM 322	Credit Unit: 2.0	Contact Hours: 2	
GOAL: This course is designed to acquaint the student with the						
Course Specification:			THEORETICAL	PRACTICAL CONTENT		
CONTENT						
General Objective 1.0: know the meaning and significance of ergonomics in industrial safety						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Define ergonomics 1.2 Explain the significance of ergonomics 1.2 State factors relevant in ergonomics: nature of job, biological capability, body dimensions, acceptable working hours etc.	Defines Ergonomics List factors essential in ergonomics	-projection -textbooks - internet - lecture notes tutorial	▪ -	▪ -	List factors essential in ergonomics
General Objective 2.0: Understand Human Biological Systems Essential to Ergonomics						

4-5	<p>2.1 Name parts of the human skeleton and associated muscles for movement</p> <p>2.2 Explain heartbeat, breathing process and oxygen consumption/energy production at rest and at work.</p> <p>2.3 List the main parts of the central nervous system (CNS) and the peripheral nervous system (sensory and motor nerve)</p> <p>2.4 State the pathway of nervous impulse in reflex action and a voluntary action.</p> <p>2.5 Explain the risk factors for musculoskeletal injuries</p> <p>2.6 Discuss two Ergonomic solutions to reduce the risk factors for musculoskeletal injuries</p>	<p>Describe the components of the human skeleton and associated muscles for movement.</p> <p>Explain process essential in ergonomics both at rest and at work.</p> <p>Describe the nervous system, reflex and voluntary actions</p> <p>Show ergonomics checklist for task</p>	<p>-projection</p> <p>-textbooks</p> <p>- internet</p> <p>- lecture notes</p> <p>tutorial</p>	<p>Identify two Ergonomic solutions to reduce the risk factors for musculoskeletal injuries</p>	<p>Guide students to identify two Ergonomic solutions to reduce the risk factors for musculoskeletal injuries</p>	<p>Describe the components of the human skeleton and associated muscles for movement</p>
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General Objective 3.0: Understand Ergonomics in Physical Effort Tasks

6-7	<p>3.1 Explain the three main types of physical effort tasks – full body dynamic work, localized muscular work, static muscular work.</p> <p>3.2 Explain parameters for measurement of physical work – oxygen consumption, heart beat rate, blood pressure, body temperature, sweat rate.</p> <p>3.3 Explain the factors influencing results in 3.2 such as sex, age, environment, etc.</p> <p>3.4 Explain work and rest cycles, recovery time formula and its importance in rest pauses during physical effort tasks.</p> <p>3.5 Explain biomechanical factors in work and some causes of disability of biomechanical origin</p>	<p>Describes physical effort tasks and parameters for measurement of physical work.</p> <p>Describe and demonstrate the proper way to lift a load.</p> <p>Explain factors that influence parameters for measurement of physical work.</p> <p>Assign problems on work rest cycles and recovery time formula to students to solve.</p> <p>Explains biomechanical factors and causes of disability of biomechanical origin</p>	<p>-projection -textbooks - internet - lecture notes - tutorial ergonomics checklist for task</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Explain physical effort tasks and parameters for measurement of physical work</p>
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		Show ergonomics checklist for task				
General Objective 4.0: Know the Effects of Environment on Performance in Physical Work						
8-10	<p>4.1 Explain the effect of heat on performance at work.</p> <p>4.2 State factors which influence gain or loss heat – ambient temperature, relative humidity, air velocity, radiant heat.</p> <p>4.3 Explain anti action of heat load – length of time a man carryout a specific task in a particular thermal environment.</p> <p>4.4 Explain heat stress index and the basis.</p> <p>4.5 Explain reduction of heat stress in a work environment.</p>	<p>Explains how heat can affect work performance</p> <p>Describes factors that influence gain or loss of heat.</p> <p>Gives the formula for heat stress index and ask students to determine the heat stress index of the environment.</p> <p>• Explain the control of heat stress in the work environment</p>	<p>-projectio n</p> <p>-textbooks</p> <p>- internet</p> <p>- lecture notes</p> <p>tutorial</p>			Describes factors that influence gain or loss of heat.
General Objective 5.0: Understand Ergonomics in Psychomotor Tasks						
11	5.1 Define psychomotor tasks and list distinguishing features and examples of psychomotor tasks e.g.	Explains Psychomotor tasks and enumerates distinguishing	<p>-projection</p> <p>-textbooks</p> <p>- internet</p> <p>- lecture notes</p>	▪ -	▪ -	Explains Psychomotor tasks and enumerates distinguishing features.

	<p>automobile driving.</p> <p>5.2 Describe task evaluation in psychomotor tasks.</p> <p>5.3 Explain the effects of excessive standing and excessive sitting in tasks and the remedy.</p>	<p>features.</p> <p>Describes task evaluation.</p> <p>Guide students to compare and contrast the effects of excessive standing and sitting in tasks and their remedies.</p>	tutorial			
General Objective 6.0: Understand Ergonomics in Visual Inspection Tasks						
12-13	<p>6.1 State the meaning of visual inspection tasks and the two main categories – acceptance inspection and process control.</p> <p>6.2 State factors significant in the design of inspection tasks – vision and illumination, sensory memory, psychological and social factors.</p> <p>6.3 Explain factors that influence detecting and discrimination of signal characteristics in human vision during inspection</p>	<p>Explains Visual Inspection Tasks and categories.</p> <p>State factors significant in the design of inspection tasks.</p> <p>List out factors that influence the detection and discrimination of signal characteristics.</p> <p>Explain psychological factors that influence</p>	<p>-projection</p> <p>-textbooks</p> <p>- internet</p> <p>- lecture notes</p> <p>- tutorial ergonomics checklist for task</p>	-	-	State factors significant in the design of inspection tasks.

	<p>tasks – niuty glare, ageetc.</p> <p>6.4 Explain the psychological factors of training alertness, perceptual organization, learning and motivation in effectiveness in visual inspection tasks.</p> <p>6.5 Explain conditions for good visual inspection task design – lack of ambiguity, work done small loots, adequate time etc.</p>	<p>effectiveness of visual inspection tasks.</p> <p>List condition for good visual inspection task designand show ergonomicschecklist for task</p>				
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General Objective 7.0: Know Workplace Design in Ergonomics

14	<p>7.1 Explain a good workplace design in relation to operator efficiency and safety.</p> <p>7.2 Define Anthropometry</p> <p>7.3 State the main anthropometric dimensions necessary forthe design of workplacesin regards to sitting and standing postures.</p> <p>7.4 Explain the meaningand significance of working surface and statedimensions of working</p>	<p>Explains a good workplace design</p> <p>Explains Anthropometry and anthropometric dimensions for workplace design.</p> <p>Explains the meaningand significance of -work envelope - workplace height - footrest and foot pedals</p>	<p>-projection</p> <p>-textbooks</p> <p>- internet</p> <p>- lecture notes</p> <p>- tutorial</p> <p>-ergonomicschecklist for task</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Explain the meaning and significance ofworking surface and state dimensions of working surface for males and females.</p>
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	<p>surface for males and females.</p> <p>7.5 Explain the meaning and significance of working envelope and state dimensions for right hand side of the maximum working envelope for males and females.</p> <p>7.6 Explain the meaning and significance of workplace height and describe the design dimensions of a sit-stand, standing, and sitting workplaces.</p> <p>7.7 Explain the significance of and state good design parameters of footrests and foot pedals.</p> <p>7.8 Explain selection of fixed or swivel chairs in particular jobs and state the generally acceptable chair dimensions in relation to industrial population.</p>	<p>Describe the types of chairs in particular jobs and acceptable chair dimensions.</p> <p>Show ergonomics checklist for task</p>				
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PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Instrumentation and laboratory analysis	CODE: ESM 325	Credit Unit: 3.0	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course is designed to equip students with the scientific knowledge to carry out laboratory analysis with scientific Equipment .			
YEAR: ONE (1), SEMESTER: ONE (1)	PRE-REQUISITE:	PRACTICAL: 2 HOURS/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <ol style="list-style-type: none"> 1.0 Understand the principles and instrumentation of and colorimeter spectrophotometer and colorimeter. 2.0 Know the operation and care of flame photometer and spectrometers. 3.0 Know the operation and care of Atomic absorption spectrophotometers (AAS). 4.0 Know the operation and care of the X-ray spectroscope. 5.0 Know the operation and care of electrolytic conductivity bridge; coulometric titration; PH meter; auto titration; polarograph. 6.0 Know the operation and care of radioactive detectors and counters. 7.0 Understand the operation and care of gas chromatographic equipment, fluorimeter, polarimeter and refractometer. 8.0 Know the concept of hydrogen ion concentration. 9.0 Know the various types of electrodes used in measuring ions like fluoride, nitrate, etc. 10.0 Know the principles of autoradiography. 11.0 Know the use and maintenance of colony counter. 			

12.0 Know the use and maintenance of autoclave, centrifuge and incubator

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL AND SAFETY MANAGEMENT TECHNOLOGY

Course: Instrumentation and Laboratory Analysis **Course Code:** ESM 325 **Credit Unit:** 3 **Contact Hours:** 3

GOAL: This course is designed to provide the student

Course Specification: **Theoretical** **Practical Content:** 2 hrs
Content: 1hrs

GENERAL OBJECTIVE 1.0: Understand the Principles and Instrumentation of colorimetry and spectrophotometry

Course Specification: **THEORETICAL** **PRACTICAL CONTENT**
CONTENT

Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 State the wave length within the electromagnetic spectrum. 1.2 Distinguish between wavelength of light within the visible region and invisible region. 1.3 Explain the similarities in the working principle of the colorimeter and spectrophotometer. 1.4 Identify the various parts of a	Explain the differences between wavelength of light within the visible region and invisible region and the similarities in the working principle of the colorimeter and spectrophotometer. Exemplify the various parts of a colorimeter and the functions of	Relevant transparencies; Overhead projector Colorimeter; Spectrophotometer; Filters. Spectrophotometer samples solvents Screw driver; Fine brush; Bellow brush; Lens tissue.	Carry out measurement using colorimeters. Carry out routine maintenance on the colorimeter e.g. care of filters and cuvettes. Determine concentration of samples applying	Guide students to: -carry out measurement using colorimeters. -carry out routine maintenance on the colorimeter e.g. care of filters and cuvettes.	What are the similarities in the working principle of the colorimeter and spectrophotometer

	<p>colorimeter. 1.5 Explain the functions of the parts in 1.4 above. 1.6 State basic similarities and differences between a colorimeter and spectrophotometer. 1.7 Explain the limitations of colorimeter in microbiological studies. Explain the term spectrophotometry. 1.9 List the various sources of light for spectrophotometric determination. 1.10 Describe diffraction grating 1.11 Explain the functions of diffraction grating in spectrophotometry. 1.12 Explain the term interference</p>	<p>the parts in 1.4 above.</p> <ul style="list-style-type: none"> • Explain the similarities and differences between a colorimeter and spectrophotometer <p>Explain the functions of diffraction grating in spectrophotometry. the term interference filter.</p> <p>Explain the function of optical filter in spectrophotometry. State the basic laws of spectrophotometry viz: Bonger Lambert's law, Beer's law.</p> <p>Explain the working principles</p>		<p>Beer - Lambert's Law and using spectrophotometer.</p> <p>Carry out minor maintenance work on the spectrophotometer e.g. dusting, replacement of lamps etc.</p>	<p>-determine concentration of samples applying Beer - Lambert's Law and using spectrophotometer.</p> <p>-Carry out minor maintenance work on the spectrophotometer e.g. dusting, replacement of lamps etc.</p>	
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	<p>filter.</p> <p>1.13 State the function of optical filter in spectrophotometry.</p> <p>1.14 State the basic laws of spectrophotometry viz: Bonger Lambert's law, Beer's law.</p> <p>1.15 Explain the working principles of the spectrophotometer.</p> <p>1.16 List the functions of the parts in the optical system of a spectrophotometer.</p> <p>1.17 List the different types of detections used in spectrophotometry.</p> <p>1.18 List the functions of parts in the optical system of a spectrophotometer.</p> <p>1.8 List the different types of detection used in spectrophotometry.</p>	<p>of the spectrophotometer.</p> <p>List the functions of the parts in the optical system of a spectrophotometer.</p> <p>List the different types of detections used in spectrophotometry.</p>				
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GENERAL OBJECTIVE 2.0: Know the operation and care of flame photometers and spectrometers

3-4	<p>2.1 Explain the principle of operation of the flame photometer.</p> <p>2.2 Explain the various parts of a photometer.</p> <p>2.3 State the functions of the various parts of atomizer, e.g. carbon rod.</p> <p>2.4 State the similarities and differences between the spectrophotometer and flame photometer.</p> <p>2.5 List the errors inherent in practical flame photometry and how they can be corrected particularly as applied to biology.</p> <p>2.6 Explain how to correct the errors in 2.5 above.</p> <p>2.7 Describe parts of the Spectrometers.</p> <p>2.8 Explain the functions of the parts</p>	<p>Explain the various parts of a photometer. and the functions of the various parts of atomizer, e.g. carbon rod.</p> <p>State the similarities and differences between the spectrophotometer and flame photometer.</p> <p>List the errors inherent in practical flame photometry and how they can be corrected particularly as applied to biology.</p>	<p>Relevant transparencies; Overhead projector</p> <p>flame photometer Atomizer cleaning device. Lamp nose plier; Star screwdriver Calibrator.</p> <p>Service manual; Atomizer cleaning device; Lens tissue</p>	<p>Determine sodium, potassium and calcium using flame photometer omission spectrum.</p> <p>Clean atomizer using cleaning probe.</p> <p>Record spectra of known compound using Raman Spectrophotometer.</p> <p>Carry out routine maintenance on Spectrophotometer.</p> <p>Carry out typical maintenance routines for the flame</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -determine sodium, potassium and calcium using flame photometer omission spectrum. -clean atomizer using cleaning probe. -record spectra of known compound using Raman Spectrophotometer -carry out routine maintenance on Spectrophotometer 	<p>State the similarities and differences between the spectrophotometer and flame photometer.</p>
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	in 2.7 above.			photometer e.g. clearing deposits from the atomizer.	-carry out typical maintenance routines for the flame photometer e.g. clearing deposits from the atomizer.	
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GENERAL OBJECTIVE 3.0: Know the operation and care of Atomic Absorption Spectrophotometers (AAS)

5-6	<p>3.1 Explain how to Identify the parts of an AAS e.g. extension sources.</p> <p>3.2 Describe the working principle of each of the component parts of the AAS (especially the hollow cathode lamp).</p> <p>3.3 Describe the steps for operating the AAS.</p>	<p>Use diagrams and sketches AAS. Describe the working principle of each of the component parts of the AAS (especially the hollow cathode lamp).</p> <p>Explain the steps for operating the AAS</p>	<p>Relevant transparencies; Overhead projector</p> <p>AAS</p>	<p>Draw a schematic labeled diagram of the AAS.</p> <p>Measure the absorbance of a sample of known concentration using the AAS.</p> <p>Carry out routine maintenance on an AAS</p>	<p>Guide students to measure the absorbance of a sample of known concentration using the AAS.</p> <p>Guide students to carry out routine maintenance on an AAS</p>	<p>State the working principle of each of the component parts of the AAS</p>
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GENERAL OBJECTIVE 4.0: Know the operation and care of the X-ray spectroscope

7-9	<p>4.1 Explain how to Identify the parts of the X-ray spectroscope.</p> <p>4.2 Describe the parts listed in 4.1 above.</p> <p>4.3 Draw a block diagram of an X-ray spectroscope.</p> <p>4.4 Describe the operation and working principles of the units such as collimation, filters, analyzing crystals and detectors.</p> <p>4.5 Draw non-dispersive X-ray absorption meter.</p> <p>4.6 List the parts of an X-ray fluorescence spectrometer.</p> <p>4.7 Describe parts of an X-ray fluorescence spectrometer</p>	<p>Use diagrams and sketches to explain parts of the X-ray spectroscope.</p> <p>the parts listed in 4.1 above.</p> <p>4.3 Draw a block diagram of an X-ray spectroscope.</p> <p>Describe the operation and working principles of the units such as collimation</p>	<p>X-ray fluorescence spectrometer;</p> <p>Filters</p> <p>Lens tissue</p>	<p>Measure the absorption of a given sample using the X-ray instrument and also by varying the filters.</p> <p>Measure the absorption of a given sample using the X-ray instrument and also by varying the filters.</p> <p>Carry out routine care of the instrument e.g. cleaning of filters, verification of optical instruments.</p>	<p>Guide students to:</p> <p>-measure the absorption of a given sample using the X-ray instrument and also by varying the filters.</p> <p>measure the absorption of a given sample using the X-ray instrument and also by varying the filters.</p> <p>-carry out routine care of the instrument e.g. cleaning of filters, verification of optical instruments.</p>	<p>State the operation and working principles of the units such as collimation, filters, analyzing crystals and detectors.</p>
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GENERAL OBJECTIVE 5.0 Know the operation and care of electrolytic conductivity bridge; coulometric titration; PH meter; auto titration; polarograph

10-11	<p>5.1 List the component parts of: (i) Electrolytic conductivity bridge (ii) Coulometric titration (iii) Auto titration (iv) P^H meter (v) Polarography.</p> <p>5.2 Describe the various parts of the instruments in 5.1 above.</p> <p>5.8 Explain the principle of operation of the instruments in 5.1 above.</p>	<p>Use diagrams and sketches to explain the component parts of: (i) Electrolytic conductivity bridge (ii) Coulometric titration (iii) Autotitration (iv) P^H meter (v) Polarography.</p> <p>Explain the various parts of the instruments in and Explain the principle of operation of the instruments in 5.1 above</p>	<p>Conductivity Bridge; Coulometric Titriatry; Auto titrator; pH meter; Polarograph</p>	<p>Carry out various measurements using the instruments in 5.1</p> <p>Carry out routine care of the instruments in 5.1</p>	<p>Guide students to:</p> <p>-carry out various measurements using the instruments in 5.1</p> <p>-carry out routine care of the instruments in 5.1</p>	<p>List the component parts of: (i) Electrolytic conductivity bridge (ii) Coulometric titration (iii) Auto titration (iv) PH</p>
GENERAL OBJECTIVE 6.0: Know the operation and care of radioactive detectors and counters						
12-14	<p>6.1 List the various radioactive detectors and counters with photographic envision, ionization chambers and</p>	<p>Use diagrams and sketches to explain the various radioactive detectors and counters with</p>	<p>Radioactive sources; Geiger Muller counter; ionization counter; Proportional counter;</p>	<p>Obtain accurately the counts per second of a radioactive</p>	<p>Guide students to:</p> <p>-obtain accurately the counts per second of a</p>	<p>List the various radioactive detectors and counters with photographic</p>

	<p>proportional counters, scintillation counters, semi-conductor detectors, Geiger-Muller counter.</p> <p>Explain the operation of each detector and counter in 6.1 above.</p>	<p>photographic envision, ionization chambers and proportional counters, scintillation counters, semi-conductor detectors, Geiger- Muller counter</p>	<p>Semiconductor detector</p>	<p>source (emitter) using a gas counter.</p> <p>Measure counter per sec of a beta emitter using scintillating counter.</p> <p>Measure counts per sec for an emitter using proportional counters.</p> <p>Carry out routine care of detectors and counters in 6.1 above.</p>	<p>radioactive source(emitter) using a gas counter.</p> <p>-measure counter per sec of a beta emitter using scintillating counter.</p> <p>-measure counts per sec for an emitter using proportional counters.</p> <p>-carry out routine care of detectors and counters in 6.1 above.</p>	<p>envison, ionization chambers and proportional counters, scintillation counters, semi-conductor detectors, Geiger-Muller counter.</p>
<p>General Objective 7.0: Understand the operation and care of gas chromatographic equipment fluorimeter, polarimeter and refractometer</p>						
	<p>7.1 Explain gas chromatography</p>	<p>Use diagrams and sketches to explain parts of</p>	<p>Gas chromatograph Fluorimeter</p>	<p>Carry out measurements using instruments</p>	<p>Guide students to : -carry out</p>	<p>Identify the parts of: (i) Gas</p>

	<p>7.2 Identify the parts of: (i) Gas chromatograph (ii) Fluorimeter Polarimeter iv) Refractometer</p> <p>1 7.3 Explain the working principles of each instrument in 7.2 above</p>	<p>Gas chromatograph Fluorimeter Polarimeter Refractometer</p>	<p>Polarimeter Refractometer</p>	<p>in 7.2above. Carry out routine care and maintenance of instruments in 7.2</p>	<p>measurements using instruments in 7.2 above. carry out routine care and maintenance of instruments in 7.2</p>	<p>chromatograph Fluorimeter(iii) Polarimeter (iv) Refractometer</p>
<p>GENERAL OBJECTIVE 8.0: Know the concept of hydrogen in concentration</p>						
	<p>8.1 Explain the term pH 8.2 Explain why the pH scale ranges from 0 to 14. 8.3 State Bronsted-Lowry theory of acid and base. 8.4 Calculate the pH of an acid and a base applying the theory in 8.3 above. 8.5 Explain the functions of buffer with example. 8.6 Enumerate the main problems involved in pH measurement. 8.7 Explain how the problems in 8.6 above</p>	<p>Explain the term pH, pH scale ranges from 0 to 14. Explain Bronsted-Lowry theory of acid and base and calculate the pH of an acid and a base applying the theory. Explain the functions of buffer with example. p^H.</p>	<p>pH meter; Buffer tablets.</p>	<p>Determine the pH of solutions by using a pHmeter. Carry out routine maintenance of pH-meter e.g. cleaning and reactivation of the electrodes.</p>	<p>Guide students to measure pH of different solutions. Guide students to carry out routine maintenance of pH-meter e.g. cleaning and reactivation of the electrodes</p>	<p>State the usefulness of pH Enumerate the main problems involved in pH measurement</p>

	are overcome. 8.8 Describe The potentiometric method of determination of P ^H .					
GENERAL OBJECTIVE 9.0: Know the various types of electrodes used in measuring ions like fluoride, nitrate, etc.						
	9.1 Identify ion - selective electrodes 9.2 State the uses of ion -selective electrodes 9.3 Explain the basic principles of operations of an ion-selective electrode. Explain the relationship between activity and concentration of an ion. 9.5 List the various types of gas measuring electrodes. 9.6 Identify an oxygen electrode. 9.7 Identify the various uses of an oxygen electrode.	Explain the basic principles of operations of an ion-selective electrode, the relationship between activity and concentration of an ion and the various types of gas measuring electrodes: oxygen electrode, electrodes for pH measurement e.g. glass, combination. Explain the	Fluoride electrode; Ion- selective electrode; Oxygen electrode Glass electrode; Combination electrode	Measure accurately oxygen concentration using the gas measuring electrodes. Carry out maintenance of electrode including recharging.	Guide students to: -measure accurately oxygen concentration using the gas measuring electrodes. -carry out maintenance of electrode including recharging.	Explain the basic principles of operations of an ion- selective electrode

	<p>9.8 List electrodes for pH measurement e.g. glass, combination</p> <p>9.9 Describe the routine maintenance of electrodes e.g. in store in distilled water, use correct concentration of reactivator.</p>	<p>maintenance of electrodes.</p>				
<p>General Objective 10.0: Know the principle of autoradiography</p>						
	<p>10.1 Explain autoradiography</p> <p>10.2 Identify the components used in autoradiography</p> <p>10.3 Describe the applications of autoradiography</p> <p>10.4 Demonstrate the techniques of autoradiography.</p>	<p>Use diagrams and sketches to explain autoradiography, components used in autoradiography, the applications of autoradiography and the techniques of autoradiography.</p>	<p>Autoradiography Equipment</p>	<p>Demonstrate the techniques of autoradiography</p>	<p>Guide students to demonstrate the techniques of autoradiography</p>	<p>List the various techniques of autoradiography</p>
<p>General Objective 11.0: Know the use and maintenance of colony counters</p>						

	<p>11.1 Identify types of bacterial colony counters.</p> <p>11.2 Identify the parts of the counter in 13.1 above.</p> <p>11.3 Explain the function of each part in 13.2 above.</p> <p>9.5 Describe the principle of operation of the colony counter.</p>	<p>Use diagrams and sketches to explain the functions of different types of colony counters.</p>	<p>. Colony counter</p>	<p>Count bacteria colonies using colony counter.</p> <p>Carry out routine maintenance and repair of colony counters</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -count bacteria colonies using colony counter. -carry out routine maintenance and repair of colony counters. 	<p>Describe the principle of operation of the colony counter</p>
<p>General Objective 12.0: Know the use and maintenance of autoclave, centrifuge and incubator</p>						
	<p>12.1 State the functions of:</p> <ul style="list-style-type: none"> (a) Autoclave (b) Centrifuge (c) Incubator. <p>12.2 Identify the parts of the instruments in 12.1 above.</p> <p>12.3 Explain the functions of the parts in 12.2 above.</p>	<p>Use diagrams and sketches to explain the functions of:</p> <ul style="list-style-type: none"> (a) Autoclave (b) Centrifuge <p>Incubator.</p>	<p>Autoclaves; Centrifuge; Incubator</p>	<p>Sterilize centrifuge.</p> <p>Use centrifuge for separation.</p> <p>Grow organism using incubator</p> <p>Carry out routine maintenance of the instruments in 12.1</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -sterilize centrifuge for separation. -grow organism using incubator. --carry out routine maintenance of 	<p>State the functions of:</p> <ul style="list-style-type: none"> (a) Autoclave (b) Centrifuge <p>Incubator.</p>

					the instruments in 12.1	
ASSESSMENT: The continuous assessment; tests and quizzes will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.						

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Waste Utilization	CODE: 326	Credit Unit: 3	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course aims to equip the students with the knowledge and skills for treatment and conversion of waste materials into useful Products			
YEAR: ONE (1), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 2 HOURS/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <ol style="list-style-type: none"> 1.0 Understand the composition and characteristics of wastes 2.0 Know the basic principles of wastes hierarchy 3.0 Know the implications of poor waste handling to man's health and his environment 4.0 Know waste collection and disposal methods 5.0 Understand the concept of waste - to – wealth to create job openings. 			

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
Course: Waste Utilization		Course Code: ESM 326		Credit Unit: 2.0		Contact Hours: 1-0-2
GOAL: This course is designed to acquaints students with knowledge and skills for treatment and conversion of waste materials into useful Products						
Course Specification:			THEORETICAL	PRACTICAL CONTENT		
CONTENT						
General Objective 1.0: Understand the composition and characteristics of wastes						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Define waste 1.2 Classify wastes according to their sources: a) Domestic b) Municipal c) Industrial d) Agricultural e) Commercial and; f) Health care 1.3 Classify wastes according to their characteristics: (a) Combustible (b) Non-combustible (c) Hazardous	Explain the different kinds of waste found in the environment. Explain classification of waste according their sources as listed in 1.2 Explain characteristics of wastes listed in 1.3. Explain factors influencing waste generation Use the	Laptop White board Text Books Internet Projector Lecture Notes Samples	Identify different types of waste generated in the environment.	Guide the studentsto identify the different types of waste generated in the environment Guide students to display samples of wastes Guide students to conduct	Explain the different kinds of waste found in the environment

	<p>Non-hazardous.</p> <p>1.4 Classify wastes according to their physical appearance:</p> <ul style="list-style-type: none"> • Paper • Organics • Glass • Metals • Construction debris <p>1.5 Classify wastes according to nature:</p> <ul style="list-style-type: none"> • Solid • Liquid • Gaseous <p>1.6 Enumerate factors influencing Waste generation:</p> <ul style="list-style-type: none"> ▪ Population density ▪ Economic standing ▪ Social standing 	<p>physical appearances to classify waste as given in 1.4</p> <p>Use state of matter to classify waste as given in 1.5.</p> <p>Explain factors influencing Waste generation e.g.</p> <ul style="list-style-type: none"> • Population density • Economic standing • Social standing 			laboratory analysis of samples	
General Objective 2.0: Know the basic principles of wastes hierarchy						

4-5	<p>2.1 Define Waste hierarchy</p> <p>2.2 Explain the concept of Waste hierarchy</p> <ul style="list-style-type: none"> ▪ Waste prevention (Rejection) ▪ Waste minimization ▪ Waste recycling ▪ Waste recovery ▪ Waste treatment ▪ Waste disposal <p>2.3 State the purposes of Waste Hierarchy.</p> <p>2.4 Enumerate Waste minimization guide i.e.:</p> <ul style="list-style-type: none"> • Waste stream analysis • Waste reduction/minimization assessment. <p>2.5 Explain Waste stream analysis.</p> <p>2.6 Enumerate methods of waste disposal</p>	<p>Give the meaning of Waste hierarchy, purpose of waste hierarchy.</p> <p>Explain waste minimization:</p> <p>a) Waste stream analysis</p> <p>waste reduction/minimization Assessment</p> <p>Explain Waste stream analysis.</p> <p>Explain waste disposal methods</p>	<p>Laptop White board Text Books Internet Projector Lecture Notes Samples</p>	<p>Carry out field trips to waste management authorities.</p> <p>Observe waste collection and disposal practices.</p> <p>Identify the waste hierarchy i.e.</p> <p>Waste prevention (Rejection)</p> <p>Waste minimization</p> <p>Waste recycling</p> <p>Waste recovery</p> <p>Waste treatment</p> <p>Waste disposal.</p>	<p>Guide students to :</p> <p>-carry out field trips to waste management authorities.</p> <p>-observe waste collection and disposal practices.</p> <p>-identify the waste hierarchy i.e.</p> <p>Waste prevention (Rejection)</p> <p>Waste minimization</p> <p>Waste recycling</p>	
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				<p>Identify techniques of waste minimization.</p> <p>Identify waste disposal methods.</p> <p>Undertake waste stream analysis.</p>	<p>Wasterecovery</p> <p>Wastetreatment</p> <p>Wastedisposal.</p> <p>-identify techniquesof waste minimization.</p> <p>-identify waste disposal methods.</p> <p>-Undertake waste stream analysis.</p>	
General Objective 3.0: Know the implications of poor waste handling to man’s health and his environment						
6-7	<p>3.1 Name common pollutants in waste handling such as:</p> <ul style="list-style-type: none"> ▪ dioxins ▪ furans ▪ Nitrogen 	<p>Explain common pollutants in waste handling.</p> <ul style="list-style-type: none"> • Explain the health 	<p>Laptop White board</p> <p>Text Books</p> <p>Internet Projector</p> <p>Lecture Notes</p> <p>Samples</p>	<p>Identify health problems associated with waste handling such as:</p> <p>Reproductive</p>	<p>Guide students to:</p> <p>-identify health problems associatedwith waste handling</p>	<p>Explain the causative organisms of the health problems above, resultingfrom poor waste handling.</p>

	<p>Oxide</p> <ul style="list-style-type: none"> ▪ Sulphur Oxide ▪ Lead ▪ Cadmium ▪ Mercury ▪ Chromium, ▪ Arsenic ▪ Beryllium <p>3.2 Explain health problems associated with poor waste handling such as;</p> <ul style="list-style-type: none"> ▪ Reproductive effects ▪ Congenital malformations ▪ Cancer ▪ Cardiovascular disorders ▪ respiratory infection ▪ Hepatitis B ▪ Lassa fever 	<p>implications of poor handling of waste, e.g.</p> <ul style="list-style-type: none"> • Reproductive effects • Congenital malformations • Cancer • Cardiovascular disorders • respiratory infection • Hepatitis B • Lassa fever <p>Explain the causative organisms of the health problems above, resulting from poor waste handling</p>		<p>effects</p> <p>Congenital malformations Cancer Cardiovascular disorders respiratory infection Hepatitis B Lassa fever.</p> <p>Identify the causative organisms of the health problems above, resulting from poor waste handling.</p> <p>Identify pollutants in waste handling</p> <p>Identify the nature of pollutants inherent in waste handling.</p>	<p>such as:</p> <p>Reproductive effects Congenital malformations Cancer Cardiovascular disorders respiratory infection Hepatitis B Lassa fever.</p> <p>-identify the causative organisms of the health problems above, resulting from poor waste handling.</p> <p>-identify pollutants in waste handling</p> <p>identify the nature of pollutants</p>	
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					inherent in waste handling.	
General Objective 4.0: Know waste collection and disposal methods						
8-10	<p>4.1 Explain solid waste collection and disposal processes such as:</p> <ul style="list-style-type: none"> ▪ Generation ▪ Segregation ▪ Primary collection ▪ Secondary collection ▪ Treatment/Recovery ▪ Disposal <p>4.2 Explain solid waste disposal methods:</p> <ol style="list-style-type: none"> a) Open burning b) Incineration c) Composting d) Barging into sea e) Land Filling . <p>4.3 Name the liquid wastes e.g.</p> <ol style="list-style-type: none"> a) Sewage b) Sullage 	<p>• Explain the processes of solid waste collection and disposal listed in 4.1</p> <p>Explain the various methods of disposal of solid waste listed in 4.2.</p> <p>Explain the liquid wastes e.g.</p> <ol style="list-style-type: none"> d) Sewage e) Sullage f) Urine <p>Explain various means and/or facilities of disposal of excreta.</p> <p>Explain good practice of disposal of excreta vis-a-vis sewage management.</p> <p>Explain composition of excreta such as;</p>	<p>Laptop White board Text Books Internet Projector Lecture Notes Samples</p>	<p>Identify solid waste collection methods.</p> <p>Identify solid waste disposal collection methods.</p> <p>Identify liquid waste disposal methods.</p> <p>Identify various means and facilities of solid treatment and disposal.</p> <p>Identify various</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -identify solid waste collection methods. -identify solid waste disposal methods. -identify liquid waste collection methods. -identify liquid waste disposal methods. -identify various means and facilities of solid treatment and disposal. 	<p>Explain good practice of disposal of excreta vis-a-vis sewage management</p>

	<p>c) Urine</p> <p>4.4 Describe methods/ facilities of excreta disposal:</p> <p>a) Conservancy b) Pit latrine c) Sanplat latrine d) VIP latrine e) Pour flush latrine</p> <p>4.5 Enumerate composition of excreta such as;</p> <p>a) Nitrogen b) Phosphorus c) Potassium d) Organic carbon e) Pathogens</p> <p>4.6 Explain sewage disposal methods:</p> <p>a) Physical b) Chemical c) Biological</p>	<p>a) Nitrogen b) Phosphorus c) Potassium d) Organic carbon Pathogens</p> <p>Explain sewage disposal methods such as:</p> <p>a) Physical method b) chemical method Biological method</p>		<p>means and facilities of liquid waste treatment and disposal.</p> <p>Identify various means and facilities used in sewage management.</p>	<p>-identify various means and facilities of liquid waste treatment and disposal. identify various means and facilities used in sewage management</p>	
<p>General Objective 5.0: Understand the concept of waste - to – wealth to create job opening</p>						

11	<p>5.1 Define the term waste-to-wealth.</p> <p>5.2 Explain wealth creation from solid wastes e.g.</p> <p>a) Manure production from:</p> <p>i. House-hold wastes</p> <p>ii. Community waste composting into organic fertilizer</p> <p>b) Biogas Generation from:</p> <p>i. House-hold sewage</p> <p>ii. Municipal Solid wastes</p> <p>b) Conversion of Extruders</p> <p>c) Aggregators Rollers</p>	<p>Explain what waste-to-wealth means with examples.</p> <p>Explain how to collect, sort out, process and turn waste into useful products, examples in 5.2.</p> <p>Explain the process of wealth creation from waste waters e.g.</p> <ul style="list-style-type: none"> • Use of treated effluent for agriculture 	<p>Laptop Text Books Internet Projector Lecture Notes Samples</p>	<p>Perform conversion of waste materials to useful products.</p> <p>Identify locally-fabricated machines and processing equipment used in converting wastes-to-wealth e.g.:</p> <p>Hoppers Extruders Aggregators Rollers</p> <p>Set up a demonstration household composting facilities</p>	<p>Guide students to:</p> <p>-perform conversion of waste materials to useful products.</p> <p>-identify locally-fabricated machines and processing equipment used in converting wastes-to-wealth e.g.:</p> <p>Hoppers Extruders Aggregators Rollers</p> <p>-set up a demonstration house-hold composting</p>	<p>Explain what waste-to-wealth means</p>
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PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Remote Sensing Application	CODE: 327	Credit Unit: 2	CONTACT HOURS: 2 HOURS/WEEK
GOAL: This course is designed to expose students to the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance.			
YEAR: ONE (1), SEMESTER: ONE (2)	PRE-REQUISITE: none	PRACTICAL: 1HOURS/WEEK	

GENERAL OBJECTIVES

On completion of this course, the Student should be able to:

- 1.0 Understand the use of Lasers in Surveying
- 2.0 Know the Geometric Characteristics of Thermal, Radar, Landsat and Spot Imageries
- 3.0 Understand the Techniques of Interpretation of Thermal, Radar, L/Sat & SPOT Imageries
- 4.0 Understand Planimetric, Analogue and Digital Techniques for Image Enhancement
- 5.0 Know the Calibration Parameters for the Application of Remotely Sensed Data in Environmental Resource Management
- 6.0 Understand the Basic Principles of Geographical Information System and its Application in Environmental Monitoring and protection
- 7.0 **Understand the Application of Remote Sensing Equipment to Environmental Monitoring and Industrial Safety..**
- 8.0 Understand Lidar application for classification grid merging and map scaling.

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
Course: Remote Sensing Application			Course Code: ESM 327	Credit Unit: 2.0	Contact Hours: 2	
GOAL: This course is designed to expose students to the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance.						
Course Specification:			THEORETICAL	PRACTICAL CONTENT		
CONTENT						
General Objective 1.0: Understand how to use of Lasers in Surveying						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Explain how to give an account of the historical background of position-fixing by satellite. 1.2 Explain the Doppler shift of frequency and its use in position-fixing by means of satellite systems 1.3 Describe the global positioning system 1.4 Describe typical position-fixing equipment e.g. magnavox MX 2502, the wild WM101 for recording and computing satellite data and display of 3-	Explain GPS Explain the historical background of position fixing by satellite Describe various equipment used Explain position fixing in relation to satellite signals and Doppler measurement	GPS magnavox MX 2502 wild WM101	Use global positioning system (GPS)	Guide students to use of global positioning system(GPS)	Explain the position-fixing technique

	<p>dimensional fix results</p> <p>1.5 Explain the position-fixing technique, with special reference to:</p> <ul style="list-style-type: none"> i. Satellite signals: stable ii. frequencies for Doppler iii. measurements, timing signal iv. predicted orbital parameters v. The Doppler measurement vi. Minimum observation required for a fix 					
<p>General Objective 2.0: Know the Geometric Characteristics of Thermal, Radar, Landsat and Spot Imageries</p>						

4-5	<p>2.1 Describe the sources of distortions present in imageries</p> <p>2.2 Explain the causes of each type of distortion</p> <p>2.3 Describe the effects of slant range and ground range on SLAR and SPOT imageries</p> <p>2.4 Explain relief displace in SLAR and SPOT imageries</p>	<p>Explain distortions in imageries</p> <ul style="list-style-type: none"> • Explain the effects of start range and relief in SLAR/SPOT <p>Imageries</p> <p>Explain spectral signature and parallax on thermal, SLAR Landsat and SPOT imageries</p>	<p>MSS, LandsatSPOT, SLAR imageries and CCT"s</p>	<p>Determine parallaxes on thermal, SLAR Landsat and SPOT imageries</p>	<p>Guide students to determine parallaxes on thermal, SLAR Landsat and SPOT Imageries</p>	<p>Explain the characteristics of signal returns from</p>
General Objective 3.0: Understand the Techniques of Interpretation of Thermal, Radar, L/Sat & SPOT Imageries						
6-7	<p>3.1 State the bands and ranges of pulse transmission of SOLAR and SPOT Landsat and Thermalsystem.</p> <p>3.2 Describe the photographic characteristics of like-polarized and cross-polarized of SOLAR imageries</p>	<p>Explain bands and ranges of pulse transmission</p> <p>Discuss radiant temperatures of earth features.</p> <ul style="list-style-type: none"> • State the advantages and disadvantages of remotely sensed imageries. 	<p>WhiteboardGraphs</p>	<p>Determine the differences in radiant temperatures existing within a scene.</p>	<p>Guide students to determine the differences in radiant temperatures existing within a scene.</p>	<p>List the component of SOLAR and SPOT transmission</p>

	<p>Describe the diurnal radiant temperature for soil, rock and water.</p> <p>3.4 Determine the differences in radiant temperatures existing within a scene.</p> <p>3.5 Explain the development of digital terrain model of thermal maps</p> <p>3.6 State the advantages and limitations of remotely sensed imageries for thermal; radar; Landsat and spot.</p>					
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General Objective 4.0: Understand Planimetric, Analogue and Digital Techniques for Image Enhancement

8-10	<p>4.1 Define image enhancement</p> <p>4.2 Mention the different methods of image enhancement</p> <p>4.3 Explain the methods of density slicing colour enhancement, contrast stretching smoothing and edge enhancement</p> <p>4.4 Explain the necessity of coaxilling data for image Enhancement</p>	<p>Define image enhancement</p> <ul style="list-style-type: none"> • Explain methods of image enhancement such as density slicing, smoothing etc 	Whiteboard	▪ -	▪ -	List the different method of image enhancement
General Objective 5.0: Know the Calibration Parameters for the Application of Remotely Sensed Data in Environmental Resource Management						
11	<p>5.1 Differentiate the bands used in environmental remotesensing</p> <p>5.2 Explain the energy bands suitable for different earth resources</p> <p>5.3 Explain the use of composite bands in</p>	<p>Explain the Electromagnetic Spectrum</p> <p>Explain energy bands suitable forearth features</p> <p>Explain the use of thermal scanners in</p>	Whiteboard	▪ -	▪ -	State the advantages and limitation of thermal,radar, Landsat andSPOT Imageries

	<p>the study of earth resources</p> <p>5.4 Explain the bands used for air, water and land pollution</p> <p>5.5 Explain the use of thermal scanners in sensing seepages of oil on underground water</p> <p>5.6 State the advantages and limitation of thermal, radar, Landsat and SPOT imageries</p>	<p>sensing seepage and land pollution</p> <p>State advantages and limitations of each scanner</p>				
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General Objective 6.0: Understand the Basic Principles of Geographical Information System and its Application in Environmental Monitoring and protection						
12-13	<p>6.1 Define Geographical Information System (GIS).</p> <p>6.2 Define environmental monitoring</p> <p>6.3 Describe the basic principles of Geographical Information System</p> <p>6.4 Describe the application of information technology in environmental monitoring</p> <p>6.5 Describe the basic elements of environmental Monitoring</p> <p>Explain the use of GIS in environmental monitoring and protection</p>	<p>Define G.I.S.</p> <p>Explain the basic principles of GIS</p> <p>Describe application of information technology in environmental monitoring</p> <ul style="list-style-type: none"> • Explain use of GIS in environmental monitoring and protection 	Whiteboard	▪ -	▪ -	Explain the use of GIS in environmental monitoring and protection
General Objective 7.0: Understand the Application of Remote Sensing Equipment to Environmental Monitoring and Industrial Safety.						
14	<p>7.1 Describe the use of the following: Side looking Airborne lidar (SLAR), Multispectral scanner, Radiometer, Diachronic Filter Landsat</p>	<p>Describe the use of SLAR, MSS, Radiometer, GPS, GIS GPR etc</p> <p>Solve environmental</p>	SLAR, MSS, Radiometer, GPS, GIS GPR	Use SLAR, MSS, Radiometer, GPS, GIS GPR to solve environmental problems in the	Guide students to use SLAR, MSS, Radiometer, GPS, GIS GPR to solve	Describe the use of remote Sensing equipment

	<p>Imagery, Sport Satellite, Photographic Records from space, GPS, GIS, GPR (Ground Penetraty Radar)</p> <p>7.2 Describe the use the equipment enumerate in 7.1 to solve environmental problems in the following areas Population dynamic, Water Resources management, Desert encroachments, Oil spillage, Biodiversty monitoring, Air pollution monitoring, Industrial pollution and monitoring Disaster information managementsystem</p>	<p>problems such as water Resources. Management, Oil spillage, air pollution etc</p> <ul style="list-style-type: none"> • Prepare contingency plan for the above 		<p>following areas Population dynamic, Water Resources management, Desert encouragement, Oil spillage, Biodiversty monitoring, Air pollution monitoring, Industrial pollution and monitoring Disaster information management system</p>	<p>environmental problems in the following areas Population dynamic, Water Resources management, Desert encouragement, Oil spillage, Biodiversty monitoring, Air pollution monitoring, Industrial pollution and monitoring Disaster information management system</p>	
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GENERAL OBJECTIVE 8.0: Understand Lidar application for classification grid merging and map scaling

	<p>8.1 Explain Airborne Lidar System</p> <p>8.2 Describe how to use Lidar system for Airborne classification</p> <p>8.3 Describe how to use Lidar for classifying point clouds</p> <p>8.4 Explain Lidar time series</p> <p>8.5 Describe Lidar application for forestry</p> <p>Describe grids from Lidar for forestry application</p> <p>8.7 Describe Lidar grid merges</p> <p>8.8 Explain Map scale using Lidar application</p>	<p>Explain the system, use and classification of lidar system.</p> <p>Explain the Lidar application for forestry</p> <p>Explain Lidar grid emerges</p> <p>Map scale using Lidar application</p>	<p>Whiteboard</p>	<p>Demonstrate application of Airborne Lidar system for point cloud</p> <p>Use Airborne Lidar system for forestry application</p>	<p>Guide students on the application of Airborne Lidar system for point cloud</p> <p>Guide students on the use of Airborne Lidar system for forestry</p>	<p>Describe Lidar system for airborne classification</p>
<p>ASSESSMENT: The continuous assessment; tests, quizzes, field works etc. will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.</p>						

YEAR TWO, SEMESTER ONE COURSE

PROGRAMME: Higher National Diploma in Environmental Science and Management Technology			
COURSE: Environmental Legislation, Enforcement and Compliance	CODE: ESM 412	Credit Unit: 2	CONTACT HOURS: 2 HOURS/WEEK
GOAL: This course is designed to enable students understand Government requirements for manufacture and sales of goods and services to safeguard health and safety and conserve the Environment			
YEAR: ONE (2), SEMESTER: ONE (1)	PRE-REQUISITE:	PRACTICAL: 0 HOURS/WEEK	
<p>GENERAL OBJECTIVE:</p> <p>On completion of this course, the students should be able to:</p> <ol style="list-style-type: none"> 1.0 Understand the national acts, regulations and laws 2.0 Know laws relating to planning schemes 3.0 Understand laws relating to forestry and mining 4.0 Understand the laws relating to water and land pollution control in Nigeria 5.0 Understand existing environmental laws in Nigeria for controlling air pollution 6.0 Know some international conventions and other countries environmental laws and how they are administered. 7.0 Know environmental regulatory bodies and their functions 			

PROGRAMME: Higher National Diploma in Environmental Science and Management Technology						
Course: Environmental Legislation, Enforcement and Compliance			Course Code: ESM 412	Credit Unit: 2		Contact Hours: 2
GOAL: This course is designed to enable students understand Government requirements for manufacture and sales of goods and service to safeguard health and safety and conserve the Environment						
Course Specification:			THEORETICAL	PRACTICAL CONTENT		
CONTENT						
General Objective 1.0: Understand the National Acts, Regulations And Laws						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Explain the common law relating to Negligence 1.2 Explain 1999 Constitution of Nigeria: Concurrent Legislative list part II of the 2 nd Schedule, item 17 1.3 Explain the national policy on the environment 1989 Explain federal government, federal state, and local	Explain federal, state, and local government environmental acts regulations, limits, standards guides Explain petroleum laws and regulations and food safety regulations Explain the following Public	Board. Audio- Visual Systems.	▪ -	▪ -	Explain the national policy on the environment 1989

	<p>government environmental acts regulations, limits, standards guides</p> <p>1.5 Explain petroleum laws and regulations</p> <p>1.6 Explain the food safety regulations</p> <p>1.7 Explain the following Public health laws: Food and drug acts 1974, Standard organization of Nigeria act 1971, Animal disease control act 1988, The marketing of breast milk substitute act 1990, NAFDAC act, 1993.</p> <p>1.8 Explain the act 1987</p> <p>1.9 Explain compendium of Nigeria labour laws 1997</p> <p>1.10 Explain compendium of Nigeria social and labour laws 2001</p> <p>1.11 Explain nuclear safety and radiation protection act 1995</p> <p>1.12 Explain workplace</p>	<p>health laws: Food and drug acts 1974, Standard organization of Nigeria act 1971,</p> <p>Animal disease control act 1988, The marketing of breast milk substitute act 1990, NAFDAC act, 1993.</p> <p>Explain the factories act 1987, compendium of Nigeria labour laws 1997, compendium of Nigeria social and labour laws 2001 and nuclear safety and radiation protection act 1995.</p> <p>Explain workplace on HIV/AIDS, Sea fisheries act 1990</p>				
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	factories on HIV/AIDS 1.13 Explain Sea fisheries act 1990 Explain national crop varieties and livestock breeds act 1987	national crop varieties and livestock breeds act 1987.				
General Objective 2.0: Know Laws Relating to Planning Schemes						
4-5	2.1 Distinguish between Planning Authority and Planning Scheme 2.2 List composition responsibilities of such authorities 2.3 State the power of Planning Authorities 2.4 Explain provisions on land acquisition, land compensation and betterment 2.5 Describe the Procedure in declaring an area a planning area Explain the scope, contents and effects of schemes.	Distinguish between planning authority and planning scheme. List composition and responsibilities of such authorities. Explain provisions on land acquisition, Compensation and betterment. Describe procedure in declaring an area a planning area. • State laws concerning	Board. Audio-Visual Systems. Survey Equipment.	▪ -	-	List composition responsibilities of planning authorities

		“protected” and Reserved Forests and Prohibitions.				
General Objective 3.0: Understand laws relating to forestry and mining						
6-7	<p>3.1 State laws concerning „Protected“ and „Reserved“ forests</p> <p>3.2 List practices prohibited in forest areas, and penalties attached</p> <p>3.3 Explain the provision on parks, game reserves and wildlife sanctuaries</p> <p>3.4 Explain restriction on methods of hunting and disturbance of animals</p> <p>3.5 Define mining licenses, mining lease and way-leases</p> <p>3.6 State laws governing prospecting and working at mines</p>	<p>Explain the provision on parks, game reserves and wildlife sanctuaries.</p> <p>Explain methods restricting hunting and disturbance of animals.</p> <p>State laws governing prospecting and Working at mines.</p> <ul style="list-style-type: none"> • Explain safety regulations in underground mine working 	Board. Audio- Visual Systems.	▪ -	▪ -	Explain restriction on methods of hunting and disturbance of animals

	Explain safety regulations in underground mine Working.					
General Objective 4.0: Understand the laws relating to water and land pollution control in Nigeria						
8-10	<p>4.1 Explain the laws enabling the River Basin Development Authorities to control pollution in the rivers and lakes in each authority's area</p> <p>4.2 Explain the laws relating to "Oil in Navigable Waters"</p> <p>4.3 Identify existing laws designed to tackle problem of oil pollution at sea within 50 miles from land and outside the territorial waters of Nigeria</p> <p>4.4 Explain the various Petroleum Acts and regulations for prevention of pollution of water-courses during oil operations</p> <p>4.5 Explain the role of Petroleum Inspectorate with regard to environmental protection in</p>	<p>Explain the laws enabling the River Basin Development Authorities to control pollution in the rivers and lakes in each authority's area, laws relating to "Oil in Navigable Waters"</p> <p>Explain the existing laws designed to tackle problem of oil pollution at sea within 50 miles from land and outside the territorial waters of Nigeria, various Petroleum Acts and regulations for prevention of pollution of water-courses during oil operations and the</p>	Board. Maps	▪ -	▪ -	Identify existing laws designed to tackle problem of oil pollution at sea within 50 miles from land and outside the territorial waters of Nigeria

	<p>the Nigerian Oil Industry</p> <p>4.6 Explain the development of water pollution laws in Nigeria</p> <p>Explain the sections of the Public Health Act Concerned with control of water and land pollution</p>	<p>role of Petroleum Inspectorate with regard to environmental protection in the Nigerian Oil Industry.</p> <p>Explain Public Health Act Concerned with control of water and land pollution</p>				
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General Objective 5.0: Understand existing environmental laws in Nigeria for controlling air pollution

11	<p>5.1 Explain the Gas Re-injection Act as it relates to control of air pollution</p> <p>5.2 Explain the Petroleum Refining Regulations as they relate to control of air pollution</p> <p>5.3 Explain the Noxious Act as it relates to air pollution control</p> <p>5.4 Explain sections of the</p>	<p>Explain the Gas Re-injection Act, Petroleum Refining Regulations, Noxious Act, sections of the Public Health Act concerned with prevention and control of atmospheric pollution</p> <p>Explain the philosophy of setting emission standards, the advantages and</p>	<p>Board and Legal Material</p> <p>International Journals on Environment</p>	-.	-	<p>Explain the Petroleum Refining Regulations as they relate to control of air pollution</p>
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	<p>Public Health Act concerned with prevention and control of atmospheric pollution</p> <p>5.5 Explain the philosophy of setting emission standards in environmental pollution control</p> <p>Describe the advantages and disadvantages of setting emission standards.</p>	<p>disadvantages of setting emission standards in environmental pollution control</p>				
General Objective 6.0: Know some international conventions and other countries environmental laws and how they are administered						
12-13	<p>6.1 Explain the ILO code of practices, guides and manuals</p> <p>6.2 Explain the ILO conventions and recommendations since 1981 concerning occupational safety and health and the working environment</p> <p>6.3 Explain the air quality guidelines for the European</p>	<p>Explain the ILO code of practices, guides and manuals, ILO conventions and recommendations since 1981 concerning occupational safety and health and the working environment</p> <p>Explain the air quality guidelines for the European</p>	<p>Board and Legal</p> <p>Material</p> <p>International Journals on Environment</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Explain the ILO conventions and recommendations since 1981 concerning occupational safety and health and the working environment</p>

<p>region, 1987</p> <p>6.4 Explain the standards on limits for substances and characteristic affecting acceptability of water for domestic uses</p> <p>6.5 Explain the importance of the US National Environmental Quality Act of 1969 to Environmental Protection.</p> <p>Explain the importance of the US National Environmental Quality Act of 1970 to Environmental Protection</p> <p>6.7 Identify the functions of the Environmental Protection Agency [EPA] in USA.</p> <p>6.8 Identify the functions of the US Council on Environmental Quality.</p>	<p>region, 1987</p> <p>Explain the standards on limits for substances and characteristic affecting acceptability of water for domestic uses and the importance of the US National Environmental Quality Act of 1969 to Environmental Protection.</p> <p>Explain the functions of the Environmental Protection Agency [EPA] in USA and the functions of the US Council on Environmental Quality.</p> <p>Explain Britain's Control of Pollution Act 1974, the role of</p>				
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	<p>6.9 Explain Britain's Control of Pollution Act 1974</p> <p>6.10 Explain the role of Britain's Alkali Inspectorate</p> <p>6.11 State the functions of Health and Safety Executives in relation to pollution control in Britain</p> <p>6.12 Compare the activities of Britain's Department of Environment with the Department of Environmental Planning and Protection of Nigeria's Federal Ministry of Environment</p>	<p>Britain's Alkali Inspectorate, the functions of Health and Safety and executives in relation to pollution control in Britain</p> <ul style="list-style-type: none"> • Explain the activities of Britain's Department of Environment with the Department of Environmental Planning 				
General Objective 7.0 Know environmental regulatory bodies and their functions						
14	<p>7.1 Outline the administrative legal framework in Nigeria.</p> <p>7.2 List the function of</p>	<p>Explain the functions of regulatory bodies, such as:</p>	<p>Board and Legal Material</p> <p>International Journals on Environment</p>	▪ -	▪ -	<p>List the function of National Environmental Standards and</p>

	<p>the following regulatory bodies:</p> <ul style="list-style-type: none"> --Ministry of Environment - Ministry of Petroleum Resources -Ministry of Mines Steel and Development -Ministry of Labour and Productivity -National Environmental Standards and Regulations Enforcement Agency (NESREA). National Oil Spill Detection and Response Agency. 	<ul style="list-style-type: none"> --Ministry of Environment - Ministry of Petroleum Resources -Ministry of Mines Steel and Development -Ministry of Labour and Productivity -National Environmental Standards and Regulations Enforcement Agency (NESREA). •National Oil Spill Detection and Response Agency 				<p>Regulations Enforcement Agency (NESREA).</p>
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ASSESSMENT: The continuous assessment; tests, quizzes, field works etc. will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.

PROGRAMME: Higher National Diploma in Environmental Science and Management Technology			
COURSE: Advanced Environmental Assessment	CODE: ESM 413	Credit Unit: 3	CONTACT HOURS: 1 HOURS/WEEK
GOAL: The course is designed to teach students the key elements of an environmental impact assessment (EIA), techniques, and development processes			
YEAR: ONE (2), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 1 HOUR/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <ol style="list-style-type: none"> 1.0 Understand the Concept of Environmental Assessment 2.0 Understand Environmental Working Documents 3.0 Understand Public Participation 4.0 Understand Environmental Impacts and Resource Factors 5.0 Understand Screening process for EIA 6.0 Understand Scoping process for EIA 7.0 Understand Assessment Preparation and Review 8.0 Understand the concepts of reporting and reviewing for EIA 9.0 Understand the concepts of decision making and mitigation measures used for environmental impacts 10.0 Understand the necessity of monitoring the EIA process and project management 11.0 Understand concepts from EIA to predict future direction. 			

PROGRAMME: Higher National Diploma in Environmental Science and Management Technology							
Course: Advanced Environmental Assessment			Course Code: ESM 413	Credit Unit: 3		Contact Hours: 3	
GOAL: The course is designed to teach students the key elements of an environmental impact assessment (EIA), techniques, and development processes							
Course Specification:			THEORETICAL	PRACTICAL CONTENT			
CONTENT							
General Objective 1.0: Know the							
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Outcome	Learning	Teachers' Activities	Evaluation
1-2	1.1 Define the term Environmental Assessment(EA), Environmental Impact Assessment (EIA) and 1.2 Describe EA as contained in the national environmental Policy Act 1.3 Describe the evolution of EIA 1.4 Describe the guiding principles for an EIA 1.5 Explain law, policy, and institutional arrangement for EIA 1.6 Explain public involvement and consultation in EIA	Explain Environmental Assessment (EA), Environmental Impact Assessment (EIA) and explain how EA as contained in the national environmental Policy Act Give the evolution of EIA and the guiding principles. Explain law, policy and institutional arrangement and	Whiteboard Legal Documents		<ul style="list-style-type: none"> ▪ - 	<ul style="list-style-type: none"> ▪ - 	Explain public involvement and consultation in EIA

		public involvement and consultation in EIA				
GENERAL OBJECTIVE: 2.0: Understand Environmental Working Documents						
4-5	<p>2.1 Explain various types of environmental working documents such as EIA, Environmental Auditing.</p> <p>2.2 Explain the legal conditions and regulations on preparing EIA. EA. etc.</p> <p>2.3 Explain how to prepare samples of EIA. EA. document formats.</p> <p>2.4 Describe Environmental Contract Documents such as legal and technical aspects</p> <p>2.5 Discuss how to Prepare samples of environmental contract documents.</p> <p>2.6 Explain the general processing requirements:-</p> <p>a) Notice of Intent</p> <p>b) Environmental</p>	<p>Explain types of environmental working documents such as legal technical aspects and legal conditions for preparing E.I.A., E.A.</p> <p>Explain how environmental contract documents are prepared.</p> <ul style="list-style-type: none"> • Explain the general process requirements 	Whiteboard Legal Documents	<p>Prepare samples of EIA. EA. document formats.</p> <p>Prepare samples of environmental contract documents.</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -Prepare samples of EIA. EA. document formats. -Prepare samples of environmental contract documents 	List the types of environmental working documents

	<p>Assessment</p> <p>c) Draft E.I.S.</p> <p>Finding of No. Significant impact</p>					
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GENERAL OBJECTIVE 3.0: Understand Public Participation

6-7	<p>3.1 Explain the following:</p> <ul style="list-style-type: none"> - Effective public participation - Public information and involvement - Participation as a group member - Benefits from an effective public participation programme. <p>3.2 Explain hindrances to 3.1 above.</p> <p>3.3 Organise 3.1 above</p> <p>Evaluate 3.1 above.</p>	<p>Explain:</p> <ul style="list-style-type: none"> - Effective public participation - Public information and involvement - Participation as a group member • Benefits from an effective public participation programme. 	<p>Charts Public meetings and visual aids.</p>	<ul style="list-style-type: none"> ▪ - 	<ul style="list-style-type: none"> ▪ - 	<p>Explain effective public participation</p>
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GENERAL OBJECTIVE 4.0: Understand Environmental Impacts and Resource Factors

8-10	<p>4.1 Classify the different types of impacts, viz:</p> <ul style="list-style-type: none"> - direct impacts - indirect impacts - cumulative impacts <p>4.2 Explain the various types of impacts</p> <p>4.3 Measure various types of impact</p> <p>4.4 List examples of impacts</p> <p>4.5 Explain categories of resource factors namely</p> <ul style="list-style-type: none"> - atmosphere - water - land - biological environment - sound - human aspect 	<ul style="list-style-type: none"> • Identify various impacts and their classes. <p>Give examples and measure various impacts</p> <ul style="list-style-type: none"> • Explain categories of resource factors such as water, atmosphere and human aspects etc. 	<p>Charts Public meetings and visual aids.</p>	<ul style="list-style-type: none"> ▪ - 	<ul style="list-style-type: none"> ▪ - 	<p>Explain the various types of impacts</p>
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	- economic aspects					
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General Objective 5.0: GENERAL OBJECTIVE 5.0: Understand Screening process for EIA

11	<p>5.1 Explain the term screening List element of screening List what information is required in a screening document</p> <p>5.5 Explain what areas are examined in a screening</p> <p>5.5 Develop questions to help one analyze the areas of examination</p> <p>5.6 Evaluate a project as a screener and produce a screening document</p>	<p>Explain the term</p> <p>- screening</p> <p>- element of screening information required in a screening document</p> <p>- areas that are examined in a screening</p> <p>Explain how to construct questions to help one analyze</p>	<p>Charts Public meetings and visual aids.</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Explain information required in a screening document</p>
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		the areas of examination Explain how to value a project as a screener and produce a screening document				
GENERAL OBJECTIVE 6.0: Understand Scoping process for EIA						
12-13	<p>6.1 Explain the term scoping</p> <p>6.2 List element of scoping</p> <p>6.3 List what information is required in a scoping document</p> <p>6.5 Explain what areas are examined in a scoping Develop questions to help one analyze the areas of examination</p> <p>6.6 Evaluate a project as a scoping exercise and produce a list of elements that are contained in the document as a report</p>	<p>Explain the term scoping, element of scoping, information is required in a scoping document</p> <p>• Explain the areas that are examined in a scoping</p>	Charts Public meetings and visual aids.	▪ -	▪ -	Explain what information is required in a scoping document

GENERAL OBJECTIVE 7.0: Understand Assessment Preparation and Review						
14	<p>7.1 Define the scope of the environmental assessment project.</p> <p>7.2 Explain the need for the following: Interdisciplinary team</p> <ul style="list-style-type: none"> - Baseline studies - Scoping, i.e. <p>7.3 Describe assessment methodologies. Explain how to prepare an environmental assessment (EA) document from results of the impact analysis.</p> <p>7.5 Explain document review e.g. Internal and inter agency reviews.</p> <p>Explain how to Prepare a document review of an environmental Assessment Project.</p>	<p>Specify the scope of the environmental assessment project and assessment methodology.</p> <p>Explain the need for inter-disciplinary team, scoping and baseline studies.</p> <ul style="list-style-type: none"> • Prepare environmental assessment (EA) document from results of the impact analysis and review an environmental assessment project 	<p>Charts Public meetings and visual aids.</p>	<p>Prepare an environmental assessment (EA) document from results of the impact analysis.</p> <p>Prepare a document review of an environmental Assessment Project</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> - Prepare an environmental assessment (EA) document from results of the impact analysis. - Prepare a document review of an environmental Assessment Project 	<p>Prepare an environmental assessment (EA) document from results of the impact analysis.</p>
GENERAL OBJECTIVE 8.0: Understand the concepts of reporting and reviewing for EIA						

	<p>8.1 Describe the element of an EIA report</p> <p>8.2 Explain how to identify an ineffective EIA report</p> <p>8.3 Explain how to identify steps in the reviewing process</p> <p>8.4 Explain the range of review methods</p> <p>8.5 Explain the table of review criteria ratings</p>	<p>Explain the element of an EIA and EIA report</p> <p>Explain the steps in the reviewing process And the range of review methods Explain the table of review criteria ratings</p>	<p>Charts Public meetings and visual aids.</p>	<p>-</p>	<p>-</p>	<p>State steps in the reviewing process</p>
<p>GENERAL OBJECTIVE 9.0: Understand the concepts of decision making and mitigation measures used for environmental impacts</p>						
	<p>9.1 Describe the mitigation measures for EI</p> <p>9.2 Describe the components of an impact management plan</p> <p>9.3 Describe EIA aims and concepts</p> <p>9.4 Explain common EIA implementation</p> <p>9.5 Explain EIA implementation within decision making organization.</p>	<p>Explain the mitigation measures for EI and the components of an impact management plan</p> <p>Explain EIA aims and concepts and implementation within decision making organization</p>	<p>Charts Public meetings and visual aids.</p>	<p>-</p>	<p>-</p>	<p>Explain common EIA implementation</p>

	9.6 Explain public reviewer challenge.					
GENERAL OBJECTIVE 10.0: Understand the necessity of monitoring the EIA process and project management						
	<p>10.1. Describe the purpose for monitoring</p> <p>10.2 Describe the process of monitoring program.</p> <p>10.3 Explain how to identify the tasks of a good project manager.</p> <p>10.4 Explain how to identify considerations in the selection of team members.</p> <p>10.5 Explain importance of scheduling and budget preparation.</p>	<p>Explain purpose, process of monitoring program.</p> <p>List tasks of a good project manager and considerations in the selection of team members.</p> <p>List the importance of scheduling and budget preparation.</p>	<p>Charts Public meetings and visual aids.</p>	-	-	<p>Explain importance of scheduling and budget preparation.</p>

GENERAL OBJECTIVE 11.0: Understand concepts from EIA to predict future direction

	11.1 Explain Sustainability 11.2 Explain immediate and short term challenges of an EIA	Explain immediate and short term challenges of an EIA	Charts Public meetings and visual aids.	-	-	Define sustainability
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ASSESSMENT: The continuous assessment; tests, quizzes, field works etc. will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Sanitation and WasteManagement	CODE: ESM 414	Credit Unit: 3	CONTACT HOURS: 1 HOURS/WEEK
GOAL: This course is designed to provide students with the knowledge and skills required to carry out industrial sanitation and waste management			
YEAR: ONE (2), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 1 HOUR/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <ul style="list-style-type: none"> 1.0 Understand the fundamentals of workplace sanitation and waste disposal 2.0 Understand the need for proper layout of industries and provision of essential facilities 3.0 Know the various methods of controlling industrial waste 4.0 Understand sanitation procedures in an industrial environment 5.0 Understand the role of various Agencies in control of industrial waste 6.0 Know the different methods of solid waste management 			

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY

Course: Sanitation and Waste Management	Course Code: ESM 414	Credit Unit: 2.0	Contact Hours: 2-0-1
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GOAL: This course is designed to provide students with the knowledge and skills required to carry out industrial sanitation and waste

Course Specification:	THEORETICAL	PRACTICAL CONTENT
CONTENT		

General Objective 1.0: Understand the fundamentals of workplace sanitation and waste disposal

Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Outcome	Learning	Teachers' Activities	Evaluation
1-2	1.1 Define industrial wastes 1.2 Classify industrial waste 1.3 Explain how to identify sources of industrial waste 1.4 Explain characteristics of industrial waste 1.5 Explain the public health implication of public wastes Explain wholesome and unwholesome of water.	Explain industrial wastes, classification and sources of industrial waste Explain the public health implication of public wastes and the wholesome and unwholesome water	-projector -textbook -internet -lecture note -tutorial	Identify different types of industrial wastes.		Guide the students to identify industrial wastes	Explain characteristics of industrial waste

General Objective 2.0: GENERAL OBJECTIVES: 2.0 Understand the Common Diseases of Food Animals, their Prevention and Control

4-5	<p>2.1 Describe an ideal layout of an industry</p> <p>2.2 Explain the essential facilities needed in an Industry</p> <p>2.3 Explain the risks associated with poor sanitary conditions in an industry</p> <p>2.4 Describe appropriate measures to address the problems created in 2.3 above</p>	<ul style="list-style-type: none"> • Explain an ideal layout of an industry and the essential facilities needed in an industry • Explain the risks involved in a un-sanitized industry 	<p>-projection</p> <p>-textbooks</p> <p>Internet</p> <p>lecture notes</p>	<ul style="list-style-type: none"> ▪ - 	-	<p>Explain the essential facilities needed in an industry</p>
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GENERAL OBJECTIVES: 3.0 Understand the Principles Of Managing Sewage Design

	<p>3.1 Explain industrial Health control measures under the following</p> <p>Engineering</p> <ul style="list-style-type: none"> • Substitution • modification of equipment <p>Administrative e.g</p> <ul style="list-style-type: none"> • . shifting • Motivation (incentives annual leave etc). 	<p>Explain industrial Health control in</p> <p>Engineering</p> <p>substitution</p> <p>ii. modification of equipment</p> <p>b. Administrative e.g.</p> <p>i. shifting</p> <p>ii. Motivation (incentives, annual leave etc).</p>	<p>-projection</p> <p>-textbooks</p> <p>- internet</p> <p>- lecture notes</p> <p>- tutorial</p>	-	-	<p>Explain the specific methods of disposal of industrial waste according to its characteristics</p>
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	<ul style="list-style-type: none"> • Inspection etc Personal protection e.g use of gloves, aprons boots, goggles 3.2 Explain the specific methods of disposal of industrial waste according to its characteristics (gaseous, liquid and solid) 3.3 Describe problems of industrial waste	iii. Inspection etc. c. Personal protection e.g. use of gloves, aprons, boots, goggles				
General Objective 4.0: Understand Sanitation Procedures on Industrial Environment						
8-10	4.1 Describe various ways of ensuring environmental sanitation in an industry. 4.2 Explain procedures involved in plant inspection with a view to detecting and abating to nuisances 4.3 Explain how to carry out plant inspection and health education Programmes in industry. Write technical report on industrial visit	Explain various ways of ensuring environmental sanitation in an industry and procedures involved in plant inspection with a view to detecting and abating to nuisances Explain processes involved in writing a	-projection - -textbooks internet - lecture notes - tutorial -Plant	Carry out plant inspection and health education programmes in industry	Guide students to carry out plant inspection and health education programmes in industry	Describe various ways of ensuring environmental sanitation in an industry

		technical report on industrial visit				
GENERAL OBJECTIVE 5.0: Understand the Role of Various Agencies in Control of Industrial Waste						
11	<p>5.1 Describe the role of Governmental and Non-Governmental Agencies in:</p> <ul style="list-style-type: none"> - legislation - direct involvement of industry - industrial Health Education <p>5.2 Describe the contributions of other professionals in the control of industrial waste</p>	<p>Explain the role of Governmental and Non-Governmental Agencies in:</p> <ul style="list-style-type: none"> - legislation - direct involvement of industry - industrial Health Education 	<ul style="list-style-type: none"> - projection - textbooks - internet - lecture notes <p>tutorial</p>	<ul style="list-style-type: none"> ▪ - 	<ul style="list-style-type: none"> ▪ - 	<p>Explain the contributions of other professionals in the control of industrial waste and management.</p>

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Environmental Project Management	CODE: ESM 416	Credit Unit: 2	CONTACT HOURS: 2 HOURS/WEEK
GOAL: This course is designed to introduce students to project management concepts and tools and its application to environmental projects			
YEAR: TWO (2), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 0 HOURS/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <ol style="list-style-type: none"> 1.0 Understand the key concepts and element of project management 2.0 Understand how to develop a project plan using the twelve steps of project planning. 3.0 know how to set up project plan 4.0 know how to constitute and Manage Project team 5.0 know how to track and Monitor a Project 6.0 Understand project cost analysis. 7.0 Understand the knowledge necessary to manage the differences inherent in large and small projects and programs. 8.0 Understand the knowledge necessary to manage the problems and opportunities that occur during the course of a project. 9.0 Understand the variety of project management tools and methods 10.0 Understand the processes and techniques involved in the evolution, revolution, and termination of a project. 			

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
Course: Environmental Project Management			Course Code: ESM 416	Credit Unit: 2		Contact Hours: 2
GOAL: This course is designed to introduce students to project management concepts and tools and its application to environmental projects						
Course Specification: CONTENT			THEORETICAL	PRACTICAL CONTENT		
General Objective 1.0: Understand the key concepts and element of project management						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	<p>1.1 Describe a project in terms of a definition; and the key components.</p> <p>1.2 Describe the different factors that can have impact on a project.</p> <p>1.3 Describe the guidelines used in setting the stage for successful project.</p> <p>1.4 Describe the four steps in analyzing a project from the past.</p>	<p>Explain projects and its key components, the role of Governmental and Non-Governmental Agencies in:</p> <ul style="list-style-type: none"> - legislation - direct involvement of industry <p>industrial Health Education</p>	<p>Chalkboard</p> <p>Multi-media</p> <p>Magnetic Board</p> <p>Markers</p>	▪ -	▪ -	Explain the different factors that can have impact on project

	1.5 Describe the characteristics of a successful project					
General Objective 2.0: understand how to develop a project plan using the twelve steps of project planning.						
4-5	2.1 Describe the steps used in defining a project. 2.2 Describe the overall structure used in presenting the project plan.	<ul style="list-style-type: none"> • Explain in detail items 2.1 – 2.2 	Chalkboard Multi-media Chart	▪ -	-	Explain the steps used in defining a project
General Objective 3.0: Know how to set up project plan						
6-7	3.1 Describe the process of defining a task. 3.2 Illustrate the four types of tasks. 3.3 Describe the process of scheduling.	<ul style="list-style-type: none"> • Explain in detail the various types of tasks and their interrelationships and interdependencies 	Chalkboard Multi-media Magnetic Board	▪	▪	List the various types of task
General Objective 4.0 : Know how to constitute and Manage Project team						

8-10	<p>4.1 Describe a project team in terms of: key types of people.</p> <p>4.2 Describe the process of managing the team in terms of: addressing problems with the team; getting more out of a team member; bringing in someone new in the middle of the project; and getting rid of a team member.</p> <p>4.3 Describe the process of dealing with team issues, specifically: project disasters; team enjoyment; team rewards; and team suggestions</p>	<p>Explain the process of managing the team in terms of: addressing problems with the team; getting more out of a team member; bringing in someone new in the middle of the project; and getting rid of a team member.</p> <p>Explain the process of dealing with team issues, specifically: project disasters; team enjoyment; team rewards; and team suggestions</p>	<p>Chalkboard</p> <p>Multi-media</p> <p>Magnetic Board</p> <p>Markers</p>	<p>▪ -</p>	<p>▪ -</p>	Describe a project team
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General Objective 5.0 Know how to track and Monitor a Project

11	<p>5.1 Describe the key management activities involved in tracking and monitoring a project.</p> <p>5.1 Describe the key aspects of project administration</p>	<p>Explain how to track and monitor a project.</p> <p>Discuss the key aspects of project administration</p>	<p>Multi-media</p> <p>Magnetic Board Markers</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Explain how to track and monitor a project</p>
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General Objective 6.0: Understand project cost analysis.

12-13	<p>6.1 Describe the characteristics of project costs.</p> <p>6.2 Describe the six steps in calculating planned project costs and the trade-offs of accuracy versus effort in those calculations.</p> <p>6.3 Describe the guidelines to be used for building a project budget.</p> <p>6.4 Compare and contrast the concept of budget versus</p>	<p>• Explain the six steps in calculating planned project costs and the trade-offs of accuracy versus effort in those calculations.</p>	<p>Multi-media</p> <p>Magnetic Board Markers</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Describe the six steps in calculating planned project costs and the trade-offs of accuracy versus effort in those calculations.</p>
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	actual costs. 6.5 Describe the concepts of earned value and activity-based costing					
General Objective 7.0 Understand the knowledge necessary to manage the differences inherent in large and small projects and programs.						
14	<p>7.1 Describe the size of a project in terms of: measuring project size; relating project size with potential risk; and sizing a project</p> <p>7.2 Describe the characteristics of large and small projects.</p> <p>7.3 Describe the four levels of projects that address the size and complexity of different projects and approaches for managing the different levels.</p>	<ul style="list-style-type: none"> • Discuss in details how to manage both small and large projects taking cognizance of the potential risks. 	<p>Multi-media</p> <p>Magnetic Board Markers</p>	▪	▪	Explain the characteristics of large and small projects
General Objective 8.0: Understand the knowledge necessary to manage the problems and opportunities that occur during the course of a project						
	8.1 Describe the five steps to be used in defining and addressing project issues	<ul style="list-style-type: none"> • Explain Project Management issues 	<p>Multi-media</p> <p>Magnetic</p>	▪	▪	Explain Project Management issues

	and opportunities. 8.2 Describe the possible symptoms and underlying issues that may occur when a project runs into problems, as well as possible solutions.		Board Markers			
General Objective 9.0 Understand the variety of project management tools and methods						
	9.1 Describe the role that communications play in project management. 9.2 Describe the types and uses of communications necessary to good project management. 9.3 Describe project management software in terms of: what it is; why it is used and the five key activities that relate to its use.	• Explain various project management tools and methods with specific examples.	Multi-media Magnetic Board Markers	▪	▪	Explain various project management tools and methods
General Objective 10.0 Understand the processes and techniques involved in the evolution, revolution, and termination of a project						
	10.1 Describe the process of project change and death in	• Explain the processes and techniques in the	Multi-media Chart	▪	▪	Explain the processes and techniques in the evolution, revolution

	<p>terms of: characteristics of change; approaches for implementing change; and approaches for killing a project.</p> <p>10.2 Describe the process of project reviews in terms of: defining a project's success; and conducting a project review.</p> <p>10.3 Describe the value of project management to organizations and individuals</p>	<p>evolution, revolution and termination of a project</p>				<p>and termination of a Project</p>
<p>ASSESSMENT: The continuous assessment; tests, quizzes, field works etc. will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.</p>						

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Advanced Man and Environment	CODE: ESM 417	Credit Unit: 2.0	CONTACT HOURS: 2 HOURS/WEEK
GOAL: This course is designed to enable the student know the impact of man's activities on the environment.			
YEAR: TWO (2), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 0 HOURS/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <p>1.0 Understand the role of man as a geomorphological agent</p> <p>2.0: Understand man's impact on climate and the atmosphere</p> <p>3.0: Understand the powers of man in further environmental changes.</p>			

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
COURSE: Advanced Man and Environment			Course Code: ESM 417	Credit Unit: 2.0	Contact Hours: 2-0-0	
GOAL: This course is designed to acquaint the student with t This course is designed to enable the student know the impact of man’s activities on the environment.						
Course Specification:			THEORETICAL	PRACTICAL CONTENT		
CONTENT						
General Objective 1.0: Understand the Role of Man as a Geomorphological Agent						
Week	Specific Learning Outcome	Teachers’ Activities	Learning Resources	Specific Learning Outcome	Teachers’ Activities	Evaluation
1-2	1.1 Describe landforms produced by excavations 1.2 Describe landforms produced by waste dumping 1.3 Explain the role of man in accelerated sedimentation 1.4 Describe the impact of man in ground subsidence 1.5 Explain the role of man in accelerated weathering of landforms	Explain landforms produced by excavations, waste dumping Role of man in accelerated sedimentation Describe the impact of man in ground subsidence Explain the role of man in accelerated weathering of landforms.	-projection -textbooks - internet - lecture notes tutorial	▪ -	▪ -	Describe the role man on landform, ground subsidence and coastal erosion

	<p>1.6 Explain the role of man in accelerated massmovement of landforms</p> <p>1.7 Describe the various aspects of man's deliberate modifications of channels</p> <p>1.8 Explain the role of man in accelerated coastalerosion</p> <p>1.9 Explain man's Influence on Seismicity andvolcanoes</p>					
General Objective 2.0: Understand man's impact on climate and the atmosphere						
4-5	<p>2.1 Explain the carbon dioxide problem</p> <p>2.2 Explain the problemof other gases</p> <p>2.3 Explain the problemof aerosols</p> <p>2.4 Explain the problemof thermal pollution ofair</p> <p>2.5 Describe the role of atmospheric pollutionin climate</p>	<p>Explain the problem of carbon dioxide and other gases and aerosols</p> <p>Explain the problem of thermal pollution of air atmospheric pollution in climate modification.</p> <p>Explain the effects of</p>	<p>-projection</p> <p>-textbooks</p> <p>- internet</p> <p>- lecture notes</p> <p>tutorial</p>	▪		<p>Describe man's impacton the atmosphere</p> <p>List the influence of aerosol on the environment</p>

	<p>modification.</p> <p>2.6 Describe the effects of high-flying aircraft on the upper atmosphere</p> <p>2.7 Explain vapour trails in relation to climate modification</p> <p>2.8 Explain the „Green House“ effect</p> <p>2.9 Explain the possible effects of water diversion schemes on micro-climates</p> <p>2.10 Describe the role of man in creating urban climates</p> <p>2.11 Describe the role of smoke haze on photochemical smog formation</p> <p>2.12 Explain the effects of artificial rain-making on climate modification</p>	<p>high-flying aircrafts on the upper atmosphere</p> <p>Explain vapour trails in relation to climate modification</p> <ul style="list-style-type: none"> • Explain the „Green House“ effect <p>Explain the possible effects of water diversion schemes on micro-climates</p>				
GENERAL OBJECTIVE: 3.0: Understand the Powers of Man in Further Environmental Changes						
6-7	3.1 Explain the powers of man in the proliferations of environmental impacts	Explain the powers of man in the Proliferations of	-projection -textbooks - internet	▪	▪	Describe how man's activities in the environment

	<p>3.2 Distinguish between reversible and irreversible environmental changes.</p> <p>3.3 List examples of reversible environmental changes</p> <p>3.4 List examples of irreversible environmental changes</p> <p>3.5 Describe the susceptibility of the environment to changes</p> <p>3.6 Describe the role of nature in resisting</p>	<p>environmental impacts</p> <p>List the differences between reversible and irreversible environmental changes.</p> <p>List examples of reversible environmental changes</p> <p>List examples of irreversible environmental changes</p>	<p>- lecture notes tutorial</p>			<p>influences reversible and irreversible changes</p>
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PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: ENVIRONMENTAL TOXICOLOGY	CODE: ESM 418	Credit Unit: 3.0	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course is designed to enable the student know the effect of toxic chemicals on biological organism at Population community, Ecosystem and biosphere level			
YEAR: ONE (1), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 0 HOURS/WEEK	
GENERAL OBJECTIVES			
On completion of this course, the Student should be able to:			
1.0 Understand the Basic Concepts of Toxicology			
2.0 Know the History and scope of Toxicology			
3.0 Understand Toxicology			
4.0 Know Toxicity Factors			
5.0 Know Hazardous substances			
6.0 Understand Pesticide Toxicology			

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
Course: Environmental toxicology			Course Code: ESM 418	Credit Unit: 3.0	Contact Hours: 3	
GOAL: This course is designed to enable the student know the effect of toxic chemicals on biological organism at population community, Ecosystem and biosphere level						
Course Specification:			THEORETICAL	PRACTICAL CONTENT		
CONTENT						
General Objective 1.0: Know the						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Define the following: <ul style="list-style-type: none"> • Toxicant • Toxic • Toxicity • Pollutant • Dose • LC50 and • LD50 1.2 Classify toxicants. 1.3 List some environmental toxicants, their sources and effects on the environment and health. 1.4 Describe the different types of toxicity namely:- chronic toxicity; development and reproductive toxicity; mutagenicity.	Explain Toxicant, Toxic, Toxicity, Pollutant, Dose, LC50 and LD50, Explain toxicants. As it relates to environment: chronic toxicity; development and reproductive toxicity; mutagenicity.	Soil test kits pH meter, Turbid meter centrifuge and magnetic stirrer shakers. Membrane filtration apparatus. EP Kit	Analyze air, water and soil samples and identify toxicants in them. Determine toxicity using extraction Analyze air, water and soil samples and identify toxicants in them.	Guide students to : -analyze air, water and soil samples and identify toxicants in them. -determine toxicity using extraction -analyze air, water and soil samples and identify toxicants in	Describe the different types of toxicity namely:- chronic toxicity; development and reproductive toxicity; mutagenicity. Differentiate between chronic , development and reproductive toxicity

	<p>1.5 Describe the different manifestations of toxicity e.g. physiological malfunction, Carcinogenicity, teratogenicity, mutagenicity, and death.</p> <p>1.6 Describe how toxicity is determined using standardized laboratory test (EP. i.e. Extraction Procedure)</p> <p>1.7 List the contaminants and their maximum concentration used for EP toxicity test.</p> <p>1.8 State when a substance is designated as EP</p>	<p>Explain how toxicity is determined using standardized laboratory test (EP. i.e. Extraction Procedure)</p> <p>List the contaminants and their maximum concentration used for EP toxicity test.</p> <p>State when a substance is designated as EP</p>		<p>Determine toxicity using extraction procedure</p>	<p>them.</p> <p>determine toxicity using extraction procedure</p>	
<p>General Objective 2.0: Know the History and scope of Toxicology</p>						

4-5	<p>2.1 Explain the different stages in the history of toxicology namely; Antiquity; Middle Ages; Age of Enlightenment; Modern Toxicology.</p> <p>2.2 Describe the different branches of toxicology namely Environmental Toxicology, Forensic toxicology, Clinical toxicology, economic toxicology.</p>	<p>Explain stages of toxicology in: Antiquity; Middle Ages; Age of Enlightenment; Modern Toxicology.</p> <p>List the different branches of toxicology such as: Environmental Toxicology, Forensic economic toxicology, Clinical toxicology,</p>	<p>-projection -textbooks - lecture notes tutorial</p>	<p>▪ -</p>	-	Explain the different stages in the history of toxicology/
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General Objective 3.0: Understand Toxicology

6-7	<p>3.1 Explain the meaning and importance of toxicology.</p> <p>3.2 Describe the toxicology of food additives and contaminants.</p> <p>3.3 Determine the toxicity of food additives and contaminants in food samples.</p> <p>3.4 Describe the method of</p>	<p>Explain toxicology. As additives and contaminants.</p> <p>Explain how to determine the toxicity of food additives and contaminants in food samples.</p> <p>List atmospheric</p>	<p>Centrifuge, hot plate shakers, magnetic stirrer, white tiles melting point apparatus.</p> <p>Air sample anaerobic jar Incubator, thermometer, spectrophotometer, alcohol analyser, moisture analyser etc.</p>	<p>Conduct Practical analysis of food toxicants</p> <p>Determine the toxicity of food additives and contaminants in food samples.</p>	<p>Guide students to:</p> <p>-conduct Practical analysis of food toxicants</p> <p>-determine the toxicity of food additives and contaminants in food samples.</p>	<p>Explain the meaning and importance of toxicology</p> <p>List pollutant toxicity</p> <p>What is soil toxicity</p>
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	<p>analysis of food toxicants.</p> <p>3.5 List atmospheric pollutants e.g. carbon monoxide, asbestos, chlorofluorocarbon, photochemical smog, oxides of nitrogen and sulphur.</p> <p>3.6 Explain the sources and toxicity of the various atmospheric pollutants listed in 3.5 above.</p> <p>3.7 Describe the method of analysis of atmospheric toxicants.</p> <p>3.8 Determine the toxicity of atmospheric toxicants.</p> <p>3.9 List aquatic pollutants.</p> <p>3.10 Explain the sources of toxicity of the pollutants, listed in 3.9 above.</p> <p>3.11 Describe the methods of analysis of aquatic toxicants.</p> <p>3.12 List types soil pollutants.</p> <p>3.13 Explain the sources of toxicity of soil pollutants listed in 3.12 above.</p>	<p>pollutants e.g. carbon monoxide, asbestos, chlorofluorocarbon, photochemical smog, oxides of nitrogen and Sulphur.</p> <p>Explain the methods of analysis of aquatic toxicants and soil pollutants</p>		<p>Determine the toxicity of atmospheric toxicants</p> <p>Determine the toxicity of aquatic toxicants.</p> <p>Determine the toxicity of soil pollutant.</p>	<p>determine the toxicity of atmospheric toxicants</p> <p>-determine the toxicity of aquatic toxicants.</p> <p>determine the toxicity of soil pollutant.</p>	
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	3.14 Describe the methods of analysis of soil toxicants.					
General Objective 4.0: Know Toxicity Factors						
8-10	<p>4.1 Explain the influence of route of administration on toxicity.</p> <p>4.2 Explain how to identify the animals used in toxicity tests.</p> <p>4.3 Describe the effects of chemical interactions on toxicity.</p> <p>4.4 Describe the biological toxicity e.g. barriers, biotransformation, sensitivity of organs, etc.</p> <p>4.5 Explain the effects of dose and duration of exposure on toxicity.</p> <p>4.6 Describe the effects of the following host factors on toxicity:</p> <ul style="list-style-type: none"> • Species, strain and individual differences. • Sex, Hormonal status and pregnancy. 	<p>Explain the influence of route of administration on toxicity and the animals used in toxicity tests.</p> <p>Explain the effects of chemical interactions on toxicity and the biological toxicity e.g. barriers, biotransformation, sensitivity of organs, etc.</p> <p>Explain the effects of dose and duration of exposure on toxicity.</p>	<p>Centrifuge, hot plate shakers, magnetic stirrer, white tiles melting point apparatus.</p> <p>Air sample anaerobic jar Incubator, thermometer. Animal sample</p>	<p>Identify the animals used in toxicity tests.</p> <p>Administer toxins into a guinea pig through different routes and determine the influence of route of administration on toxicity</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -identify the animals used in toxicity tests. <p>administer toxins into a guinea pig through different routes and determine the influence of route of administration on toxicity</p>	<p>Explain the influence of route of administration on toxicity.</p>

	<ul style="list-style-type: none"> • Age • Nutritional Status • Diseases. <p>4.7 Describe the physical and social factors that modify toxicity in organisms.</p>					
General Objective 5.0: Know Hazardous substances						
11	<p>5.1 Define hazardous substances.</p> <p>5.2 Explain the characteristics of hazardous substances.</p> <p>5.3 Discuss hazardous wastes generated by Business and industries.</p> <p>5.4 Describe methods of hazardous substances control from the point of generation to the point of ultimate disposal.</p>	<p>Explain hazardous substances, types and their characteristics.</p> <p>Explain hazardous wastes generated by Business and industries and methods of hazardous substances control from the point of generation to the point of ultimate disposal.</p>	<p>-projection</p> <p>-textbooks</p> <p>- internet</p> <p>- lecture notes</p> <p>tutorial Industrial visit</p>	<p>Identify hazardous wastes generated by Business and industries.</p> <p>Carry out a visit to industries to know the different hazardous waste generated by them.</p>	<p>Guide students to:</p> <p>-identify hazardous wastes generated by Business and industries.</p> <p>carry out a visit to industries to know the different hazardous waste generated by them.</p>	<p>Explain the characteristics of hazardous substances</p> <p>List the five types of hazards</p> <p>Define hazard symbols of warning</p>

General Objective 6.0: Understand Pesticide Toxicology						
12-13	<p>6.1 Define a pesticide.</p> <p>6.2 Describe the toxicology of organic chemicals namely organo-chlorides, organophosphates and carbonates.</p> <p>6.3 Describe the toxicology of inorganic pesticides e.g. Arsenic compounds, Lead salts, copper salts.</p> <p>6.4 Explain metabolism degradation of pesticides in the body.</p> <p>6.5 Determine the toxicity of some selected pesticides.</p> <p>6.6 Explain the dangers of pesticide residues in the environment.</p> <p>6.7 Determine pesticide residues in the environment.</p> <p>6.8 List the different types of plant and animal toxins. Determine the toxicity of various plant and animal toxins.</p>	<p>Explain the toxicology of organic chemicals namely organo-chlorides, organophosphates and carbonates. and the toxicology of inorganic pesticides e.g. Arsenic compounds, Lead salts, copper salts.</p> <p>Explain metabolism degradation of pesticides in the body.</p> <p>Explain how to determine the toxicity of some selected pesticides.</p> <p>Explain the dangers of pesticide residues in the environment and how to determine the toxicity of</p>	<p>Osmometer/ Osmotic level determination meter, pH meter, Total dissolved solid meter. Total dissolved oxygen meter balances, melting point apparatus and toxicity kit.</p>	<p>Determine the toxicity of some selected pesticides</p> <p>Determine pesticide residues in the environment.</p> <p>Determine the toxicity of various plant and animal toxins</p>	<p>Guide students to: -determine the toxicity of some selected pesticides</p> <p>Determine pesticide residues in the environment.</p> <p>determine the toxicity of various plant and animal toxins</p>	<p>Describe the toxicology of organic chemicals namely organo-chlorides, organophosphate and carbonates.</p>

	6.10 Describe radioactive materials and their toxicity. 6.11 Describe poly-halogenated compounds and their toxicity	various plant and animal toxins				
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PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: construction, machine and tools safety	CODE: ESM 419	Credit Unit: 2	CONTACT HOURS: 2 HOURS/WEEK
GOAL: This course is designed to acquaint students with the necessary knowledge required on how to handle different tools and machines			
YEAR: ONE (1), SEMESTER: TWO (2)	PRE-REQUISITE: None	PRACTICAL: 2 HOURS/WEEK	
GENERAL OBJECTIVES			
On completion of this course, the Student should be able to:			
1.0 Understand construction site activities			
2.0 Understand the Principles of Guarding			
3.0 Know safety in metal working machinery.			
4.0 Know Safety in Woodworking Machinery			
5.0 Know safety in the Use of Hand and Portable Power Tools.			

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
Course: Construction Safety, Machinery and Tools Safety			Course Code: ESM 419	Credit Unit: 3	Contact Hours: 3	
GOAL: This course is designed to acquaint students with the necessary knowledge required on how to handle different tools and machines						
Course Specification:			THEORETICAL	PRACTICAL CONTENT		
CONTENT						
General Objective 1.0: Understand construction site activities						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Mention types of construction sites 1.2 Describe the basic safe applications of tools in construction sites (ropes, hoist, chains, bolts, drilling, welding, crane, conveyor, wire) and their deterioration. 1.3 Describe safety practices outlining general safe practices in construction operations. 1.4 State the significance and activities involved in lateral bracing and	List types of construction sites and tools used in construction. Explain best safety practices and in construction operations. Explain bracing and scaffolding. List the guidelines for excavation.	PPE, tool components, workshops and field.			Describe safety practices outlining general safe practices in construction operations.

	<p>scaffolding.</p> <p>1.5 Explain the fundamental safety procedure for demolition operations</p> <p>1.6 List the guidelines involved in excavation</p>					
General Objective 2.0: Understand the Principles of Guarding						
4-5	<p>2.1 Explain the meaning of the term “guarding” the major areas of safety as considered with machines.</p> <p>2.2 Explain guarding during maintenance of machines and written policy for ZMS (Zero Mechanical State)</p> <p>2.3 Explain guarding of hazards.</p> <p>2.4 Explain point-of-operation protective devices.</p> <p>2.5 Explain the guarding of Power transmissions in machinery.</p>	<p>Explain the term “guarding” the major areas of safety as considered with machines.</p> <ul style="list-style-type: none"> • Explain guarding of hazards, point-of-operation, protective devices and the guarding of Power transmissions in machinery. 	<ul style="list-style-type: none"> • Machines <p>Charts</p>	<ul style="list-style-type: none"> ▪ - 	-	<p>Explain the guarding of Power transmissions in machinery.</p>
General Objective 3.0: Know safety in metal working machinery						

6-7	<p>3.1 List various types of metalworking machinery.</p> <p>3.2 State the general safety rules in operating metalworking machinery.</p> <p>3.3 Explain the functional components, the associated hazards and the safety precautions to be observed in the following metalworking machinery:</p> <ul style="list-style-type: none"> • Turning machines, • Boring machines • Milling machines • Planning machines • Grinding machines 	<p>List different types of metalworking machines and associated hazards.</p> <p>Demonstrate with relevant machines associated hazards</p> <p>Visit workshop/industry</p>	Charts, Machines,	Demonstrate with relevant machines associated hazards	Guide students to demonstrate with relevant machines associated hazards	List different types of metalworking machines and associated hazards
General Objective 4.0: Know Safety in Woodworking Machinery						
8-10	<p>4.1 Explain the general Safety Principles in woodworking machinery as it concerns:</p> <p>(a) Electrical components;</p> <p>(b) Guards;</p> <p>(c) Work areas; (d) Material handling; (e) Inspection; (f) Health of Personnel; (g) Personal protective equipment</p>	<p>List with examples of woodworking machines and their respective components.</p> <p>Show relevant personal protective equipment.</p> <p>List safety and health hazards</p>	Woodworking machines Personal protective equipment, tools and components. Charts Workshops	Demonstrate safety precaution and safe handling of special woodworking tools and equipment	Guide students to demonstrate safety precaution and safe handling of special woodworking tools and equipment	List woodworking machines and their respective components

	<p>and (h) Standards and Codes. 4.2 Explain the Safety Precaution in the application of the following types of Saws:</p> <ul style="list-style-type: none"> • Circular, • Over- head swing and straight- line pull cut-off saws, • Under-slung cut-off saws, • Radial Saws, • Power-feed ripaws, • Band saws & • Routers. <p>4.3 Explain Safety Precautions in the applications of the various woodworking equipment e.g.:</p> <ul style="list-style-type: none"> ▪ Jointer/Planers, ▪ Shapers, ▪ Power-feed (thickness) Planers, ▪ Sanders, ▪ Lathes & ▪ Routers. 	<p>associated work activities.</p> <p>Demonstrate safety precaution and safe handling of special wood working toolsand equipment.</p> <p>Visit workshops or industry.</p>				
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General Objective 5.0: Know safety In the Use of Hand and Portable Power Tools

11	<p>5.1 Explain safe practices, centralized tool control and correct ways of carrying tools as they concern the prevention of accidents in the application of hand and portable power tools.</p> <p>5.2 Explain techniques of inspection and control of hand and portable power tools and its significance.</p> <p>5.3 State the hazards associated with and the safety precautions needed in the application of the hand tools: State the hazards associated with and the safety precautions needed in the application of the following portable power Tools: (a) Electric tools (b) Air-powered tools etc.</p> <p>5.5 State type of eye protection equipment</p>			■	■	
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YEAR TWO SEMESTER TWO

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Ecological Disaster, Prevention and Control	CODE: ESM 421	Credit Unit: 3	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course is designed to give students knowledge needed to identify various environmental hazards and how to control them.			
YEAR: TWO(2), SEMESTER: TWO (2)	PRE-REQUISITE: none	PRACTICAL: 0 HOURS/WEEK	

GENERAL OBJECTIVES

On completion of this course, the Student should be able to:

- 1.0 Understand the concept of environmental hazards
- 2.0 Understand the basic principles of desertification
- 3.0 Understand the Process of Soil Erosion
- 4.0 Understand the Basic Principles of Floods
- 5.0 Understand basic principles of drought

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY

COURSE: Ecological Disaster, Prevention and Control	Course Code: ESM 421	Credit Unit: 3	Contact Hours: 3
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GOAL: This course is designed to give students knowledge needed to identify various environmental hazards and how to control them.

Course Specification:	THEORETICAL	PRACTICAL CONTENT
CONTENT		

General Objective 1.0: Understand the concept of environmental hazards

Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Outcome	Learning	Teachers' Activities	Evaluation
1-2	1.1 Define an environmental hazard 1.2 Define geographical hazard 1.3 State the environmentalist definition of environmental deterioration 1.4 Explain the concept of environmental quality 1.5 Describe climatological factors as agents of environmental hazards.	Define -geographical hazard -Environmental deterioration, -environmental quality, Explain climatological factors as agents of environmental hazards.	Audio visual AidsCharts		▪ -	▪ -	State the environmentalist definition of environmental hazards

General Objective 2.0: Understand the basic principles of desertification

4-5	<p>2.1 Define desertification</p> <p>2.2 Describe the process of desert encroachment</p> <p>2.4 Identify the causal agents of desert encroachment Explain types and patterns of desertification</p> <p>2.5 Explain the effects of desert advancement on the environment</p> <p>2.6 Explain the climatological hypothesis of desertification</p> <p>Describe ways of preventing desertification</p>	<p>Explain encroachment and the causal agents of desert encroachment.</p> <p>List :</p> <ul style="list-style-type: none"> -types - patterns and effects of desertification and also the effects of desert advancement on the environment <ul style="list-style-type: none"> • Explain the climatological hypothesis of desertification and state ways of preventing desertification 	Audio visual Aid Charts	Identify the causal agents of desert encroachment	Guide students to identify the causal agents of desert encroachment	<p>Explain types and patterns of desertification</p> <p>Explain the climatological hypothesis of desertification</p>
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General Objective 3.0: Understand the Process of Soil Erosion

6-7	<p>3.1 Describe the soil erosion process</p> <p>3.2 List causes of erosion</p> <p>3.3 Explain the effect of erosion on soil</p> <p>3.4 Describe glacial scars and wave erosion</p>	<p>Explain the soil erosion, the causes and types of erosion, such as: glacial scars and wave erosion</p> <p>List the effect of erosion on soil</p>	Auto visual Aid	▪ -	▪ -	List various erosion features
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	<p>3.5 Describe erosion patterns in different soil types</p> <p>3.6 List various erosion features</p> <p>3.7 Explain irrigation as a soil erosion hazard</p> <p>Explain ways of preventing erosion</p>	<ul style="list-style-type: none"> • Explain the erosion patterns and features in different soil types • Explain irrigation as a soil erosion hazard and ways of prevent it. 				
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General Objective 4.0: Understand the Basic Principles of Floods

8-10	<p>4.1 Define geophysical hazard</p> <p>4.2 List geophysical occurrences in nature that disturb the environment</p> <p>4.3 Explain the environmental hazards of floods, hurricanes, typhoons, and monsoons</p> <p>4.4 Explain the role of the following in making or breaking landscapes:</p> <ul style="list-style-type: none"> - rivers and streams - earthquakes and landslides - hurricane, typhoons, monsoons 	<p>Classify types of hazards:</p> <ul style="list-style-type: none"> -geophysical hazard and -environmental hazards <p>List geophysical occurrences in nature that disturb the environment</p> <p>List the environmental hazards of floods, hurricanes, typhoons, and monsoons</p>	<p>Magnetic Board, Auto visual Aid</p>	<p>Identify flood-susceptible areas</p>	<p>Guide students to identify flood- susceptible areas</p>	<p>Explain the environmental hazards of floods, hurricanes, typhoons, and monsoons</p>
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	<p>and floods</p> <p>4.5 Describe flood as a natural phenomenon</p> <p>4.6 Identify flood-susceptible areas</p> <p>Explain ways of preventing floods.</p>	<p>Explain the role of the following in making or breaking landscapes:</p> <ul style="list-style-type: none"> - rivers and streams earthquakes and landslides - hurricane, typhoons, monsoons and floods <p>Describe flood as a natural phenomenon</p> <ul style="list-style-type: none"> • Explain ways of preventing floods 				
General Objective 5.0: Understand basic principles of drought						
11	<p>5.1 Define drought as a natural phenomenon</p> <p>5.2 Describe the drought process</p> <p>5.3 Identify the causal agents of drought</p> <p>5.4 Describe the early warning systems of drought</p>	<p>Explain drought as a natural phenomenon</p> <p>Explain the drought process, the causal agents of drought</p> <p>Explain the early warning systems of</p>	Auto visual AidCharts	Identify the causal agents of drought	Guide students to identify the causal agents of drought	Explain the climatological hypothesis of drought formation

	5.5 Explain the climatological hypothesis of drought formation	drought and the climatological hypothesis of drought formation.				
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PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Environmental Performance	CODE: ESM 422	Credit Unit: 2	CONTACT HOURS: 2 HOURS/WEEK
GOAL: The course is designed to provide students with clear and meaningful picture of any organization's environmental performance by collecting absolute data information on performance.			
YEAR: ONE (1), SEMESTER: ONE (1)	PRE-REQUISITE:	PRACTICAL: 0 HOURS/WEEK	
<p>GENERAL OBJECTIVE:</p> <p>On completion of this course, the students should be able to:</p> <ol style="list-style-type: none"> 1.0 Understand life cycle analysis/material utilization efficiency 2.0 Understand the environmental benchmarking compliance 3.0 Understand business and the environment 4.0 Understand principles of social responsibility/community affair, safety, health environment and security programme 			

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
COURSE: Environmental Performance			Course Code: 422	Credit Unit: 2.0		Contact Hours: 2
GOAL: The course is designed to provide students with clear and meaningful picture of any organization's environmental performance by collecting absolute data information on performance.						
Course Specification:			THEORETICAL	PRACTICAL CONTENT		
CONTENT						
General Objective 1.0: Understand Life Cycle Analysis/Material Utilization Efficiency						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Define the term: (i) life cycle Analysis (ii) Material utilization Efficiency 1.2 Explain the goal and purpose of LCA and material utilization efficiency 1.3 Mention four main phases of LCA and Describe each of them 1.4 Describe the use of data analysis on LCA and mode of collection	Explain the term: (i) life cycle Analysis (ii) Material utilization Efficiency Explain the goal and purpose and phases of LCA and material utilization efficiency Explain the use of data analysis on LCA and mode of collection.	Magnetic Board, Auto visual Aid	▪ -	▪ -	Describe the use of data analysis on LCA and mode of collection
General Objective 2.0: Understand the Environmental Benchmarking Compliance						

4-5	<p>2.1 Mention local contribution to global climate change</p> <p>2.2 State the communication strategy used in environmental benchmarking compliance</p> <p>2.3 Explain the terms (i)Nature (ii)Biodiversity (iii)Pollution</p> <p>2.4 Describe environmental waste production and management</p> <p>2.5 Describe the importance of green urban arrears and sustainable land</p> <p>2.6. Explain water consumption and waste water treatment.</p> <p>2.7 Describe noise</p>	<p>Explain local contribution to global climate change</p> <p>Explain the communication strategy used in environmental benchmarking compliance</p> <p>Explain the terms (i)Nature (ii)Biodiversity (iii)Pollution</p> <p>Explain environmental waste production and management</p> <p>Explain the importance of green urban arrears and sustainable land and water consumption and wastewater treatment.</p>	Magnetic Board, Auto visual Aid	<ul style="list-style-type: none"> ▪ - 	-	Explain various ways used to accomplish environmental benchmarking compliance
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	pollution	Explain noise pollution				
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General Objective 3.0: Understand Business and The Environment

6-7	<p>3.1 Describe the concept of environment and business</p> <p>3.2 Explain types of business environment</p> <p>3.3 List different components of business environment</p> <p>3.4 Explain environment factor affecting business of an Organisation</p> <p>3.5 State how economic problems affect business environment</p> <p>3.6 Explain how does</p>	<p>Explain the concept of environment and business</p> <p>Explain types, components and factor affecting an Organization of business environment</p> <p>Explain how economic problems affect business environment and how does ethnic behavior affect the performance of</p>	<p>Magnetic Board, Auto visual Aid</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Describe the concept of environment and business</p>
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	<p>ethnic behavior affects the performance of employee or an Organisation</p> <p>3.7 Describe what extent will political instability impact business environment</p> <p>3.9 State five major variables found in an Organisation</p> <p>3.10 Explain internal and external environment</p>	<p>employee or an Organisation</p> <ul style="list-style-type: none"> • Explain extent to which political instability impact business environment, internally and externally. 				
General Objective 4.0: Understand Principles of Social Responsibility/Community Affair, Safety, Health Environment And Security Programme						
8-10	<p>4.1 Define corporate social responsibility (CSR)</p> <p>4.2. Explain corporate social responsibility.</p> <p>4.3 List the benefits of CSR</p> <p>4.4 Explain how does CSR relate to stress at work</p> <p>4.5. Describe the policy on community affair safety,</p>	<p>Explain corporate social responsibility (CSR) and corporate social responsibility. Explain the benefit of CSR and how CSR relate to stress at work.</p> <p>Explain the policy on community affair safety, health,</p>	<p>Magnetic Board, Auto visual Aid</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Explain how does CSR relate to stress at work</p>

	<p>health ,environment and security(CASHES)</p> <p>4.6.Describe the relationship between business operator and the community in terms of safety, health, environment and security</p> <p>4.7.Enumerate (CASHES) regulation/ references and standards</p> <p>4.8. Explain night work precautions in an environment</p> <p>Describe health, medical and welfare programme for hostingcommunity</p>	<p>environment and security (CASHES)</p> <p>Explain the relationship between business operator and the community in terms of safety, health, environment and</p> <ul style="list-style-type: none"> • security. 				
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PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Sampling Methods for Polluted Sites	CODE: ESM 423	Credit Unit: 3	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course designed to give students the knowledge and skills for sampling methods of contaminated sites			
YEAR: TWO (2), SEMESTER: TWO (2)	PRE-REQUISITE: none	PRACTICAL: 2 HOURS/WEEK	

GENERAL OBJECTIVES

On completion of this course, the Student should be able to:

- 1.0 Understand Environmental Methods and Techniques
- 2.0 Know how to obtain soil samples for chemical analysis
- 3.0 Know how to view construction of a monitoring well after drilling a borehole
- 4.0 Know how to operate organic, vapour analyzers for use in performing a soil gas survey
- 5.0 Know utility location demonstration for a subsurface data collection
- 6.0 Understand how to use a backhoe for collecting soil sample
- 7.0 Understand how to perform a hydraulic response test in a monitoring well to determine hydraulic conductivity.
- 8.0 Understand how to conduct water level survey to determine the water table gradient and direction of ground water flow.

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY**COURSE:** Sampling Methods for Polluted Sites **CODE:** ESM 423 **Credit Unit: 3** **Contact Hours: 3****GOAL:** This course is designed to give students the knowledge and skills for sampling methods of contaminated sites**Course Specification:**
CONTENT **THEORETICAL** **PRACTICAL CONTENT****General Objective 1.0:** Understand Environmental Methods and Techniques

Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 List sampling techniques and analytical methods used to determine common pollutants. 1.2 Explain the complexity of pollution issues and environmental chemistry with emphasis on chemicals'' fugacity and environmental partitioning. 1.3 Explain how to analyze environmental issues in order to select appropriate sampling and analytical methods to quantitatively and	Explain sampling techniques and analytical methods used to determine common pollutants.and the complexity of pollution issues and environmental chemistry with emphasis on chemicals'' fugacityand environmental partitioning. Explain how to	Laptop White board Text Books Internet Projector Lecture Notes Audio visual	Determine common pollutants in air, water, wastewater, sediment andsoil using sampling and analytical techniques.	Guide student to determine common pollutantsin air, water, wastewater, sediment and soil using sampling and analytical techniques	List sampling techniques and analytical methods used to determine common pollutants. What are the limitations of sampling procedures of analytical methods in environmental analysis

	<p>qualitatively</p> <p>1.4 Assess the magnitude of environmental contamination/pollution</p> <p>1.5 Describe how to apply statistical tools and modeling applications to process, analyze and interpret data obtained in environmental sampling and analyses.</p> <p>1.6 Discuss the advantages and limitations of the sampling procedures and analytical methods employed in environmental Analyses</p>	<p>analyze environmental issues in order to select appropriate sampling and analytical methods to quantitatively and qualitatively assess the magnitude of environmental.</p> <p>Explain advantages and limitations of the sampling procedures and analytical methods employed in environmental analyses</p>				
<p>General Objective 2.0: Know how to obtain soil samples for chemical analysis</p>						

4-5	<p>2.1 Explain concerns associated with sample collection procedure and labelling, sample tool decontamination procedures.</p> <p>2.2 Explain the following: Soil vapour screening and core logging.</p> <p>2.3 Describe how to practice soil vapour screening as an aid to sample selection and core logging.</p>	<ul style="list-style-type: none"> Explain concerns associated with sample collection procedure and labelling, sample tool decontamination procedures and how to practice soil vapour screening as an aid to sample selection and core logging. 	<p>Laptop White board Text Books Internet Projector Lecture Notes</p>	<p>Perform soil vapour screening as an aid to sample selection and core logging.</p>	<p>Guide students to perform soil vapour screening as an aid to sample selection and core logging</p>	<p>Explain soil vapour screening and core logging.</p>
General Objective 3.0: Know how to view construction of a monitoring well after drilling a borehole						
6-7	<p>3.1 Explain the method to develop and purge a monitoring well.</p> <p>3.2 Describe the methods and concerns in collecting water samples for a variety of chemical contaminants, and preservation</p>	<p>Explain how to develop and purge a monitoring well. and methods and concerns in collecting water samples for a variety of chemical</p>	<p>Laptop White board Text Books Internet Projector Lecture Notes</p>	<p>Identify the method to develop and purge a monitoring well.</p>	<p>Guide students to identify the method to develop and purge a monitoring well.</p>	<p>Describe the methods and concerns in collecting water samples for a variety of chemical contaminants, and preservation</p>

	techniques.	contaminants, and preservation • techniques.				techniques.
General Objective 4.0: Know how to operate organic, vapour analyzers for use in performing a soil gas survey						
8-10	4.1 Define soil survey. 4.2 Describe how to conduct a soil survey and collect vapor samples. 4.3 Enumerate the problems or conditions that may affect the survey results.	Explain how to conduct a soil survey and collect vapor samples. • Discuss the problems or conditions that may affect the survey results.	Laptop White board Text Books Internet Projector Lecture Notes	Conduct a soil survey and collect vapor samples	Guide students to conduct a soil survey and collect vapor samples	Explain the problems or conditions that may affect the survey results.
General Objective 5.0: GENERAL OBJECTIVE 5.0: know utility location demonstration for a subsurface data collection						
11	5.1 Explain how to Identify different types of geophysical tools. 5.2 Describe how to use different types of geophysical tools 5.3 Describe the problems or conditions that may affect the	Explain different types of geophysical tools and how to use the different tools and the problems or conditions that may affect the geophysical result.	Laptop White board Text Books Internet Projector Lecture Notes Geophysical tools	Identify different types of geophysical tools	Guide students to identify different types of geophysical tools	State how to use different types of geophysical tools

	geophysical results					
GENERAL OBJECTIVE 6.0: Understand how to use a backhoe for collecting soil sample						
12-13	<p>6.1 Explain the use of headspace test to determine the presence of volatile organics.</p> <p>6.2 Describe the correct safety procedures when working alongside excavating equipment.</p>	<p>Explain the use of headspace test to determine the presence of volatileorganics.</p> <p>• Explain the correct safety procedures when working alongside excavating equipment.</p>	<p>Laptop Text Books Internet Projector Lecture Notes Calculators Geophysical tools</p>	<p>Demonstrate the use of headspace test to determine the presence of volatile organics</p>	<p>Guide students to determine the presence of volatile organics using head spacetest.</p>	<p>List the correct safety procedures when working alongside excavating equipment</p>
GENERAL OBJECTIVE 7.0: Understand how to perform a hydraulic response test in a monitoring well to determine hydraulic conductivity.						
14	<p>7.1 Define hydraulic conductivity.</p> <p>7.2 Describe how to conduct a hydraulic response test.</p> <p>7.3 Describe the procedure used for applying either the Bouwer and Rice method or the Hvorslev method.</p>	<p>Explain hydraulic conductivity and how to conduct a hydraulic responsetest and the procedure used forapplying either the</p>	<p>Laptop White boardText Books Internet Projector Lecture Notes Calculators Geophysical tools</p>	<p>Perform a hydraulic responsetest in a monitoring well to determine hydraulic conductivity</p>	<p>Guide students to perform a hydraulic response test in a monitoring well to determine hydraulic conductivity</p>	<p>Describe how to conduct a hydraulic response test</p>

	<p>7.4 Describe how to gather data using a data logger.</p> <p>7.5 Calculate hydraulic conductivity using field data.</p>	<p>Bouwer and Rice method or the Hvorslev method.</p> <p>Explain how to gather data using a data logger and calculate hydraulic conductivity using field data.</p>				
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GENERAL OBJECTIVE 8.0: Understand how to conduct a water level survey to determine the water table gradient and direction of ground water flow

	<p>8.1 Explain how to use an electric watertape to measure water levels in a monitoring well.</p> <p>8.2 Explain how to use a surveying level to determine relative borehole elevations.</p> <p>8.3 Explain how to</p>	<p>Explain the use of electric water tape to measure water levels in a monitoring well and surveying level to determine relative borehole elevations.</p> <p>Explain how to calculate ground water elevations.</p>	<p>Laptop White board Text Books Internet Projector Lecture Notes Calculators</p> <p>Electric watertape Survey</p>	<p>Use an electric water tape to measure water levels in a monitoring well.</p> <p>Use a surveying level to determine relative borehole elevations.</p> <p>Calculate ground water elevations.</p> <p>Prepare a hydraulic gradient map.</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -use an electric water tape to measure water levels in a monitoring well. -use a surveying level to determine relative borehole elevations. -calculate groundwater elevations. -prepare a hydraulic 	<p>State the importance of water level in a monitoring well.</p>
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	<p>Calculate groundwater elevations.</p> <p>8.4 Explain how to Prepare a hydraulic gradient map.</p> <p>8.5 Explain how to Determine the direction of ground water flow</p>	<p>And prepare a hydraulic gradient map to the direction of ground water flow.</p>	<p>level</p>	<p>Determine the direction of ground water flow</p>	<p>gradient map. -determine the direction of ground water flow</p>	
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ASSESSMENT: The continuous assessment; tests, quizzes, field works etc. will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY			
COURSE: Polluted Site Investigation and Remediation	CODE: ESM 424	Credit Unit: 3	CONTACT HOURS: 3 HOURS/WEEK
GOAL: This course is designed to acquaint students with the summary of the main processes in the management of polluted sites, site audit, site investigation, sampling, risk assessment, remediation			
YEAR: TWO (2), SEMESTER: TWO(2)	PRE-REQUISITE:	PRACTICAL: 2 HOURS/WEEK	
<p>GENERAL OBJECTIVES</p> <p>On completion of this course, the Student should be able to:</p> <ol style="list-style-type: none"> 1.0 Understand Environmental Site Assessment and Audit 2.0 Know Environmental Site Investigation Techniques and Methods 3.0 Understand the elements within the Contaminated Site Regulation that apply to contaminated site remediation plans 4.0 Know remediation plan of sites restoration. 5.0 Know when risk assessment should be considered for management of polluted site Know basic in-situ and ex-situ remediation strategy. 6.0 Know basic in-situ and ex-situ remediation strategies 7.0 Know remediation design and implementation 8.0 Understand ex-situ thermal and biological treatment technologies for remediation of organic contaminants. 9.0 Know Air-flushing technologies for remediation of organic contaminants 10.0 Understand free product-recovery and groundwater treatment. 			

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
COURSE: Polluted Site Investigation and Remediation		CODE: ESM 424	Credit Unit: 3.0			Contact Hours: 3
GOAL: This course is designed to acquaint students with the summary of the main processes in the management of polluted sites, site audit, site investigation, sampling, risk assessment, remediation						
Course Specification:		THEORETICAL	PRACTICAL CONTENT			
CONTENT						
General Objective 1.0: Understand Environmental Site Assessment and Audit						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	1.1 Define environmental site assessment, environmental site investigation and environmental audit. 1.2 Differentiate the above (1.1) with examples. 1.3 Explain the regulatory context for environmental site assessment and environmental audit. 1.4 Describe how to locate potential environmental concerns associated with a host of industrial or commercial properties. 1.5 Explain the different types of environmental audits based	Explain environmental site assessment, environmental site investigation and environmental audit. Explain the regulatory context for environmental site assessment and environmental audit and how to locate potential environmental concerns associated with a host of industrial or	Text Books Internet Projector Calculators	Locate potential environmental concerns, associated with a host of industrial or commercial properties	Guide student to locate potential environmental concerns, associated with a host of industrial or commercial properties	Differentiate between an environmental site assessment, environmental site investigation and an environmental audit including examples of their respective contextual uses. Explain how to evaluate the different types of

	<p>on the process to perform an audit.</p> <p>1.6 Explain how to Identify the element within the contaminated sites regulations that apply to site investigation procedures</p>	<p>commercial properties.</p>				<p>environmental activities.</p>
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General Objective 2.0: Know Environmental Site Investigation Techniques and Methods

4-5	<p>2.1 List environmental site investigation techniques and methods.</p> <p>2.2 Describe the concepts of non-invasive assessment techniques to site assessment.</p> <p>2.3 Illustrate the application of invasive techniques used in site characterization.</p> <p>2.4 Explain the statistical relevant to sample location and analysis of analytical data in the planning of sampling programs.</p> <p>2.5 Describe how to design site investigation based on evaluation of field data.</p>	<p>Explain environmental site investigation techniques and methods.</p> <p>Explain the concepts of non-invasive assessment techniques to site assessment and the application of invasive techniques used in site characterization.</p> <p>Explain the statistical relevant to sample location and analysis of analytical data in the planning of sampling programs and how to</p> <ul style="list-style-type: none"> • design site investigation based 	Text Books Internet Projector Audio visuals	Perform site investigation based on evaluation of field data.	Guide students to perform site investigation based on evaluation of field data.	List environmental site investigation techniques and methods Explain the statistical relevant to sample location and analysis of analytical data in the planning of sampling programs.
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		on evaluation of field data				
General Objective 3.0: Understand the element within the contaminated site regulations the apply to remediation						
6-7	<p>3.1 Describe remedial screening chart</p> <p>3.2 Explain feasibility analyses, cost analysis and pilot study.</p> <p>3.3 Explain the use of remedial charts, feasibility analyses, cost analysis, pilot studies, and using different remedial strategies in tandem.</p> <p>3.4 Describe the evaluation process for site remediation</p>	<p>Explain the use of remedial charts, feasibility analyses, cost analysis, pilot studies, and using different remedial strategies in tandem.</p> <p>Explain the evaluation process for site remediation common to soil and ground water remediation.</p>	<p>Text Books</p> <p>Internet Projector</p> <p>Lecture Notes</p> <p>Audiovisuals</p> <p>charts</p>	Identify remedial screening chart	Guide students to identify remedial screening chart	Explain feasibility analyses, cost analysis and pilot study

	<p>common to soil and ground water remediation.</p> <p>3.5 Explain the concepts of designing a site remediation plan and a monitoring system.</p>	<ul style="list-style-type: none"> Explain the concepts of designing a site remediation plan and a monitoring system. 				
General Objective 4.0: Know remediation plan site restoration						
8-10	<p>4.1 List in-situ and ex-situ remediation strategy.</p> <p>4.2 Explain excavation and replacement as a remedial strategy.</p> <p>4.3 Explain soil vapour extraction and air sparging techniques.</p> <p>4.4 Describe what contaminants are suitable for applying soil vapour extraction (SVE) and Air sparging (AS).</p>	<p>Explain in-situ and ex-situ remediation strategy with excavation and replacement as a remedial strategy.</p> <p>Explain soil vapour extraction and air sparging techniques and contaminant soil vapour extraction (SVE)</p> <ul style="list-style-type: none"> and Air sparging (AS) 	<p>Text Books</p> <p>Internet</p> <p>Projector</p> <p>Lecture Notes</p> <p>Calculators</p> <p>Geophysical tools</p>	<ul style="list-style-type: none"> - 	<ul style="list-style-type: none"> - 	<p>Explain soil Vapour extraction and air sparging techniques</p>
General Objective 5.0: Know when risk assessment should be considered for management of contaminated site						
11	<p>5.1 Describe a contaminated site</p> <p>5.2 Describe the elements that</p>	<p>Discuss a contaminated sites and the elements that comprise a risk</p>	<p>Text Books</p> <p>Internet</p> <p>Projector</p> <p>Lecture Notes</p>	<p>Apply risk assessment methodology in analyzing case study data</p>	<p>Guide Student to apply risk assessment methodology</p>	<p>Explain the elements that comprise a risk assessment and</p>

	comprise a risk assessment and the necessary data to support risk assessment. 5.3 Explain risk assessment methodology in analyzing case study data	assessment and the necessary data to support risk assessment.	Calculators Geophysical tools		in analyzing case study data	the necessary data to support risk assessment
General Objective 6.0: Know basic in-situ and ex-situ remediation strategies						
12-13	6.1 Explain the basic steps to accomplish remediation. Describe how remediation process will be effective at the site. 6.3 Explain the physical, biological and chemical processes involved in site remediation. 6.4 Compare in-situ versus ex-situ, on-site versus off-site treatment and land disposal.	Explain the basic steps to accomplish remediation and how remediation process will be effective at the site. • Explain the physical, biological and chemical processes involved in site remediation and compare in-situ versus ex-situ, on-site versus off-site treatment and land disposal.	Laptop Text Books Internet Projector Lecture Notes Geophysical tools	▪ -	▪ -	Explain the physical, biological and chemical processes involved in site remediation
General Objective 7.0: Know remediation design and implementation						
14	7.1 Describe treatability studies, field, bench and pilot tests.	Explain treatability studies, field, and bench and pilot tests.	Laptop Text Books	▪ -	▪ -	Describe how to develop soil and

	<p>7.2 Explain how to develop soil and groundwater management plans.</p> <p>7.3 Explain remedial technologies for controlling exposure pathways.</p>	<p>• Describe how to develop soil and groundwater management plans and remedial technologies for controlling exposure pathways.</p>	<p>Internet Projector Lecture Notes Calculators</p>			<p>groundwater management plans.</p>
<p>GENERAL OBJECTIVE 8.0: Understand ex-situ thermal and biological treatment technologies for remediation of organic contaminants</p>						
	<p>8.1 Explain ex-situ thermal and biological treatment technologies for remediation of</p> <p>8.3 organic contaminants</p> <p>8.4 Explain the characteristics of organic contaminants.</p> <p>8.5 Explain thermal treatment: incineration and thermal desorption.</p> <p>8.6 Explain land farming: treatability studies, design considerations, and performance monitoring</p>	<p>Describe the ex-situ thermal and biological treatment technologies for remediation of organic contaminants, the characteristics of organic contaminants and thermal treatment: incineration and thermal desorption.</p> <p>Explain treatability studies, design considerations, and performance</p>	<p>Text Books Internet Projector</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Explain ex-situ thermal and biological treatment technologies for remediation of organic contaminants</p> <p>Explain land farming: treatability studies, design considerations, and</p>

		monitoring of land farming				performance monitoring
GENERAL OBJECTIVE 9.0: Know Air-flushing technologies for remediation of organic contaminants						
9.1	Explain the physical/chemical principles: air flow in unsaturated and saturated porous media, mass transfer, partitioning between phases and in-situ biodegradation.	Explain physical/chemical principles of airflow in unsaturated and saturated porous media, mass transfer, partitioning between phases and in-situ biodegradation.	Text Books Internet Projector Lecture Notes Calculators	▪ -	▪ -	Explain the physical/chemical principles of air flow in unsaturated and saturated porous media
9.2	Explain SVE and AS system design considerations: pilot-scale tests, pipe/well sizing and spacing and blower sizing.	List SVE and AS system design considerations: pilot-scale tests, pipe/well sizing and spacing and blower sizing.				

GENERAL OBJECTIVE 10.0: Understand free product-recovery and groundwater treatment

<p>10.1 Explain free product-recovery and groundwater treatment</p> <p>10.2 Explain the physical/chemical/biological processes involved in free product recovery.</p> <p>10.3 Explain free product-recovery methods.</p> <p>10.4 Explain in-situ groundwater treatment methods.</p> <p>10.5 Explain pump and test methods.</p>	<p>Explain free product-recovery and groundwater treatment and the physical/chemical/biological processes involved in free product recovery.</p> <p>Explain free product-recovery methods and in-situ groundwater treatment methods. Explain pump and test methods.</p>	<p>Text Books Internet Projector Lecture Notes Calculators</p>	<p>▪ -</p>	<p>▪ -</p>	<p>Explain free product-recovery and groundwater treatment</p> <p>Evaluate in-situ groundwater treatment methods. Evaluate pump and test methods</p>
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PRACTICAL GUIDE FOR HND I AND II	
COURSE: House Keeping Emergency Preparedness/Contingency Response	
CODE: ESM 311	
SPECIFIC LEARNING OUTCOME	TEACHERS ACTIVITIES
<p>Identify work areas/ work space and the areas needing housekeeping</p> <p>Identify types of dirt, litter, garbage etc</p> <p>Identify tools/equipment's in housekeeping</p> <p>Identify potential hazards in workplace</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -identify workareas/ work space and the areas needing housekeeping -identify types of dirt, litter, garbage etc -identify tools/ equipment's inhousekeeping -identify potentialhazards in Workplace
<p>Identify escape route and places of assembly point.</p> <p>Demonstrate the use to radios during emergency situations.</p> <p>Identify firefighting equipment's.</p> <p>Simulate a safetyevacuation drill</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> : identify escape route and assembly points. - demonstrate the use to radios during emergency situations. - identify firefighting equipment's. -simulate a safetyevacuation d
<p>Carryout a contingencyplan for a workplace</p>	<p>Guide students to develop and Organize a contingency planfor a work place</p>
<p>Identify safety andhealthcare systems</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -prepare a safetyand healthcare plan

<p>Identify the general environmental and safety guide line for industries in terms of:</p> <ul style="list-style-type: none"> • Environmental • Occupational Health and Safety • Community health and safety <p>Construction and Decommissioning</p>	<p>- identify the general environmental and safety guide line for industries in terms of: Environmental, Occupational Health and Safety Community health and safety,</p> <p>Construction and Decommissioning</p>
<p>Identify an unsafe condition in work place.</p> <p>Identify an unsafe act</p> <p>Identify the main factors to be investigated in an unsafe condition</p>	<p>Guide students to carry out a safety audit for a case study.</p> <p>Guide students to prepare an accident report for a case study.</p>
<p>COURSE TITLE: Environmental Biotechnology</p>	<p>CODE : ESM 312</p>
<p>conduct a practical on biodegradation xenobiotic compounds (hydrocarbons, detergent, dyes and pesticide)</p> <p>Carry out practical on phyto- remediation</p>	<p>Guide student to conduct a practical on biodegradation xenobiotic compounds (hydrocarbons, detergent, dyes and pesticide)</p> <p>Guide student to Carry out practical on phyto- remediation Carry out practical on air, water and soil toxicity testing</p>
<p>carry out practical on anaerobic aerobic digestion</p> <p>carry out treatment on waste water.</p>	<p>Guide student to carry out practical on anaerobic aerobic digestion</p>

	Guide student to carry out treatment on waste water.
COURSE: Water Supply and Wastewater Treatment	CODE: 313
Identify the wholesome water and unwholesomewater	Guide the studentsin identifying wholesome water and unwholesomewater
Identify possible sourcesof water supply to community. Disinfect well	Guide the studentsin identifying various sources ofwater supply to community. Guide students todisinfect well
Visit a conventionalwater treatment plant	Guide student to identify the characteristics of awater treatment Condiment plant area. -Visit a conventional watertreatment plant
Visit industrial wastewatertreatment plant. Design chemical feed systems that will allow the estimation of chemical sludge production.	Guide student tovisit industrial wastewater treatment plant. Guide students todesign chemical feed systems thatwill allow the estimation of chemical sludge production. Guide students to plot adsorption isotherms and breakthrough curves (adsorptionand ion exchange

Plot adsorption isotherms and breakthrough curves (adsorption and ion exchange)	
Visit municipal wastewater treatment plant. Measure municipal wastewater strength based on the physical and chemical characteristics of the wastewater.	Guide student to visit municipal wastewater treatment plant. Guide students to measure municipal wastewater strength based on the physical and chemical characteristics of the wastewater.
Visit drinking water treatment plant. Measure key bacteriological water quality parameters	Guide student to visit drinking water treatment plant. Guide students to measure the key bacteriological water quality parameters
Identify appropriate materials for collecting water samples Prepare sampling bottles for water collection Collect water samples Dispatch sample bottles to the laboratory for analysis Package and label sample bottles for transportation Culture water samples for Indicator organism Identify other organism e.g. protozoa etc. In water samples from under the microscope	Guide student to: -identify appropriate materials for collecting water samples -prepare sampling bottles for water collection -collect water samples -dispatch sample bottles to the laboratory for analysis -package and label sample bottles for transportation Culture water samples for Indicator organism -identify other organism e.g. protozoa etc. In water samples from under the microscope

Identify hard water by its characteristics Remove water hardness Treat water for Odour	-identify hard water by its characteristics -remove water hardness -treat water for Odour
COURSE: Environmental and Health Risk Assessment	
CODE: 314	
Identify risks associated with different development activities.	Guide students to identify Risk assessment in activities such as mining.
Determine if an epidemiological studies prove can be linked to diseases..	Guide students to determine if an epidemiological studies prove can be linked to diseases
Determine the risk (carcinogenic) of working in an environment for 70 years that results in a chronic oral intake of 0.50 mg/(kg-day) of benzene. Determine the chemical specific risk for an intake of 0.00025 mg/(kg-day) of benzene via ingestion with Water.	Guide the students to conduct: -determine the risk (carcinogenic) of working in an environment for 70 years that results in a chronic oral intake of 0.50 mg/(kg-day) of benzene. -determine the chemical specific risk for an intake of 0.00025 mg/(kg-day)
Identify steps needed to assess the copper site.	Guide students to identify needed to assess the copper site.
COURSE: FUNDAMENTALS OF GEO-INFORMATICS	
CODE: ESM 315	
Identify all the drawing instruments (compasses, dividers, protractors, set squares, pencil, etc.)	Guide students to: -Identify all the drawing instruments (compasses, dividers, protractors, set squares, pencil, etc.) Guide students to demonstrate the procedure for ink-drawing and lettering techniques

Demonstrate the procedure for ink- drawing and lettering techniques	
Measure horizontal and vertical angels using theodolite.	Guide students to measure horizontal and vertical angels using theodolite
Perform calculations of bearings, distances and co-ordinates from traverse surveys	Guide students to perform calculations of bearings, distances and co-ordinates from traverse surveys
Conduct a tachometric exercise. Determine tachometric constants from field measurement. Plot contours from tachometric measurements Carry out compass traversing of a closed figure	Guide students to: -conduct a tachometric exercise. -determine tachometric constants from field measurement. -plot contours from tachometric measurements carry out compass traversing of a closed Figure
COURSE: Environmental Auditing And Management Systems CODE: ESM 321	
Identify the different types of ISO family	Guide the student to identify different types of ISO
Identify possible leadership qualities that can make an industry grow	Guide the student to identify possible leadership qualities that can make an industry grow
Identify steps for developing the emergency response plan	Guide the students in identifying various emergency response plans.
Carry out a specific environmental audit	Guide the students to carry out an environmental audit
COURSE: ERGONOMICS CODE: ESM 322	
Identify two Ergonomic solutions to reduce the risk factors for musculoskeletal injuries	Guide students to identify two Ergonomic solutions to reduce the risk factors for musculoskeletal injuries
COURSE: ENVIRONMENTAL TOXICOLOGY CODE: ESM 323	
Soil test kits pH meter, Turbid meter centrifuge and	Analyze air, water and soil samples and identify

<p>magnetic stirrer shakers. Membrane filtration apparatus.</p> <p>EP Kit</p>	<p>toxicants in them.</p> <p>Determine toxicity using extraction</p> <p>Analyze air, water and soil samples and identify toxicants in them.</p> <p>Determine toxicity using extraction procedure</p>
<p>Conduct Practical analysis of food toxicants</p> <p>Determine the toxicity of food additives and contaminants in food samples.</p> <p>Determine the toxicity of atmospheric toxicants</p> <p>Determine the toxicity of aquatic toxicants.</p> <p>Determine the toxicity of soil pollutant.</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -conduct Practical analysis of food toxicants -determine the toxicity of food additives and contaminants in food samples. determine the toxicity of atmospheric toxicants -determine the toxicity of aquatic toxicants. determine the toxicity of soil pollutant.
<p>Identify the animals used in toxicity tests.</p> <p>Administer toxins into a guinea pig through different routes and determine the influence of route of administration on toxicity</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -identify the animals used in toxicity tests. administer toxins into a guinea pig through different routes and determine the influence of route of administration on toxicity
<p>Identify hazardous wastes generated by Business and industries.</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -identify hazardous wastes generated by Business and industries.

Carry out a visit to industries to know the different hazardous waste generated by them.	carry out a visit to industries to know the different hazardous waste generated by them.
Determine the toxicity of some selected pesticides Determine pesticide residues in the environment. Determine the toxicity of various plant and animal toxins	Guide students to: -determine the toxicity of some selected pesticides -determine pesticide residues in the environment. determine the toxicity of various plant and animal toxins
COURSE: construction, machine and tools safety	CODE: ESM 324
Demonstrate with relevant machines associated hazards	Guide students to demonstrate with relevant machines associated hazards
Demonstrate safety precaution and safe handling of special woodworking tools and equipment	Guide students to demonstrate safety precaution and safe handling of special woodworking tools and equipment
COURSE: instrumentation and laboratory analysis	CODE: ESM 325
Carry out measurement using colorimeters. Carry out routine maintenance on the colorimeter e.g. care of filters and cuvettes. Determine concentration of samples applying Beer - Lambert's Law and using spectrophotometer. Carry out minor maintenance work on the spectrophotometer e.g. dusting, replacement of lamps etc.	Guide students to: -carry out measurement using colorimeters. -carry out routine maintenance on the colorimeter e.g. care of filters and cuvettes. -determine concentration of samples applying Beer - Lambert's Law and using spectrophotometer. -Carry out minor maintenance work on the spectrophotometer e.g. dusting, replacement of lamps etc.

<p>Determine sodium, potassium and calcium using flame photometer emission spectrum.</p> <p>Clean atomizer using cleaning probe.</p> <p>Record spectra of known compound using Raman Spectrophotometer.</p> <p>Carry out routine maintenance on Spectrophotometer.</p> <p>Carry out typical maintenance routines for the flame photometer e.g. clearing deposits from the atomizer.</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -determine sodium, potassium and calcium using flame photometer emission spectrum. -clean atomizer using cleaning probe. -record spectra of known compound using Raman Spectrophotometer -carry out routine maintenance on Spectrophotometer -carry out typical maintenance routines for the flame photometer e.g. clearing deposits from the atomizer.
<p>Measure the absorbance of a sample of known concentration using the AAS.</p> <p>Carry out routine maintenance on an AAS</p>	<p>Guide students to measure the absorbance of a sample of known concentration using the AAS.</p> <p>Guide students to carry out routine maintenance on an AAS</p>
<p>Measure the absorption of a given sample using the X-ray instrument and also by varying the filters.</p> <p>Measure the absorption of a given sample using the X-ray instrument and also by varying the filters.</p> <p>.</p> <p>Carry out routine care of the instrument e.g. cleaning of filters, verification of optical instruments.</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -measure the absorption of a given sample using the X-ray instrument and also by varying the filters. measure the absorption of a given sample using the X-ray instrument and also by varying the filters. -carry out routine care of the instrument e.g. cleaning of filters, verification of optical

	instruments.
Carry out various measurements using the instruments in 5.1 Carry out routine care of the instruments in 5.1	Guide students to: -carry out various measurements using the instruments in 5.1 -carry out routine care of the instruments in 5.1
Obtain accurately the counts per second of a radioactive source (emitter) using a gas counter. Measure counter per sec of a beta emitter using scintillating counter. Measure counts per sec for an emitter using proportional counters. Carry out routine care of detectors and counters in 6.1 above.	Guide students to: -obtain accurately the counts per second of a radioactive source (emitter) using a gas counter. -measure counter per sec of a beta emitter using scintillating counter. -measure counts per sec for an emitter using proportional counters. -carry out routine care of detectors and counters in 6.1 above.
Carry out measurements using instruments in 7.2 above. Carry out routine care and maintenance of instruments in 7.2	Guide students to : -carry out measurements using instruments in 7.2 above. carry out routine care and maintenance of instruments in 7.2
Determine the pH of solutions by using a pH meter. Carry out routine maintenance of pH- meter e.g. cleaning and reactivation of the electrodes.	Guide students to measure pH of different solutions. Guide students to carry out routine maintenance of pH- meter e.g. cleaning and reactivation of the electrodes

<p>Measure accurately oxygen concentration using the gas measuring electrodes.</p> <p>Carry out maintenance of electrode including recharging.</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -measure accurately oxygen concentration using the gas measuring electrodes. -carry out maintenance of electrode including recharging.
<p>Demonstrate the techniques of autoradiography</p>	<p>Guide students to demonstrate the techniques of autoradiography</p>
<p>Count bacteria colonies using colony counter.</p> <p>Carry out routine maintenance and repair of colony counters</p>	<p>Guide students to :</p> <ul style="list-style-type: none"> -count bacteria colonies using colony counter. -carry out routine maintenance and repair of colony counters.
<p>Sterilize centrifuge.</p> <p>Use centrifuge for separation.</p> <p>Grow organism using incubator</p> <p>Carry out routine maintenance of the instruments in 12.1</p>	<p>Guide students to:</p> <ul style="list-style-type: none"> -sterilize centrifuge -use centrifuge for separation. -grow organism using incubator. --carry out routine maintenance of the instruments in 12.1
<p>COURSE: Waste Utilization</p>	<p>CODE: 326</p>
<p>Identify different types of waste generated in the environment.</p>	<p>Guide the students to identify the different types of waste generated in the environment</p> <p>Guide students to display samples of wastes</p> <p>Guide students to conduct laboratory analysis of samples</p>
<p>Carry out field trips to waste management authorities.</p>	<p>Guide students to :</p>

<p>Observe waste collection and disposal practices.</p> <p>Identify the waste hierarchy i.e. Waste prevention (Rejection) Waste minimization Waste recycling Waste recovery Waste treatment Waste disposal.</p> <p>Identify techniques of waste minimization.</p> <p>Identify waste disposal methods.</p> <p>Undertake waste stream analysis.</p>	<p>-carry out field trips to waste management authorities.</p> <p>-observe waste collection and disposal practices.</p> <p>-identify the waste hierarchy i.e. Waste prevention (Rejection) Waste minimization Waste recycling Waste recovery Waste treatment Waste disposal.</p> <p>-identify techniques of waste minimization.</p> <p>-identify waste disposal methods.</p> <p>-Undertake waste stream analysis.</p>
<p>Identify health problems associated with waste handling such as: Reproductive effects Congenital malformations Cancer Cardiovascular disorders respiratory infection Hepatitis B Lassa fever.</p>	<p>Guide students to: -identify health problems associated with waste handling such as: Reproductive effects Congenital malformations Cancer Cardiovascular disorders respiratory infection Hepatitis B</p>

<p>Identify the causative organisms of the health problems above, resulting from poor waste handling.</p> <p>Identify pollutants in waste handling</p> <p>Identify the nature of pollutants inherent in waste handling.</p>	<p>Lassa fever.</p> <p>-identify the causative organisms of the health problems above, resulting from poor waste handling.</p> <p>-identify pollutants in waste handling</p> <p>identify the nature of pollutants inherent in waste handling.</p>
<p>Identify solid waste collection methods.</p> <p>Identify solid waste disposal methods. collection methods.</p> <p>Identify liquid waste disposal methods.</p> <p>Identify various means and facilities of solid treatment and disposal.</p> <p>Identify various means and facilities of liquid waste treatment and disposal.</p> <p>Identify various means and facilities used in sewage management.</p>	<p>Guide students to:</p> <p>-identify solid waste collection methods.</p> <p>-identify solid waste disposal methods.</p> <p>-identify liquid waste collection methods.</p> <p>-identify liquid waste disposal methods.</p> <p>-identify various means and facilities of solid treatment and disposal.</p> <p>-identify various means and facilities of liquid waste treatment and disposal.</p> <p>identify various means and facilities used in sewage management</p>
<p>Perform conversion of waste materials to useful products.</p> <p>Identify locally-fabricated machines and processing equipment used in converting wastes-to-wealth e.g.:</p>	<p>Guide students to:</p> <p>-perform conversion of waste materials to useful products.</p> <p>-identify locally- fabricated machines and processing equipment used in converting wastes- to-wealth e.g.:</p>

Hoppers Extruders Aggregators Rollers Set up a demonstration household composting facilities	Hoppers Extruders Aggregators Rollers -set up a demonstration house-hold composting
COURSE: Remote Sensing Application	CODE: 327
Use global positioningsystem (GPS)	Guide students to use of global positioning system(GPS)
Determine parallaxes onthermal, SLAR landsat and SPOT imageries	Guide students todetermine parallaxes on thermal, SLAR landsat and SPOT Imageries
Determine the differencesin radiant temperatures existing within a scene.	Guide students todetermine the differences in radiant temperatures existing within a scene.
Use SLAR, MSS, Radiometer, GPS, GIS GPR to solve environmental problems in the following areas Population dynamic, Water Resources management, Desert encouragement, Oil spillage, Biodiversity monitoring, Air pollution monitoring, Industrial pollution and monitoring Disaster information management system	Guide students touse SLAR, MSS, Radiometer, GPS,GIS GPR to solve environmental problems in the following areas Population dynamic, Water Resources management, Desert encouragement, Oil spillage, Biodiversity monitoring, Air pollution monitoring, Industrial pollutionand monitoring Disaster information management system
Demonstrate application of Airborne Lidar systemfor point cloud Use Airborne Lidarsystem for forestry application	Guide students onthe application ofAirborne Lidar system for point cloud Guide students on the use of Airborne Lidar system for forestry
COURSE: ADVANCED ENVIRONMENTAL	CODE: ESM 413

ASSESSMENT	
Prepare samples of EIA. EA. documentformats. Prepare samples of environmental contract documents.	Guide students to: -Prepare samples ofEIA. EA. documentformats. -Prepare samples ofenvironmental contract documents
Prepare an environmental assessment (EA) document from results of the impactanalysis. Prepare a documentreview of an environmental Assessment Project	Guide students to: -Prepare an environmental assessment (EA) document from resultsof the impact analysis. -Prepare a documentreview of an environmental Assessment Project
COURSE: Sanitation and WasteManagement	CODE: ESM 414
Identify different types ofindustrial wastes.	Guide the studentsto identify industrial wastes
Carry out plant inspection and health education programmes in industry	Guide students to carry out plant inspection and health education programmes in industry
COURSE: Ecological Disaster,Prevention And Control	CODE: ESM 421
Identify the causal agentsof desert encroachment	Guide students to identify the causalagents of desert encroachment
Identify flood-susceptibleareas	Guide students toidentify flood- susceptible areas
Identify the causal agentsof drought	Guide students to identify the causalagents of drought
COURSE: Sampling Methods for Polluted Sites	CODE: ESM 423
Determine common pollutants in air, water, wastewater, sediment andsoil using sampling and analytical techniques.	Guide student to determine common pollutantsin air, water, wastewater, sediment and soil using sampling and analytical techniques

Perform soil vapour screening as an aid to sample selection and core logging.	Guide students to perform soil vapour screening as an aid to sample selection and core logging
Identify the method to develop and purge a monitoring well.	Guide students to identify the method to develop and purge a monitoring well.
Conduct a soil survey and collect vapor samples	Guide students to conduct a soil survey and collect vapor samples
Identify different types of geophysical tools	Guide students to identify different types of geophysical tools
Demonstrate the use of headspace test to determine the presence of volatile organics	Guide students to determine the presence of volatile organics using headspace test.
Perform a hydraulic response test in a monitoring well to determine hydraulic conductivity	Guide students to perform a hydraulic response test in a monitoring well to determine hydraulic conductivity
Use an electric water tape to measure water levels in a monitoring well. Use a surveying level to determine relative borehole elevations. Calculate ground water elevations. Prepare a hydraulic gradient map. Determine the direction of ground water flow	Guide students to: -use an electric water tape to measure water levels in a monitoring well. -use a surveying level to determine relative borehole elevations. -calculate groundwater elevations. -prepare a hydraulic gradient map. -determine the direction of ground water flow
COURSE: Polluted Site Investigation and Remediation	CODE: ESM 424
Locate potential environmental concerns, associated with a host of industrial or commercial properties	Guide student to locate potential environmental concerns, associated with a host of industrial or

	commercial properties
Perform site investigation based on evaluation of field data.	Guide students to perform site investigation based on evaluation of field data.
Identify remedial screening chart	Guide students to identify remedial screening chart
Apply risk assessment methodology in analyzing case study data	Guide Student to apply risk assessment methodology in analyzing case study data

REQUIRED LABORATORIES/WORKSHOP/ MINIMUM EQUIPMENT FOR ND/HND ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY

S/N	Description of item	
A	<u>WATER and WASTE-WATER LABORATORY</u>	
	Toxic gas monitor with accessories for CO, NO,NO ₂ , H ₂ S	1 each
1	Sound level indicator with analogue displaymeasuring 40-120Db	1
2	Spectrometer (student-type)	1
3	Environmental Multi-meter with accessories	1
4	Soil pH meter	1
5	General Purpose Soil auger	1
6	Soil conductivity meter	1
7	Hygrometer with graduated scales -5 to 150x 1 ⁰ C, 140mm length of scale, accuracy +5 to 20%	1
8	Portable anemometer for air speeds of 50 –1000 m/m	1
9	Geiger Counter	1
10	Barometer with digital thermometer, range945 to 1045 mbar, Accuracy 1 mbar, Temperature range – 20 to 60oC, Battery Operated	1
11	Meteorological station(equip with weatherequipment)	1
12	Bio-system kit covering experiments on respiration, Photosynthesis, transpiration, osmosis, enzymes, And gas analysis	1
13	Electric Clinostat, 220 – 240V, 50 - 60 Hz,SW.	2no.(each)
14	Toxic gas monitor with accessories for CO, NO,NO ₂ , H ₂ S	1no.each
15	Sound level indicator with analogue displaymeasuring 40-120Db	2no
16	Water quality meter to measure p , conductivity/Salinity, dissolved oxygen, temperature and turbidity (Conductivitymeter)	1no.

17	Water quality field test kit covering the following tests:- <ul style="list-style-type: none"> • Alkalinity, 0.5 – 8ppm • Chloride, 2 – 100 ppm Hardness, 2 – 100 ppm Sulphite, 2 - 50 ppm	2no
18	Water Colorimetric field test kit covering the following test:- 1.0 Ammonia/Nitrogen, 0.5 – 8 ppm 2.0 Chlorine (DFD), 0.1 – 8 ppm 3.0 Chromate, 5 – 40 ppm 4.0 Iron, 0.1 – 10 ppm 5.0 PH (wide range), 3 - 10 6.0 Phosphate, ortho, 0 – 4 ppm; 5 – 250 ppm Zinc, 0.5 – 10 ppm.	1no.
19	Water titrimetric field test kit covering the following test:- <ul style="list-style-type: none"> • Alkalinity (total), 0 – 500 ppm • Colour, 0 – 100 units • Cyanide, 0 – 1 ppm • Hardness (low range), 0 – 10 ppm • Hardness (High range), 0 – 500 ppm • Dissolved oxygen, 0.04 – 20 ppm Sulphate, 1 – 750 ppm Turbidity, 5 – 100 JIM (AAS)	1no.
B	<u>ENVIRONMENTAL BIOLOGY LABORATORY</u>	
	Description	__Qty Required
1.	Binocular Microscope -	15No.
2	Prepared slides of Animal cells/tissues (various types)	50 No
3	Prepared slides of plants cells/tissues (various types)	50No

4	Plain slides (plastic)	100No
5	Petri-dishes(plastic/disposable)	200No
6	Autoclave	2No
7	Hot-Air Oven	1No
8	Incubator	1No
9	Water-bath	2No
10	Vacuum pump	2No
11.	Inoculation needles (straight or loop)	10No
12.	Colony counter	2No
13.	Bunsen Burner	15No
14.	Hot Plate	2No
15.	Electronic Balance	2No
16.	Staining rack	2No
17.	pH meter	2No
18.	Bench top	Assorted.
19.	Electric blender	2No
20.	Refrigerator	1No
21.	Durham tubes	50No
22.	Measuring cylinder (various sizes)	Assorted
23.	Glassware (test-tubes, conical flasks, beakers, (of various sizes)	Assorted
24.	Pipettes/bulb pipettes (of various capacities)	Assorted
25.	Electric shaker	2No
26.	Electric/magnetic stirrers	2No
27.	Thermometer	20No
28.	Quad rat	10No
29.	Insect net	5 sets

30.	Pooter	2No
31.	Plankton net	2No
32.	Sprinker	5No
33.	First Aid Box	1
34.	Fire extinguisher	1
35.	Technologist office	1
36.	Preparatory room	1
37.	Store	1
C	<u>CHEMISTRY LABORATORY</u>	
S/NO.	Description	QTY
1	Column Chromatograph	2no.
2	Vacuum Desiccators	2no.
3	Bunsen Burner (general purpose)	10no.
4	High speed centrifuge	2no.
5	Water-still Mane-sty 220/240V	1no.
1.	Copper Voltammeters with electrodes	1no.
2.	Electrochemical cell	2no.
3.	Electrolysis cell, OHP	2no.
4.	Hoffman Voltammeter	1no.
5.	Muffle furnace	1no.
6.	Hot plates	2no.
7.	Glasswares	Various capacities(assorted)
8.	Deionizer	1
9.	First aid box	1
10.	Fire extinguisher	1
11.	Technologist office	1
12.	Preparatory Room	1

13.	Store	1
14.	CONSUMABLES	
D	<u>Hydrology Laboratory</u>	
	Description	Q TY
1	Evaporation gauge	1
2	Hydrology apparatus	1
3	Hydrometer	1
4	Stream guage	1
5	Rain guage	
6	Model Sedimentation tank (IMPROVISED)	1
7	Portable pressure meter	1
8	Digital indicator (hand type)	1

(2) WORKSHOPS

(A) SAFETY WORKSHOP

S/No.	Description	Qty
1.	Eye protection spectacles: - general purpose grade 2 impact	30NO 15no.
2	Eye protection goggles:	15no.each

	<ul style="list-style-type: none"> - grade 2 impact - chemical, type C - dust, type D - gas, type G molten metal, type M	
3	Face shields: <ul style="list-style-type: none"> -grade 2 impact, C resistance - grade 2 impact, C and M resistance -grade 1 impact, C and M resistance -Ultraviolet 	5 each
4	Eye wash assembly	2
5	Fire extinguishers <ul style="list-style-type: none"> - BCF dry powder - BCF 	3each
6	First aid kit (up to 30 persons)	3
7	Resuscitator (Brook airway)	5
8	Lifting manikin model	1
9	Safety hand gloves: <ul style="list-style-type: none"> - sterile types - non-sterile types Heat/cold resistance type 	Assorted (1stream of 30students)
10	Hazard warning labels: <ul style="list-style-type: none"> - Chemical (corrosive, flammable, irritant, toxic) - general (laser beam, radiation, radioactive, toxic) 	1no symboleach
11	Protective coats:	(1steam of 30 students)

	- flame retardant chemical resistant	
12	Dust/mist/fumes masks	5 each
13	Respirators: - dust/mist type - mercury vapour type - nuisance odor - organic vapour acid gas	2pack 3 3 3 2
14	Safety caps (Hard hats)	30
15	Leather aprons	15
16	Fire buckets	5

B Surveying Equipment Store

S/No.	Description	Qty
1.	10 Second Total Station and Accessories	2no.
2.	Abney level	5no.
3.	Prismatic compass with tripods	3no.
4.	Hand held apparatus	5no.
5.	Clinometers	2no.
6.	Digital levelling instruments with accessories	2no.
7.	Pantograph (Small and big sets)	2each
8.	Telescopic Alidades (sighting rule)	2no.
9.	Ranging poles	3no.
10.	Pentium based computers with accessories	15no.

11.	Digital Theodolites	5no.
12.	Assorted relevant software	1no.
13.	Surveying Umbrella	5no.
14.	Staves	5no.
15.	Steel arrows	3no.
16.	Planimeters	5no.
17.	Pocket altimeter	5no.
18.	Tapes (30m, 50m, 100m)	5 each
19.	Optical square	5no.

(C) Remote Sensing Equipment

S/No.	Description	Qty
1.	Stereoscopes:- - Pocket Stereoscope - Mirror Stereoscope - Dual mirror Stereoscope Interpretoscope	1
2.	Densimeter`	1
3.	Slicer	1
4.	Scanner	1
5.	Aero-Sketchaster	1
6.	Photogrametric equipment	1
7.	Aerial photographs	1
8.	Satellite Imageries	1
9.	Global Positioning System	1
10.	Geographic Information System software (GIS)	1
11.	Computer Hardware and Software	1

Computer Studio

(3) WORKSHOPS

(A) SAFETY WORKSHOP

S/No.	Description	Qty
1.	Eye protection spectacles: - general purpose grade 2 impact	30NO 15no.
2	Eye protection goggles: - grade 2 impact - chemical, type C - dust, type D - gas, type G molten metal, type M	15no.each
3	Face shields: -grade 2 impact, C resistance - grade 2 impact, C and M resistance -grade 1 impact, C and M resistance -Ultraviolet	5 each
4	Eye wash assembly	2
5	Fire extinguishers	3each

	- BCF dry powder BCF	
6	First aid kit (up to 30 persons)	3
7	Resuscitator (Brook airway)	5
8	Lifting manikin model	1
9	Safety hand gloves: - sterile types non-sterile types Heat/cold resistance type	Assorted (1stream of 30students)
10	Hazard warning labels: - Chemical (corrosive, flammable, irritant, toxic) general (laser beam, radiation, radioactive, toxic)	1no symboleach
11	Protective coats: - flame retardant chemical resistant	(1steam of 30students)
12	Dust/mist/fumes masks	5 each
13	Respirators: - dust/mist type - mercury vapour type - nuisance odor - organic vapour acid gas	2pack3 3 3 2
14	Safety caps (Hard hats)	30
15	Leather aprons	15
16	Fire buckets	5

B Surveying Equipment Store

S/No.	Description	Qty
1.	10 Second Total Station and Accessories	2no.
2.	Abney level	5no.
3.	Prismatic compass with tripods	3no.
4.	Hand held apparatus	5no.
5.	Clinometers	2no.
6.	Digital levelling instruments with accessories	2no.
7.	Pantograph (Small and big sets)	2each
8.	Telescopic Alidades (sighting rule)	2no.
9.	Ranging poles	3no.
10.	Pentium based computers with accessories	15no.
11.	Digital Theodolites	5no.
12.	Assorted relevant software	1no.
13.	Surveying Umbrella	5no.
14.	Staves	5no.
15.	Steel arrows	3no.
16.	Planimeters	5no.
17.	Pocket altimeter	5no.
18.	Tapes (30m, 50m, 100m)	5 each
19.	Optical square	5no.

(C) Remote Sensing Equipment

S/No.	Description	Qty
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1.	<p>Stereoscopes:-</p> <ul style="list-style-type: none"> - Pocket Stereoscope - Mirror Stereoscope <p>Dual mirror Stereoscope Interpretoscope</p>	1
2.	Densimeter`	1
3.	Slicer	1
4.	Scanner	1
5.	Aero-Sketchaster	1
6.	Photogrametric equipment	1
7.	Aerial photographs	1
8.	Satellite Imageries	1
9.	Global Positioning System	1
10.	Geographic Information System software (GIS)	1
11.	Computer Hardware and Software	1

(A) Computer Studio

S/No.	Description	Qty
1.	Computer (PC)	30
2.	Printer	2
3.	Scanner	2
4.	UPS	30