

# 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.

Prof. Idris M. Bugaje 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 relateddiscipline.

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; bur 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	А	4.00
70%-74%	AB	3.50
65% - 69%	В	3.25
60% - 64%	BC	3.00
55% - 59%	С	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:

-	CGPA 3.50-4.00
-	CGPA 3.00-3.49
-	CGPA 2.50-2.99
-	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	COURSE TITLE	L	Р	CU	СН
	CODE					
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
Tota	1	•	18	4	22	22

# YEAR I SEMESTER II

S/N	COURSE CODE	COURSE TITLE	L	Р	CU	СН
1	GNS 121	Citizenship Education		0	2	2
2	GNS 102	Communication in English I		0	2	2
3	ENT 126	Introduction to Entrepreneurship I		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		1	3	3
Total			18	9	27	27

#### YEAR II SEMESTER I

S/N	COURSE COURSE TITLE		L	Р	CU	СН
	CODE					
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	2	-	2	2
		Communication				
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	1	1	19	10	29	29

#### YEAR II SEMESTER II

S/N	COURSE	COURSE TITLE	L	Р	CU	СН
	CODE					
1	GNS 202	Communication in English II	2	0	2	2
2	ESM 221	Climate Change		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 CODE:** ESM 111 **COURSE: INTRODUCTION** TO Credit Unit: 2.0 **CONTACT HOURS: 2 HOURS/WEEK** ENVIRONMENTAL MANAGEMENT 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) **PRACTICAL:** 0 HOURS/WEEK PRE-**REQUISITE:** NONE **GENERAL OBJECTIVES** On completion of this course, the Student should be able to: 1.0 Know basic concepts of environmental management Understand the scope and importance of environmental management 2.0 Understand the multidisciplinary nature of the environment. 3.0 Understand the classification and management of natural resources 4.0 Understand the classification of Natural Resources. 5.0 Understand the natural ecosystem and the impact of human activities in the environment 6.0 Understand energy and environmental management 7.0

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
Course: Introduction to EnvironmentalManagement Course Code: ESM111			Credit Unit: 2.0 Contact Hours: 2-0-0			
GOAL:	This course is designed to e	expose students to the scop	be, importance and the m	ulti –disciplinary nature c	of environmental mana	gementtechnology.
Course	Specification:	Th	eoretical Content: 2	Practical Contants 0 h	<b>r</b> a	
hrs					18	
GENE	RAL OBJECTIVE 1.0: Know	w basic concepts of enviro	nmental management			
Course	Specification:	THEOR	ETICAL CONTENT	PRACTICAL CONTE	NT	
Week	Specific Learning	<b>Teachers'</b> Activities	Learning Resources	Specific Learning	Teachers'	Evaluation
	Outcome			Outcome	Activities	
1-2	1.1 Define	<ul> <li>Explain in details</li> </ul>	• Multi-media	• -	• -	Explain some of
	environmental	withappropriate notes	• Whiteboard,			the relationships
	management	the concepts of	• Internet link			between
	1.2 Explain some of	environmental	materials, etc.			environmental
	the relationships	management				management and
	between	technology.				the environment
	environmental					
	management and					
	the environment					
	1.3 Explain the basic					
	terms and					
	concepts in					
	environmental					
	studies e.g.					
	Components of					
	environment,					
	• environmental					
	stabilization,					
	<ul> <li>environmental</li> </ul>					
	• degradation etc.					
GENE	RAL OBJECTIVE 2.0: Und	lerstand the scope and imp	portance of environment	al management		

3-4	2.1 Explain the role	• Explain the role of	Multi-media	• •	• •	State the
_	of environmental	environmental	Whiteboard			importance of
	management	management	<ul> <li>Internet link</li> </ul>			environmental
	technology in the	technology in the	Pictures video clips			management
	study of environment.	study of	materials etc			technology.
	2.2 Explain	environment.	materiais, etc.			ee ennor og je
	environmental					
	problemssuch as:					
	•Degradation					
	•denudation					
	•natural disaster					
	(earthquake flood					
	volcaniceruption					
	mass movement etc)					
	•ecological problems					
	(deforestation soil					
	erosion					
	desertification land					
	degradation pollution					
	wildlife extinction)					
	etc					
	2.3 Suggest ways of					
	providing relevant					
	solution to some of the					
	problems highlighted in					
	2.2 above.					
Genera	I Objective 3.0 Understand t	the multidisciplinary nat	ture of the environment	•		

5-6	<ul> <li>3.1 Describe the interdisciplinarynature of environmental science.</li> <li>3.2 Identify other branches of science such as geography, forestry, botany, Zoology, Geology, Physics, Chemistry, and Engineering etc.</li> <li>3.3 Describe the role of scientistsfrom various disciplines in solving some of the environmental problems mentioned in 3.1 above.</li> <li>3.4 Establish some of the links inthe individual approach in 3.2 above.</li> </ul>	<ul> <li>Explain in details withappropriate notes the multidisciplinary nature of environmental management technology.</li> </ul>	<ul> <li>Multi-media</li> <li>Whiteboard,</li> <li>Internet link materials,etc.</li> </ul>			Describe the interdisciplinary nature of environmental science involving other branches of science.
GENE	RAL OBJECTIVE 4.0: Unde	erstand the classification	and management of natur	al resources	I	I
7-9	<ul> <li>4.1 Define natural resources.</li> <li>4.2 Give examples of naturalresources.</li> <li>4.3 Classify natural resources i.e Renewable and non-renewable</li> <li>4.4 Define Forest and forestresources.</li> </ul>	Explain in details withappropriate notes the basic concepts of natural resources Explain Forest and forest resources types.	<ul> <li>Multi-media</li> <li>Whiteboard,</li> <li>Internet link</li> <li>materials,etc.</li> <li>Multi-media</li> <li>Whiteboard,</li> <li>Internet link</li> </ul>	-	-	Explain with examples natural resources Explain the effect oftimber State the problems associated with use, over

4.5 Differentiate types	sources such as		utilization and
of forest resources and	renewable and		exploitation of
their resources.	non- renewable		natural resources
4.6 List associated	energy sources		
problems suchas: use and	growing energy		
over exploitation,	proving chergy		
deforestation,			
desertification.	alternate energy		
4.7 Define human	sources.		
activities in environment	Explain why land		
e.g :	is regarded as a		
• timber	resource Discuss		
extraction,	the problem		
• mining and dam	associated with		
construction. on forest	land resources		
and tribal people	such as: land		
4.8 Explain the effect of	degradation, man		
human activities listed in	induced		
5.4 above.	landslides, soil		
4.9 Explain the	erosion and		
different type of	desertification.		
water resources			
4 10 List associated	• Explain with		
roblems suches: use	appropriate note		
and even utilization of	the problems		
and over utilization of	associated with		
surface and	the use, over		
ground water resulting	utilization and		
in flood, drought,	over exploitation		
conflict over water e.g.	of natural		
dam conflict and	resources		
problems			

4.11 Describe the			
mineral resource and			
associated problems			
with use and			
exploitation e.g			
environmental effect of			
mineralextraction			
4.12 Discuss			
problems associated			
with food resources			
such asworld food			
crises caused by			
agricultural			
problems,			
overgrazing,			
fertilizer and			
pesticide problem,			
water logging,			
salinity, climate			
changes etc.			
Performance objectives			
4.13 Describe the			
energy sources such as			
renewable and non-			
renewable energy			
sources, growing energy			
needs, and useof			
alternate energy sources.			
4.14 Describe land as a			
resource and identify the			

	<ul> <li>problem associated with</li> <li>land resources such as</li> <li>landdegradation, man</li> <li>induced landslides, soil</li> <li>erosion and</li> <li>desertification.</li> <li>4.15 Explain different</li> <li>management approaches</li> <li>natural resources e.g</li> <li>conservation,</li> <li>preservation, protection.</li> </ul>					
<b>GENE</b> 10-11	RAL OBJECTIVE 5.0:Unc5.1Define the terms	lerstand the Natural Eco Discuss in details	systems and the impact o • Multi-media	f human activities on the e	environment.	Describe the
	Ecosystem, population, community, habitat, niche. 5.2 Describe the biotic (living) and abiotic (non-living) components ofan ecosystem 5.3 Describe biotic interactions Describe the process of photosynthesis 5.4 Describe energy flow using food chains, food web and trophic level. 5.5 Describe	<ul> <li>with appropriate notes the problems associated with naturalecosystems and the</li> <li>impact of human activities on the</li> </ul>	<ul> <li>Whiteboard,</li> <li>Internet link materials,etc.</li> </ul>			causes and impacts of deforestation

	ecological pyramids					
	based on number					
	and energy					
	5.6 Describe the					
	causes and impacts					
	of habitat loss					
	5.7 Describe the					
	causes and impacts					
	of deforestation					
	5.8 Explain the need					
	for the sustainable					
	management of					
	forests					
	5.9 Describe					
	methods of					
	estimating					
	biodiversity					
	5.10 Evaluate					
	national and					
	international					
	strategies for					
	conserving the					
	biodiversity and					
	genetic resources of					
	natural ecosystems.					
Genera	<b>l Objective 6.0:</b> Understand E	nergy and Environmenta	al Management.	1		
12-14	6.1 Describe the	Explain items 6.1-	• Multi-media	•	• -	State the
	formation of the	6.9	• Whiteboard,			strategies for
	fossil fuels, coal,		• Internet link			minimizing the
	oil and gas		materials,etc.			impacts ofoil
	6.2 Classify the					spills in
	following energy					

 	 	•	
resources as			marine and coastal
renewable or			Ecosystems
non- renewable:			
• fossil fuels,			
• nuclear			
• power			
<ul> <li>power,</li> <li>biofuels</li> </ul>			
• bioideis,			
• geothermal			
power,			
hydro-electric			
power,			
• tidal power, wave			
power,			
• solar and			
• wind power. E.t.c			
6.3 Describe how each			
of these energy			
resources is used to			
generateelectricity			
6.4 Describe the			
environmental and			
social-economic			
advantages and			
disadvantages of			
each of the energy			
resource.			
6.5 Describe and			
explain the factors			
affecting the			
demand of energy			
6.6 Describe and			
explain strategies for			

	the efficient					
	management of					
	energy resources					
	6.7 Describe the causes					
	and impacts of oil					
	pollution on marine					
	and coastal					
	ecosystems.					
	6.8 State the strategies					
	of reducingoil spills					
	in marine and					
	coastal ecosystems.					
	6.9 State the strategies					
	for minimizing the					
	impacts of oil spills					
	in marine and					
	coastal ecosystems					
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 r	for the remaining 60% of the total score.					

COUR	SE: Introduction to Ecology	CODE: ESM 112	Credit Unit: 3.0	<b>CONTACT HOURS:</b> 3 HOURS/WEE				
<b>GOAL</b>	: This course is designed to introduce ns	students to Ecology, E	cological concepts and the	heir applications to residential and industri				
<b>EAR</b>	: ONE (1), <b>SEMESTER:</b> ONE (1)	PRE- REQUISITE: none	PRACTICAL: 2HOU	JRS/WEEK				
General Objectives:								
On co	ompletion of this course, the student should	d be able to:						
On completion of this course, the student should be able to:1.0Understand the importance of Ecology as a field of study.2.0Understand the population growth and industrial activities on environment.3.0Understand the effects of Abiotic Factors on Organisms and Industrial Activities in the Environment4.0Understand the critical roles soil plays in ecosystems.5.0Understand the concepts of living organism living strategies and its applications in industrial situations.6.0Understand the different types of terrestrial and aquatic communities and major eco zones in Nigeria.7.0Understand the Various concepts of species Richness, Biodiversity, Community Equilibrium, Succession, And Biogeography9.0Understand the concept of trophic structure and its applications in industrial situation10.0Understand the concept of energy flow as it applies to industrial situation.								
	.0 Understand the concept of Evolutionary Ecology, Conservation Biology, Industrial Ecology and their relationship 0 Understand the concepts of Group Selection, Individual Selection, And Life History Variation							

PROGR	PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
<b>Course:</b>	Introduction to Ecology	0	Course Code: ESM112	Credit Unit: 3.0		<b>Contact Hours:</b> 3		
<b>GOAL:</b>	This course is designed to introd	luce students to Ecology, E	Ecological concepts and the	eir applications to res	sidential and indust	trialsituations		
Course	Specification:	THE	ORETICAL CONTENT	PRACTICAL CO	NTENT			
General	<b>Objective 1.0:</b> Understand the In	mportance of Ecology as a	field of study.	-				
Week	Specific Learning Outcome	<b>Teachers' Activities</b>	Learning Resources	Specific Learning	Teachers'	Evaluation		
				Outcome	Activities			
1-2	1.1 Define ecology	Explain the importance	• Multi-media	• -	• -	Explain the importance		
		of Ecology and its	• Internet link			of the study of ecology		
	1.2 Describe the	significance to the	Materials, etc.					
	importance of the study	industry.						
	of ecology.							
	1.3 Explain why the concept							
	and							
	principles of ecology is							
	important to industry.							
General	<b>Objective 2.0:</b> Understand the po	pulation growth and indus	strial activities on environ	nent.	I			
4-5	2.1 Define population growth	Explain the various	• Multi-media	Identify short and	Guide student to	Compare and contrast		
	2.2 Compare and contrast	concepts of	• Internet link	long- life span	carry out	population growth		
	population growth strategies	population growth.	materials, etc.	organism	practical on the	strategies of		
	of organisms with short life				identification of	organisms with short		
	spans tolonger- lived				short and long-	lifespans to longer-		
	organisms.	Explain deterministic			life span	lived organisms.		
		and stochastic models			organism	List the types of		
	2.5 Define survivorship	otpopulation growth.			8	survivorship curves.		
	curves.							
	2.4 List the three							

	<ul><li>types of survivorship curves.</li><li>2.5 Define deterministic and stochastic models of populationgrowth.</li></ul>	• Give a case study and apply the concepts presented.				
	2.6 Explain carrying capacity inan environment					
	<ul><li>2.5 Explain the various elements that could influence carrying capacity.</li><li>2.6 Explain the concepts presented as they relate to an industrial situation.</li></ul>					
General	<b>Objective 3.0:</b> Understand the eff	fects of Abiotic Factors on	Organisms and Industrial	Activities in the Env	vironment.	
6-7	<ul> <li>3.1 List the abiotic factors of the environment</li> <li>3.2 Describe that limit the distribution patterns of many organisms.</li> <li>3.2 Describe, using examples, the abiotic factors and how they potentially can limit the distribution patterns of organisms .</li> <li>3.3 Explain how changes in chirtie factors and provide the second second</li></ul>	Explain in details the features of various abiotic factors of the environment that can affect local distribution patterns of organism. Explain how changes in abiotic factors can influence population growth and densities of an organism. Give a case study • and apply the concepts presented.	<ul> <li>Multi-media</li> <li>Internet link materials,etc.</li> </ul>	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 environmentand how changes in abiotic factorscan influence population growth and densities of anorganisms.

Ceneral	<ul> <li>population growth and densities of an organism.</li> <li>3.4 Explain the concepts presented as they relate to anIndustrial situation.</li> </ul>	itical roles Soil Play in Eco	system			
General	A 1 Describe the	Explain the different	• Multi-media	carry out practical	Guide student to	List the components
8-10	<ul><li>4.1 Describe the components of the Soil system.</li><li>4.2 Classify different types of soils.</li></ul>	Explain the different types of soil profile, their characteristics and properties. Classify different type of soils and the	<ul> <li>Multi-media</li> <li>Whiteboard,</li> <li>Internet link materials, soil samples</li> </ul>	to identify types of soil profile.	carry out practical to identify types of soil profile	List the components of the Soil system Classify different type of soils. Write downthe sources and fate of
	4.3 Describe the sources andfate of mineral nutrients.	<ul><li>key role of</li><li>water in soil and soil formation.</li></ul>				mineral nutrients Describe the impact
	4.4 Explain the key role of water in soil and soil formation.	Describe the impactof different types of soil on industrial activities				have on industrial activity
	4.5 Describe the impact different types of soil have onecosystem formation.	Give a case study and apply the concepts presented				
	4.6 Describe the impact of different types of soil on industrial activities					

General	General Objective 5.0: Understand the Concepts of living Organism Living Strategies and its applications in industrial situations						
11	<ul><li>5.1 Discuss the interactions of different types of organism in anenvironment.</li><li>5.2 Discuss the effect of ecological chain within the environment.</li></ul>	Explain in detail the concepts of organism living strategies and their application in an industrial situation.	<ul> <li>Multi-media</li> <li>Whiteboard,</li> <li>Internet link materials,etc.</li> </ul>	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 typesand subtypes of species interactions	
General	<b>Objective 6.0:</b> Understand the D	ifferent Types of Terrestrial	and Aquatic Communiti	es and Major Eco zo:	nes In Nigeria	ſ	
12-13	<ul> <li>6.1 Define an ecological community and its importance</li> <li>6.2 Describe the different typesof terrestrial community</li> <li>6.3 Describe the different typesof aquatic communities.</li> <li>6.4 Explain why the study of communities and their classification is important to an industrial situation</li> </ul>	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 • situation.	<ul> <li>Multi-media</li> <li>Internet link materials,etc.</li> </ul>	Identify different ecological communities	Guide the student on how to identify different ecological communities	Define an ecological community Describe the different typesof aquatic and terrestrial communities.	
General	Objective 7.0 Understand the Ma	ajor Ecozones In Nigeria	1	1	1	1	
14	7.1 List the different groups of Nigeria ecozones.	Explain in detail the major Ecozones and Ecoregions in Nigeria	• Multi-media Internet link materials,etc.		•	List the different groups ofNigeria ecozones.	

7.2 Describe the general	emphasizingon the		
biophysical characteristics	general biophysical		
of each of the different	characteristics.		Describe using examples
groups ofNigeria			the limitations and
ecozones.	Outline the limitations		problemsassociated with
	and problems		industrial activities in the
7.3 Compare and	associatedwith		Nigoria according and
contrastthe general	industrial activities in		
biophysical	the Nigeria ecozones		ecoregions.
characteristics of the	and ecoregions.		
different groups of	Compare and		
Nigeria ecozones.	contrast the		
	general		
7.4 List the Nigeria ecozones	biophysical		
andecoregions.	• characteristics of the		
	different groups of		
7.5 Describe the	Nigeria ecozones.		
biophysical			
characteristics of the			
Nigeria ecozones and			
Eco regions.			
/.6 Recognize the			
of the Nigeria apogenes			
of the Nigeria ecozofies.			
7.7 Describe the limitations			
and problems associated with			
industrial activities in the			
Nigeriaecozones and			
ecoregions			

7.8 Explain using a case study ofecozone(s) and ecoregions(s), their limitations and problems industrial activity in the an	with rea				
General Objective 8.0: Understand	the various concepts of species R	Lichness, Biodiversity, C	ommunity Equilibriu	Im, Succession, and	l Biogeography
General Objective 8.0: Understand         8.1 Explain the concepts of species richness.         8.2 Explain the concepts of biodiversity.         8.3 Explain the concepts of community stability, equilibrium, and non-equilibrium.         8.4 List different types of succession.         8.5 Give a case study to applythe concepts of succession         8.6 Explain how succession canbe deviated.         8.7 Explain using example	I the various concepts of species R         Explain the concepts of species richness, biodiversity, community stability,equilibrium and non-equilibrium, succession,         of       Explain the conceptof Island biogeography with the aid of a case study.         Give a case study to apply the concepts of island biogeography         on	<ul> <li>Multi-media</li> <li>Internet link</li> <li>materials,etc.</li> </ul>	ommunity Equilibriu	•	List examplesof species richness, biodiversity, community stability, equilibrium and non- equilibrium, succession List different types of succession.
theconcept of island					

	biogeography.				
Conora	8.8 Explain the concepts presented above as they relate toan industrial situation.	oncept of Trophic Structure	and its applications in ir	dustrial situation	
Genera	Objective 7.0. Onderstand the e	oncept of fropine Structure	and its applications in it	idustriai situation	
	9.1 Define ecosystem	Explain the relationship among different trophic	<ul><li>Multi-media</li><li>Internet link</li></ul>	•	Define ecosystem
	9.2 Describe using examples thetwo major ways in which organisms derive energy.	levels with examples Explain food web and food chain fromthe first trophic level using	• materials,etc.		Define using examples, food web andkeystone species
	9.3 Define food chain and foodweb	photosynthesis to the trophic pyramid.			
	9.4 Describe using examples thethree types of food webs.	Explain keystone species e.g sea urchins, sea otter. others are large mammalian			
	9.5 List the problems associated with food webs.	predator			
	9.6 Define keystone species				
	9.7 Explain the concepts presented as they				

	relate to an industrial situation.					
General Objective10.0: Understand the Concept of Energy Flow and applications to Industrial Situation.						
	<ul> <li>10.1 Describe using examplesthe concept of energy flow</li> <li>10.2 Describe the similarities anddifferences between energy flow and chemical flow</li> <li>10.3 Describe using examples thepositive and negative results fromdifferent energy flows and nutrient cycles interaction</li> <li>10.4 Explain the concepts presented in 10.3 as they relate to an industrial situation</li> </ul>	Explain Energy flowin an ecosystem. Describe the similarities and differences between energy flow and chemical flow Give a case study to apply the concepts of island biogeography	<ul> <li>Multi-media</li> <li>Whiteboard,</li> <li>Internet link</li> <li>materials,etc.</li> </ul>			Describe using examples theconcept of energy flow Describe the similarities and differences between energy flow and chemical flow
General Objective 11.0: Understand the Phosphorous, Carbon, Nitrogen, And Sulfur Cycles and applications in Solving Industrial Issue						
	<ul> <li>11.1 Describe the general concept of the following nutrientcycles with examples: phosphorous cycle.carbon cycle. nitrogen cycle.sulphur cycle.</li> <li>11.2 Describe using</li> </ul>	Explain items 11.1- 11.4	<ul> <li>Multi-media</li> <li>Internet link</li> <li>materials,charts</li> </ul>			Describe using examples the phosphorous and carbon Cycles

<ul> <li>example how nutrient turnover time is affected by species and location.</li> <li>11.3Describe how anthropogenic changes can affect nutrient cycling.</li> <li>11.4 Explain the concepts presented as</li> </ul>					
they relate to an industrial situation					
General Objective12.0: Unde	rstand the concept of Evoluti	onary Ecology, Conserva	1 ation Biology, Indust	trial Ecology and t	heirrelationship
					h
12.1 Define industrial ecology12.2 Explain using examples thekey components and relationships of an industrial ecosystem12.3 Compare and contrast thekey components and relationships of a natural (i.e., traditional) ecosystem with anindustrial ecosystem	<ul> <li>Define industrial ecology</li> <li>Explain using examples the key components and relationships of an industrial ecosystem</li> </ul>	<ul> <li>Multi-media</li> <li>Internet link</li> <li>materials,etc.</li> </ul>			Explain industrial ecology
GENERAL OBJECTIVE 13.0: Understand the concepts of Group Selection, Individual Selection, And Life History Variation					
13.1 Describe the concept ofpopulation	Explain items 13.1- 13.10	<ul><li>Multi-media</li><li>Internet link</li></ul>	•	•	Explain the concept of population variation

variation	• materials.etc.							
13.2 list the importance of	,							
population variation								
Describe how population								
variation can occur or								
reduced								
13.3 Describe the								
concept of natural								
selection.								
13.4 Describe how organism								
canbecome extinct								
canoccome extinct								
13.5 Explain the concepts								
presented as they relate to an								
industrial situation								
13.6 Describe the concepts of								
group selection and individual								
selection.								
13.7Describe the								
concept of								
reproductive								
strategy.								
13.8 Explain how to								
Identify different								
types of								
reproductive								
strategy								
13.9Describe what								
determinesthe								
--	--	--	--	--	--	--	--	--
reproductive								
success of an								
organism.								
13.10 Explain the concepts								
presented in 14.1 to 14.4								
as theyrelate to an								
industrial situation								
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								
<b>COURSE:</b> Introduction to Geography	<b>CODE:</b> ESM 113	Credit Unit: 3.0	<b>CONTACT HOURS:</b> 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-	PRACTICAL: 2 HOUR	S/WEEK					
	<b>REQUISITE:</b>							
	none							

#### **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								
<b>Course:</b>	Introduction to Geography	C	Course Code: 113	Credit Unit: 3.0		<b>Contact Hours:</b> 3		
Goal: Th	nis course is designed to expose st	udents to basic geographic	principles and their influe	nce on physical earth	n forms.			
Course S	Specification:	THE	ORETICAL CONTENT	PRACTICAL CO	NTENT			
General	<b>Objective 1.0:</b> Understand the S	ciences that are involved in	n surface and subsurface en	nvironmental studies				
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation		
1-2	<ul> <li>1.1 Define geography</li> <li>1.2 Explain the relationship ofgeography with the environmental</li> <li>1.3 Explain the branches of geography based on the subjectmatter and application.</li> <li>1.4 List types of data that thatare required in the field of environmental science and management.</li> </ul>	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 proces	sses that form igneous rock	KS					

4-5	2.1 Define rock	Explain Rock	Lab Coat, coveralls,	Identify special	Guide students to	Classify igneous
	2.2 Describe types of rock	And its types	safetyGlasses with solid	featureson igneous	identify special	rocks on the basis of
			side shields.	rocks.	features on	composition and
	2.2 Describe rock textures.	Classify rocks on the			igneous rocks	texture.
		basis of composition			Iglicous locks	2.3 Classifyigneous
	2.3 Classify rocks on the	and texture.				rocks on the basis of
	basis of their composition	Explain volcanic				compositio n and
	and texture.	processes.				texture
		I.				
	2.4 Explain volcanic	• Exemplify the				
	processes.	formation and				
		characteristics of				
	Describe the formation and	plutons.				
	characteristics of plutons.	-				
General	<b>Objective 3.0:</b> Understand proce	sses that form metamorphi	c rocks	I	1	
	3.1 Define igneous,	• Explain the types,	Metamorphic rock	Identify special	Guide	Explain how
67	metamorphic and	texture and	samples	featureson	students	metamorphic rocks are
0-7	sedimentaryrock	formation of the	-	metamorphic	identify	_
	Explain the formation of	three types of rocks		rocks.	special	
	each type of rocks.				features on	
	3.2 Classify metamorphic				metamorphic	
	rockson the basis of their					
	texture (foliated on non-					
	foliated)					
	3.3 Describe the grade of					
	Metamorphism as indicated by					
	foliated textures.					
General	l Objective 4.0: Understand proce	esses that form sedimentary	v rocks.			

8-10rocksand explain how they form.rocks in term of form, classification, size, shape, composition and origin.samplesfeatureson sedimentary rocks.to identify special features on sedimentary rocks.sedimentary rocks.4.2 Describe, name and classifycommon sedimentary rocks
b+10       they form.       classification, size, shape, composition and origin.       sedimentary rocks.       special features on sedimentary rocks.       basis of composition.         4.2 Describe, name and classifycommon sedimentary rocks.       4.3 Classify clastic rocks on thebasis of grain size and shape.       shape, composition and origin.       sedimentary rocks.       sedimentary rocks.       basis of composition.         4.4 Classify chemical       4.4 Classify chemical       sedimentary rocks.       sedimentary rocks.       sedimentary rocks.
4.2 Describe, name and classifycommon sedimentary rocks.shape, composition and origin.on sedimentary rocks.4.3 Classify clastic rocks on thebasis of grain size and shape.4.4 Classify chemicalImage: Composition and origin.Image: Composition and origin.
4.2 Describe, name and classifycommon sedimentary rocks.       origin.       rocks.         4.3 Classify clastic rocks on thebasis of grain size and shape.
classifycommon sedimentary rocks.       4.3 Classify clastic rocks on thebasis of grain size and shape.       4.4 Classify chemical
sedimentary rocks.         4.3 Classify clastic rocks on thebasis of grain size and shape.         4.4 Classify chemical
<ul> <li>4.3 Classify clastic rocks on thebasis of grain size and shape.</li> <li>4.4 Classify chemical</li> </ul>
4.3 Classify clastic rocks on thebasis of grain size and shape.       4.4 Classify chemical
thebasis of grain size and shape.       4.4 Classify chemical
shape. 4.4 Classify chemical
4.4 Classify chemical
4.4 Classify chemical
sedimentary rocks on the
basisof composition.
Classify organic sedimentary
rocks on the basis of origin.
Concerci Objective 5.0: Understand the Deregity and Dermachility in Deak
General Objective 5.0: Onderstand the Porosity and Permeability in Rock
5.1 Define porosity Describe porosity, Lab Coat, coveralls, Determine Guide students to Define porosity and
11 and permeability and different safety Glasses with porosity and determine permeability
porosity and permeability solid side shields, permeability of porosity and
5.2 Classify different types of rocks. rock permeability of
porositytypes. rock
5.3 Describe the rates of
porosity and permeability in
different types of rocks.
General Objective 6.0: Understand the types of aquifer as geological formations based on their Physical Properties

12-13	6.1 Describe the	Classify rocks	Lab Coat, coveralls,	<b>–</b>	■ _	Describe the various
	various types of	as aquifers or	safetyGlasses with			types of aquifers
	aquifers (aquifer,	Aquicludes.	solid side shields			(aquifer, aquitard,
	aquitard,aquifuge)	• And the variety of				aquifuge)
	6.2 Describe	subsurface aquifers that				uquituge)
	subsurface zonation	is used globally				
	based on water					
	saturation.					
	6.3 Describe the					
	characteristicsof aquifers.					
	6.4 Categorize rocks as					
	aguifersor Aguicludes.					
	6.5 Describe the variety of					
	subsurface aquifers being used					
	globally.					
General	<b>Objective 7.0:</b> Understand and Ir	nterpret a Table of Formation	1			
14	7.1 Describe criteria	Explain rock	Lab Coat, coveralls,	■ _	■ _	Describe effects of
	used tocategorize rock	Formations, Eras of the	safetyGlasses with			erosion, tilting and uplift
	units as Formations.	Geological time Scale	solid side shields.			on relationshipbetween
	7.2 Explain the Eras of the	and then relative ages.				rock units
	Geological time Scale and	•List effects of erosion,				
	theirrelative ages.	tilting and uplift on				
		relationshipbetween rock				
	7.3 Describe effects of	units.				
	erosion, tilting and uplift on					
	relationshipbetween rock					
	units.					
General	<b>Objective 8.0:</b> Understand the D	ifferences between confined	and unconfined aquifers	5.		

	0 1 D 1				Carilla standa t	<b>X7'</b> 1 ' 1 1 1 1
	8.1 Recognize recharge	Explain aquiters recharge	Lab Coat, coveralls,	Identify	Guide students	visual aids, chalk and
	anddischarge areas of	and discharge areas,	safetyGlasses with	recharge	to:	chalkboard s
	aquifers.	confined and unconfined	solid side shields.	and	-identify	
		aquifers.		discharge	rechargeand	
	8.2 Describe the			areas	discharge	
	differencebetween	Explain water flow			areas	
	confined and	• directions inconfined and		Determine		
	unconfined aquifers.			water flow	-determine	
	-			directions in	water flow	
				confined and	directions in	
	8.3 Determine water			unconfined	confined and	
	flowdirections in			aquifer	unconfined	
	confined and			uquitor	aquifer	
	unconfined aquifer.			Use a		
				notontiomotrio		
	8.4 Explain how to use					
	a potentiometric surface			surface to predict		
	to predict water			water		
	behavior in an artesian					
	well.					
General	<b>Objective 9.0:</b> Understand the E	ffect of Nonconformities on	Ground water Movemen	it		
General						
	9.1 Differentiate	• Explain the conceptof	Lab Coat, coveralls,	Identify the	Guide students	Describe processes that
	between 3major	nonconformity and	safetyGlasses with	different typesof	toidentify the	form unconformity
	unconformity types.	unconformity, erosion	solid side shields.	conformities.	different types	-
		and types of erosion.			ofconformities	
	9.2 Describe processes that					
	formunconformities					
	9.3 Different types of					
	erosion surfaces and their effect					
	on subsurface fluid flow.					

General Objective 10.0: Understand the processes that form Geological structures and their effect on surface water and groundwater.						
	10.1 Define the Law of OriginalHorizontality	Explain various aspects of structural geology	Lab Coat, coveralls, safetyGlasses with	Identify and differentiate the different types of	Guide students to identify and differentiate	Differentiate types of stress and strain involved
	10.2 Differentiate types of stressand strain involved in the formation of rocks.	strain involved in the formation of rocks, processes that create	solid side shields.	rockformation.	typesof rock formations	in the formation of rocks
	10.3 Explain processes thatcreate faults and	faults and folds.				
	folds. 10.4 Explain faults and	•Explain processes thatare involved in Interpreting strike, dip, fold and fault				
	10.5 Explain how to	<ul> <li>symbols on maps.</li> <li>Describe surface water drainage patterns and</li> </ul>				
	fold and fault symbols onmaps.	their relationship to underlying geological features				
	Differentiate surface water drainage patterns and their relationship to underlying geological features.					
	10.7 Explain the effect of structural geology on groundwater aquifers					
General	Objective 11.0: Understand ho	ow Subsurface relationship	developed between roo	ck units and their in	fluence on groun	dwater flow.

	<ul> <li>11.1 Explain terrestrial, marineand transitional depositional environment.</li> <li>11.2 Explain Depositional environments depositional Differentiate between depositional environmental onthe basis of sedimentary features.</li> <li>Describe the aquifer potential of different depositional environments onthe basis of geological characteristics.</li> </ul>	Explain terrestrial, marine and transitional depositional environment. Explain the differences betweendepositional environmental on the basis of sedimentary features. And the aquifer potential of different depositional environments on the	Lab Coat, coveralls, safetyGlasses with solid side shields.	Identify terrestrial, marineand transitional depositional environment	Guide students to identify terrestrial, marine and transitional depositional environment	Identify terrestrial, marine and transitional depositional environmen t.
Conoral	Objective 12 0: Understand the	• basis of geological characteristics.				
General	Objective 12.0. Onderstand the	basic cilliatological factor	19			
	<ul> <li>12.1 Describe the difference between climate and weather.</li> <li>12.2 Describe different types ofclimate Describe the various apparatus used for measuringweather elements.</li> </ul>	Explain weather and climate, their occurrences, distribution. Explain the conceptof climate change and the effects on human settlements. Describe the operations of equipment's used in	Lab Coat, coveralls, safetyGlasses with solid side shields.			Describe the various apparatus used for measuring weather elements

	12.4 Describe the factors/ causesresponsible for climate change. (temperature, precipitation, wind, pressure etc)	• measuring weather elements						
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	<b>CONTACT HOURS:</b> 2 HOURS/WEEK					
<b>GOAL:</b> 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)	YEAR: ONE (1), SEMESTER: TWO (2) PRE- PRACTICAL: 2 HOURS/WEEK							
	<b>REQUISITE:</b>							
	none							

## **GENERAL OBJECTIVES**

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

- 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 acidbase titrations.

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY									
COURS	E: Analytical Laboratory Skills I	С	Course Code: ESM121	Credit Unit: 2.0		Contact Hours: 0-0-2			
GOAL:	<b>GOAL:</b> This course is designed to give students the basic laboratory techniques that will enable the learner to become competent in: laboratory safety,								
identifyi	ng equipment, reading instruments	s and measuring devices.							
Course S	Course Specification: THEORETICAL CONTENT PRACTICAL CONTENT								
Genera	l Objective 1.0: Demonstrate saf	e laboratory practices, be a	able to dispose of lab chem	nicals in a safe manne	er, and maintain a	clean laboratory area			
Week	Specific Learning Outcome	<b>Teachers' Activities</b>	Learning Resources	Specific Learning	Teachers'	Evaluation			
				Outcome	Activities				
1-2			Lab coat, safety eye	1.1 Apply	Guide	List the various			
			goggle, weighing	laboratory safety	students to	laboratory safety rules			
			balance, recommended	rules and	perform 1.1-	and procedures			
			nationality and report	procedures.	1./	State how to dispage			
			notebooks.	1.2 Locate		state now to dispose			
				safety equipment		manner			
				available ill allu		manner			
				laboratory					
				13 Review					
				WHMS					
				requirements for					
				labeling chemicals					
				in thelaboratory.					
				1.4 Dispose of					
				chemicalwastes in					
				a safe and					
				responsible					
				manner.					
				1.5 illustrate					
				the required					
				emergency					

				response procedures to follow. 1.6 Illustrate the safety Obligation Form to indicate the learner'sagreement to follow 1.7 Apply the safety rulesand chemical waste disposal practices		
				Fnvironmental		
				Technology		
				program.		
General	Objective 2.0 Identify laboratory	equipment and follow Che	emical Stores procedures.			
4-5			Lab coat, safety eyegoggle, Weighing balance, recommendedlab manuals and report notebooks.	<ul> <li>2.1 Review storeroom and equipment checkout procedures.</li> <li>2.2 Obtain tool checks.</li> <li>2.3 Take Inventory of assigned locker and drawer.</li> <li>2.4 Identify</li> </ul>	Guide students to perform 2.1- 2.4	State various equipment check out procedures

Conoral	<b>Objective 3.0:</b> Weigh objects and	samples on electronic bal	30005	pieces ofcommon laboratory equipment.		
6-7		•	Lab coat, Safety eye goggle, weighing balance, lab manuals andreport notebooks	<ul> <li>3.1 Calibrate two different types of electronic analytical balances.</li> <li>3.2 Compare the ease and accuracy of weighing on analytical and top loading balances.</li> <li>3.3 Compare the weight of the same object measured on two different analytical balances.</li> <li>3.4 Weigh out a sample on an</li> </ul>	Guide students to perform 3.1- 3.8	State the waysto calibrate electronic analytical balances State when it is appropriate to use a top loading or analytical balance to weigh objects or samples

analytical
balance using
two different
techniques:
"weigh a
sample by
tarring the
container" and
"weigh asample
in a weigh boat
and
quantitatively
transfer to a
container"
3 5 Demonstrat
a weight loss
e weight loss,
to trace
to trace
amounts of
moisture on
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

	different
	aonditions
	conditions.
	3.7 Identify
	when it is
	appropriate to
	use a "top
	loading" or
	"analytical"
	balance to
	weigh objects
	orsamples.
	3.8 Select the
	correct type of
	electronic
	balance to use
	for a weighing
	procedure and
	calculate the
	accentablerange
	of mass values
	for an
	individual
	sample weighed
	On an
	Electronic
	balance.
General Objective 4.0: Operate conductivity meter and carry out co	onductivity related calculations.

		•	Lab coat weighing	4.1 Calibrate a	Guide	State how to measure
		-	balance Samples to	conductivity	students to	electrical conductivity of
8-10			beweighed	meter	perform 4 1-	electrical conductivity of
			Lab notebook etc	4.2 Measure	1 A	some solutions
			Lab notcook,ctc.	4.2 Weasure	4.4	
				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		
				accuracyand		
				precision of the		
				Analyses		
General	Objective 5.0 Determine the pH	of solutions using both a pH	meter and pH paper, and	d perform an acid-ba	se titration using a	pH meter.
			EquipmentLab	5.1 Estimate	Guide	State how to titrate a
11			coat. PH meter	the pH of a	students to	solution that contains an
11			PH naper	solution	perform 5.1-	unknown amount of
			Practical note etc	using $P^{H}$	■ 55	Hydrochloricacid to
				paper.	5.5	determine its
				II		concentrationusing a pU
				5.2 Measure		concentrationusing a pri
				the P <sup>H</sup> of		electione andpri meter

		different	
		solutions at	
		different	
		temperatures	
		andobserve	
		the effect of	
		temperature	
		on the	
		P <sup>H</sup> value	
		i varue.	
		5 3 Derform	
		3.5 Terrorini	
		a 2-point	
		to collibrate o	
		io calibrate a	
		prime 2	
		using Z	
		buffer	
		solutions,	
		each with a	
		different pH	
		value.	
		5.4 Titrate a	
		solution that	
		contains an	
		unknown	
		amount of	
		hydrochloric	
		acidto	
		determine its	
		concentration	
		using a and pH	

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.

General Objective 6.0: Car	rry out care and maintenance of	laboratory glassware, transfer liq	uids using volumetric	pipets and amicro	-pipet, and perform acid-
base titrations					
12-13	•	EquipmentLab coat, Coverall, Practical noteetc.	6.1 Interpret the meaning of markings found on examples of common laboratory volumetric glassware.	Guide students to perform 6.1- 6.6	State how to examine laboratory glassware State how to prepare a burette and perform acid-base titrations
			6.2 Examine laboratory glassware for cleanliness and select the correct method to remove the contaminatio n present.		
			6.3 Inspect volumetric glassware for cleanliness using the water bead test.		
			6.4Transfer an accurate volume of		

		liquid using	
		inquite using	
		avolumetric	
		pipet.	
		P.P.C.	
		6.5Precisely	
		Transfer an	
		accurate	
		volume of	
		liquidusing a	
		micro-pipet.	
		6.6 Prepare a	
		burette and	
		perform acid-base	
		titrations.	
ASSESS	SMENT: The continuous assessment; tests, quizzes, field w	vorks etc. will be awarded 40% of the total score. The en	d of the Semester Examination will
make up <sup>4</sup>	for the remaining 60% of the total score.		
ASSES: make up	<b>SMENT:</b> The continuous assessment; tests, quizzes, field w for the remaining 60% of the total score.	Transfer an accurate volume of liquidusing a micro-pipet. 6.6 Prepare a burette and perform acid-base titrations.	d of the Semester Examination w

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
COURSE: Environmental Chemistry I	CODE: ESM122	Credit Unit: 3.0	<b>CONTACT HOURS:</b> 3 HOURS/WEEK				
<b>GOAL:</b> This course is designed to provide students with knowledge and skills of the application of stoichiometry, thermodynamics, and kinetics							
energy use	ground level chemistr	y, greennouse gases, grobar	warming, and carbondroxide emissions and				
YEAR: ONE (1), SEMESTER: ONE (2)       PRE-       PRACTICAL: 2HOURS/WEEK							
	<b>REQUISITE:</b>						
	none						
GENERAL OBJECTIVES							
On completion of this course, the Student should b	be able to:						
1.0 Know the effect of pH on natural wa	aters.						
2.0 Understand the thermodynamic and Antarctic stratosphericozone	kinetic factors that affe	ect the steady state concentra	ations of Tropical and				
3.0 Understand the Stoichiometry, There	nodynamics and kinet	ics to describe ground level a	air chemistry				
4.0 Know the Stoichiometry, thermodyn	amics and kinetics to a	lescribe the greenhouse effe	ct 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							
COURS	E: Environmental Chemistry I	0	Course Code: 112	Credit Unit: 3.0		<b>Contact Hours:</b> 3	
GOAL: and chem	<b>GOAL:</b> 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 S	Specification:	THE	ORETICAL CONTENT	PRACTICAL CO	NTENT		
General	Objective 1.0: Know the effect of	of pH on natural waters	1	1	I		
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation	
1-2	<ul> <li>1.1 List the main sources and uses of fresh water,</li> <li>1.2 Explain the different locations of groundwater.</li> <li>1.3 Calculate the voltage of a redox reaction from tables of half reactions, and do stoichiometry calculations with these reactions.</li> <li>1.4 Describe various factors that affect the oxidizing environmental natural water.</li> <li>1.5 Define BOD (Biochemical Oxygen Demand) and COD (Chemical Oxygen Demand) and COD (Chemical Oxygen Demand).</li> <li>1.6 calculate the reactions, of C S, N and various metals of environmental</li> </ul>	Explain the sources and uses of fresh water andlocations of groundwater. Illustrate the redox reactions with calculationand 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 ofnatural 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 andground water etc	Explain how does pH affect reduction in potential Define thefollowing BOD & COD List the factors affecting oxidizingnatural water	

	<ul> <li>importance at low high values of P<sup>H</sup> and P<sup>E</sup>.</li> <li>1.7 Explain equilibrium calculations involving Ksp and Ka.</li> <li>1.8 Explain distribution diagrams to describe the</li> </ul>					
	speciation of a carbonate					
	system.					
	1.9 Calculate the pH of waters dominated by					
	dissolved CO <sub>2</sub> , and/or					
	dissolved CaCo <sub>3</sub> , and					
	predict the effect of					
	various dissolved metals					
	on $P^n$ .					
	1.10 Calculate the solubility					
	of various satisfin the					
	and hardness					
	index of natural water					
Como		 	f	1	n a cf Transie al and	1
Genera	I Objective 2.0: Understand the th	nermodynamic and kinetic	factors that affect the stea	dy state concentratio	ns of Tropical and	
Antarcuc	stratospheric ozone.				-	
4-5	2.1 Characterize the four	Characterize thefour	Magic board, lecture	• -	-	Briefly explain the
	different regions of the	different regions of	notes andrecommended			two elementarysteps
	atmosphere.	the atmosphere.	textbooks, Journals.			in the production of
		Describe the metroes of				stratospheric ozone
	2.2 Describe the nature of	Describe the nature of				I laine the events of
	interconvert between	interconvert between				Using the graphs of
	appropriations write wood in	appontrations units				concentration vs
	etmographeria chemistry	used in atmospheric				autude, give the
	aunospheric chemistry.	useu in aunospheric				evidence to prove

	chemistry.		ozonehole
2.3 State the energy ranges			
in J and $\mu$ for the three	State the energy		State non catalytic
regions of the Ultra Violet	ranges in Jand µ for		mechanism of ozone
spectrum.	the three regions of		destruction in
	the Ultra Violet		stratosphere
2.4 Describe some biological	spectrum.		
consequences of radiation			State the factors that
from these three regions.	Explain biological		affects the rate of
	consequences of		destruction of ozone
2.5 Describe how the	radiation Explain		
photochemistry of oxygen	how the		State various
changes the spectrum of	photochemistry of		important catalyst in a
sunlight above the	oxygen changes the		reaction
troposphere	spectrum of		
	sunlight above the		State condition that
2.6 Write the two elementary	troposphere Describe		result inPSC and in
steps in the production of	the two factors that		type II crystals during
stratospheric ozone	affect the production		the polar right.
2.7 Describe the two factors	ofozone.		
that affect the production of			Mention role of the
ozone.	Explain first		technician to solve
	kinetically why the		strategic problem of
2.8 Explain first kinetically	ozone layer exists at		reducing ozone
why the ozone layer exists at	an altitude of 15-35		destruction.
an altitude of 15-35 km.	km.		
2.0 Exploin			
2.9 Explain thermodynamically why	Explain the non-		
there's a temperature	catalytic mechanism		
inversion above the	of ozone destructionin		
troposphere	the		
uopospilere	stratosphere and		

	provide kinetic		
2.10 State the non-catalytic	and		
mechanism of ozone	thermodynamic		
destruction in the	reasons.		
stratosphere and provide			
kinetic and thermodynamic	Using the graphsof		
reasons why this is not a	ozone concentration		
threat to the Concentration	vs. altitude to describe		
of ozone.	what is meant by the		
	termozone hole and		
2.11 Use the graphs of ozone	given evidence to		
concentration vs. altitude to	prove its existence.		
describe what is meant by the			
term ozone hole and given	Explain mechanism I		
evidence to prove its	for the catalytic		
existence.	destruction of ozone		
	give thermodynamic		
2.12 Explain mechanism I	reasons why this is not		
for the catalytic destruction	an important		
of ozone give	mechanism at low		
thermodynamic reasons why	stratospheric altitudes.		
this is not an important			
mechanism at low	List the factors that		
stratospheric altitudes.	affect the rateof		
List the factors that affect	destruction of ozone.		
the rate of destruction of			
ozone.	Explain mechanism II		
	forthe catalytic		
2.14 Exemplify mechanism	destruction of ozone		
If for the catalytic	and the important of		
destruction of ozone.	catalysis.		
2.15 List some important			

catalysis.	Explain the kinetic		
	factors that affect the		
2.16 List the kinetic factors	rateof destruction of		
that affect the rate of	ozone and describe		
destruction of ozone and	the factor that effects		
describe the factor that	the steady state		
effects the steady state	concentration of		
concentration of ozone.	ozone.		
	Explain how atomic		
2.17 Give reasons why	chlorine is produced		
atomic chlorine is produced	"naturally" from Sea		
"naturally" from	salt, and givesome		
Sea salt, and give some	anthropogenic sources		
anthropogenic sources of	of chlorine.		
chlorine.			
	effective than		
2.18 List the two inactive or	Chlorine at		
"reservoir" forms of Cl.	destroying ozone		
2.19 State the reactions that	Explain 2.18 to		
show how they form from Cl	• 2.25		
and can react to release Cl <sup>-</sup>			
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			
2.21 Describe the conditions			
that result in PSC. And Typell			
crystals during the polar right.			

	<ul> <li>2.22Explain how inactive chlorine in the lower stratosphere is converted toactive chlorine through the polar night and Antarctic spring.</li> <li>2.23Explain in general terms how the concentrationof ozone returns to "normal"after the Antarctic spring.</li> </ul>					
	<ul> <li>2.24 List examples of ozone destruction that are not yet understood.</li> <li>2.25 Describe the role of the technician either in further study of the problems, or in current strategies for reducing ozone destruction</li> </ul>					
General	<b>Objective 3.0:</b> Understand the St	oichiometry, Thermodynai	nics and kinetics to descri	be ground level air c	hemistry	
6-7	<ul> <li>3.1 Describe the role of oxidation in the cleansing ofair.</li> <li>3.2 List the primary and secondary pollutants of photochemical smog</li> <li>3.3 Describe the production andabatement of the primary and secondary pollutants</li> </ul>	Explain the role of oxidation in air clearing and describe primary and secondary pollutants. Describe the features of acidrain and particulates and their	Magic board, lecture notes and recommended textbooks, Journal	Carry out REDOX titration	Guide student to carry out REDOX titration	What does oxidation mean in terms of air pollution Differentiatee between greenhouseeffect and global warming

	smog.					
		Explain health				
		effects of				
		photochemical				
		smog and				
		particulates on				
		Man				
		Wall				
General	<b>Objective 4.0:</b> Know the Stoichi	ometry, thermodynamics an	d kinetics to describe the	greenhouse effect an	nd global warming	
	4.1 Describe black	Explain the	Magic board,	•	•	What is black body
8 10	bodyradiation.	following: black	lecture notes and			radiation
0-10	4.2 Describe the earth's	body radiation,	recommended			What
	energybalance in terms of	the earth's energy	textbooks.			causes
	sources and sinks by	balance in terms of				black bodyradiation
	comparing how to emission	sources and sinks,				
	spectra of the sun and the	emission spectra of the				
	earth are absorbed, reflected,	sun and the earth are				
	or emitted by the earth's	absorbed, reflected, or				
	surface and itsatmosphere.	emitted by the earth's				
	1	surface and its				
	4.3 Describe the greenhouse	atmosphere				
	effect and the enhanced	aumosphere.				
	greenhouse effect in terms of	Explain theoreenhouse				
	energy transfer from the sun's	affectand the enhanced				
	input to the earth's output	graphouse offectin terms				
	thermal seattering and	of an anony transfor from the				
	subsequent heating	of energy transfer from the				
	subsequent heating.	sun s input to theearth s				
	4.4 Describe sources and	output, thermal scattering,				
	sinksof atmospheric CO <sub>2(g)</sub>	and subsequentneating.				
	andH2 <sub>o(g)</sub> .					
	4 5Describe sources and					
	sinksof atmospheric gases					

	contributing to the enhanced greenhouse effect.					
	4.6 Compare the importance of atmospheric molecules that contribute to the green house and enhanced greenhouse effects.					
	4.7Describe sources and sinksof atmospheric aerosols.					
General	<b>Objective 5.0:</b> Know the Stoichic	ometry, thermodynamics and	d kinetics to describe car	bon dioxide emissior	and energy use.	
	<ul> <li>5.1 List potential consequences of global warming.</li> <li>5.2 Quantify (using the value ofQ) global energy use for developed and developing countries</li> <li>5.3 Compare proven and estimated energy reserves fromdifferent sources (including methyl hydrates), and relate thisinformation to estimates of global releases of carbon dioxide</li> <li>5.4 Mention variety of</li> </ul>	Explain consequences of global warming Quantify (using the value of Q) global energy usefor developed and developing countries 5.4 Mention variety of schemesfor reducing the amount of carbon dioxide emitted. Explain advantages and disadvantage of each scheme	Magic board, lecture notes and Recommended textbooks.			Mentionthe advantages and disadvantages of schemes for reducing the amountof carbon dioxide omitted
	schemesfor reducing the amount of carbon dioxide					

emitted. 5 Explain advantages and disadvantage of each scheme.			
5.5 Compare the various formsof solar energy currently contributing to the energy gridgiving advantages and disadvantage of each type.			
<ul><li>5.6 Describe the production andproperties of the mixture called gasoline.</li><li>5.7 Explain why the different components are added to gasoline.</li></ul>			
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.			
5.9 Explain the advantage and disadvantages of hydrogen as afuel.			

	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	make up for the remaining 60% of the total score.						

# PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY

COURSE: Occupational Safety	<b>CODE:</b> ESM 123	Credit Unit: 3.0	<b>CONTACT HOURS:</b> 3 HOURS/WEEK					
GOAL: This course is designed to expose students to occupational safety hazards, safety problems and safe practices which would beencountered								
in the various industries during day-to-day fieldwork.								
YEAR: ONE (1), SEMESTER: ONE (1)	PRE-	PRACTICAL: 1 HOUR	WEEK					
	<b>REQUISITE:</b>							
	none							

#### **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

PROG	PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
Course	: Occupational Safety		Course Code: 123	Credit Unit:	<b>3</b> .0	<b>Contact Hours: 3</b>	}	
GOAL	: This course is designed to	expose students to occu	pational safety hazards, sa	afety problems	and safe pr	actices which would	l beencountered in the	
various	various industries during day-to-day fieldwork.							
Course Specification: Theo			eoretical Content	Practical Co	ontent:			
GENE	RAL OBJECTIVE 1.0: Knov	w the legislation concer	ned with Occupational He	alth and safety				
Course	Specification:	THE	DRETICAL CONTENT	PRACTICA	PRACTICAL CONTENT			
Week	Specific Learning	<b>Teachers' Activities</b>	Learning Resources	Specific	Learning	Teachers'	Evaluation	
	Outcome			Outcome		Activities		
1-2	1.1 Describe the	Give the history and	Audio visual, multi-	<b>-</b>		• -	List the	
	Nigeria	list out the Nigeria	media, magnetic				components of	
	Occupational	ofOccupational	board,etc				Occupational	
	Health andSafety	Health and Safety					safety:	
	Act.	Act.						
	1.2 Explain the history							
	of Occupational	Explain the						
	health and safety.	components of						
	1.3 Describe the	Occupational						
	componentsof	safety:						
	Occupational	<ul> <li>Occupational</li> </ul>						
	safety:	health medicine						
	• Occupational health	<ul> <li>Industrialhygiene</li> </ul>						
	medicine	• Industrial welfare						
	• Industrial hygiene	service						
	• Industrial welfare	<ul> <li>Ergonomics</li> </ul>						
	service	<ul> <li>Physiologic</li> </ul>						
	• Ergonomics	activities						

• Physiologic activ	vities • Psychologic				
Psychologic acti	vities activities				
• And other	• And others				
	Explain the Nigeria				
1 4 Exploin the	Pagulations related to				
1.4 Explain the	health and safety				
Nigeria	ileanin and safety,				
Regulations	workers and employers				
related toheal	in relation to health				
and safety.	and safety.				
1.5 List some of t	the				
responsibilities of	f				
workers and					
employers in rela	tion				
tohealth and safet	ty.				
1.6 Describe the					
conditionsthat mu	ıst				
exist before a wo	rker				
can refuse work.					
<b>GENERAL OBJECTIVE</b>	2.0: Know the general procedures	involved in the isolation	n of plant equipment		
3-4 2.1 Explain the	Explain items. 2.1	Magnetic board,	carry out practical on	Guide student to	List safety
proper procedure	s • -2.2	multi-media	proper procedures for	carry out practical	precautionswhich
for the isolation			the isolation of plant	on proper	are related to
of equipment.			equipment	procedures for the	equipment
2.2 List safety pro	ecautions			isolation of plant	isolation.
which are related	to			equipment	
equipment isolati	on.				
<b>GENERAL OBJECTIVE</b>	3.0: Understand how to control Ha	zard at a work site		•	

5-6	3.1 Explain how to	Engage students in a	Magnetic board,	properly use PPE	Guide student on	
	Identify some of the	discussion to list out	markers,		how to properly	
	common physical	physical hazards	etc.		use PPE	Describe some
	hazards associated	associated with the				of the key
	with the work site,	work site, and				components of
	and describe	describemethods of				safety
	methods of	controllingthem.				management
	controlling them.	Explain				andhazard
	3.2 Define engineering	engineering				control.
	controls.	controls and the				
		key components of				
	3.3. Describe some of	safetymanagement				
	the keycomponents of	and hazard control.				
	safety management and					
	hazard control.	Explain major				
		principles of				
	3.4 Describe major	controlling				
	principlesof controlling	occupational				
	occupational	environment such				
	environment such as:	as:				List the
	Mechanical	Mechanical				components of
	control e.g.	control				controlling
	shielding,	e.g. shielding,				occupational
	ventilations,	ventilations,				environment
	noise,lighting,	noise, lighting,				
	etc.	etc.				
	Administrative	Administrati				
	control, e.g.	ve control,				
	works practices,	e.g. works				
	etc.	practices, etc.				
	Personal	• Personal				
	Protective	Protective				
	Equipment (PPE) • Engineering Control (e.g.	Equipment (PPE) • Engineering Control (e.g. Engine Design)				
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	Engine Design)					
	• Ergonomic					
	3.5 Describe the					
	importance of					
	standards, codes and					
	laws.					
	3.6 Explain the role of					
	personal protective					
	equipmentin hazard					
	control					
GENER	RAL OBJECTIVE 4.0: Unde	rstand the general proced	lures involved in the isola	ation of mechanical and el	ectrical equipment	
7-9	4.1 Explain the	Explain the	magnetic board,	Properly use	Guide student on	List safety
	proper procedures for	Mechanical and	markers,	mechanical and	how to properly	precautions
	the Mechanical and	Electrical	etc	electrical equipment	isolate mechanical	which are
	Electricalisolation of	isolation of	,		and electrical	relatedto
	equipment.	equipment and	ladder, scaffold,etc		equipment	equipment
	4.2 List safety	are related to				Describe rigging
	precautions that are	equipment				methodsand safety
	related to equipment	isolations				concerns
	isolations.	• Explain the safe				
	4.3 Describe the safe	use of ladders and				
	use ofladders and	scaffolding, also				
	scaffolding.	describe the				
		regulations				
	4.4 Explain					

	regulationsrelated to ladders and scaffolding. 4.5 Describe rigging methods and safety	related to ladders and scaffolding.				
	concerns.					
GENEF	RAL OBJECTIVE 5.0: Und	lerstand the equipment a	vailable for fall protectio	n	1	
10-11	<ul> <li>5.1 Describe the current legislation pertaining to fall protection.</li> <li>5.2 Describe the various fallprotection systems.</li> <li>5.3 Describe the selection care and use of</li> </ul>	Explain the current legislation pertaining to fall protection systems and the selection, care and useof fall protection. Explain activities in Nos. 5.5 – 5.7	Audio visual aids, magnetic board Audio visual aids, magnetic board	carry out practical on the use of hearing protection devices	Guide student to carry out practical on the use of hearing protection devices	Describe the various fall protection systems Describe how a hearing protection deviceis used
	fall protection Equipment;					
	5.4 Define the terms related					
	to fall protection. 5.5 Explain the current Occupational health and safety act and regulations pertaining to worker hearing protection and conservation					

	5.6 Describe methods					
	for establishing hearing					
	protection and					
	conservationprograms.					
	5.7 Fynlain why					
	hearing conservation					
	failures occur					
	Tunures occur.					
	5.8 Explain hearing					
	protection devices,					
	selectionand ease of					
	use.					
	5.9 Explain the "real-					
	word"use of hearing					
	protection devices.					
	5.10 Explain hearing					
	protection program					
	elements, Optimization,					
	enhancement, and audits.					
GENE	RAL OBJECTIVE 6.0: Unde	erstand static electricity	produced by the moveme	nt of materials/equipment	and the procedures ne	eded to enter into,
or worl	k safely in, confined spaces	<b>D</b> 1 1 1		<b>1 1</b> . • •.	D	D 11 1
12-14	6.1 Describe how	Explain how	Magnetic board,	produce electricity	Demonstrate to	Describe how
	static	static electricity is	markers,	using static materials	student how to	static electricity
	electricity is	produced, the			produce electricity	can be controlled
	produced.	nazards of static			using static	whenflammable
		electricity and			materials	liquids are
	0.2 List the nazards of	now static				transported.
	staticelectricity.	electricity can be				

6.3 Describe how	controlled when		
static electricity	flammable liquids		
can be controlled	aretransported.		
when flammable			
liquids are	Explain a		
transported.	confined space		
	and what		
6.4 Describe how to	constitutes a		
reduceproblems	confinedspace		
with static	entry.		
electricity when			
solids are moved	• List out the		
through piping	hazards ofbeing		
and ducting	in a confined		
	space and		
6.5 Define a confined	procedures to be		
space.	used when		
(CDofine what	performing		
6.6 Define what	confined space		
constitutes a	entry.		
confined space			
entry			
6. / Describe the			
hazards ofbeing			
in a confined			
space.			
6 9 Describe procedures			
o.o Describe procedures			
lO			

	6.9 be used when performingconfined space entry					
General	<b>Objective 7.0:</b> Know the sign	nificance of the Workpla	ace Hazardous Materials	Information System (WH	MIS) and itsapplicatio	n.
	7.1 Describe the elementsand responsibilities of the	Explain the elements and responsibilities of	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
	Workplace Hazardous Materials System.	the Workplace Hazardous				completed
	7.2 Describe the six (6) classes of controlled productsunder WHMIS.	Materials System. Explain the six				
	7.3 Use proper labels for controlled products.	controlled products under WHMIS.				
	7.4 Describe Material SafetyData Sheets.					
	7.5 Describe training requirements under WHMIS					
General	Objective 8.0: Understand the	e nature of radioactive i	materials and the impact of	of ionising radiation on hu	man health and theen	vironment
	8.1 State sources of naturalsuch 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 dispose Radio Active Material	Guide student to carry out practical on how dispose Radio Active Material	List the common sources of radiation

8.2 Describe the basic elements of radioactive decay	materialsused by industry on the environment caused by their uncontrolled		
8.3 Describe the hazards and possible impact on	release.		
the environment caused by uncontrolled release of radioactive materials used byindustry.	Explain the methods used to contain and safety handle ionizing		
8.4 Describe the	radiation.		
methodsused to	Describe the		
contain and safety	correct procedure		
radiation.	to dispose of a device containing radioactive		
8.5 Describe the correct			
procedure to dispose of a			
device containing			
radioactivematerial.			
8.6 Describe the			
major nuclear			
radiation particlesand			
the SI units used to			
8.7 measure their			
presence in the			
environment.			

9.1 Describe the personal protective equipment at allable for headbody protection.Explain various forms of PPE with examples.magnetic board, etc handbody headbody protection.Explain how PPE equipment of head body protection9.2. Describe safety featuresrequired in safety belts, body hamesses and lanyards.9.2. Describe safety featuresrequired in safety belts, body hamesses and lanyards.Explain items magnetic board, etcImage: Image: Imag	General	Objective 9.0: Know the use,	, selection and care of p	ersonal protective equipm	nent		
personal protective equipment available for headbody protection.forms of PPE with examples.equipment for head body with examples.equipment for head body protection9.2. Describe safety featuresrequired in safety belts, body harnesses and lanyards.===		9.1 Describe the	Explain various	magnetic board,etc			Explaine how PPE
equipment available for headbody protection.       with examples.       with examples.       body protection         9.2. Describe safety featuresrequired in safety belts, body harnesses and lanyards.       selective       body       body         General Objective 10.0: Understand the essential role of respiration protection in the workplace.       carry out CPR using marker, PPE       Demonstrate to student how to carry out CPR using mannequin       Describe how respiratory equipment can be properly used         10.2 Describe the respiratoryhealth risks associated with exposure in the workplace.       carry out CPR using mannequin       Describe how respiratory Equipment) etc         10.3 Describe the benefits of respiratory equipment       lo.1 - 10.6       lo.1 - 10.6       lo.1 - 10.6         10.4 List the various pieces of respiratory equipment       lo.1 - 10.6       lo.1 - 10.6       lo.1 - 10.6         10.4 List the various pieces of respiratory equipment       lo.1 - 10.6       lo.1 - 10.6       lo.1 - 10.6         10.4 List the various pieces of respiratory equipment       lo.1 - 10.6       lo.1 - 10.6       lo.1 - 10.6		personal protective	formsof PPE				equipmentfor head
headbody protection.       9.2. Describe safety featuresrequired in safety belts, body harnesses and lanyards.       Image: Constraint of the sesential role of respiration protection in the workplace.       Image: Constraint of the sesential role of respiration protection in the workplace.       Image: Constraint of the sesential role of respiration protection in the workplace.       Image: Constraint of the sesential role of respiration protection in the workplace.       Image: Constraint of the sesential role of respiration protection in the workplace.       Image: Constraint of the sesential role of respiration protection in the workplace.       Image: Constraint of the sesential role of respiratory protective programs.       Image: Constraint of the sesential role of respiratory equipment) etc       Image: Constraint of the sesential role of respiratory equipment) etc       Image: Constraint of the sesential role of respiratory equipment available.       Image: Constraint of the sesential role of respiratory equipment available.       Image: Constraint of the sesential role of respiratory equipment available.       Image: Constraint of the sesential role of respiratory equipment available.       Image: Constraint of the sesential role of respiratory equipment available.       Image: Constraint of the sesential role of respiratory equipment available.       Image: Constraint of the sesential role of respiratory equipment available.       Image: Constraint of the sesential role of respiratory equipment available.       Image: Constraint of the sesential role of respiratory equipment available.       Image: Constraint of the sesential role of respiratory equipment available.       Image: Constraint of the sesential role of respiratory equipment available.       Image: Constraint of the		equipment available for	with examples.				body protection
9.2. Describe safety featuresrequired in safety belts, body harnesses and lanyards.     Image: Constraint of the sesential role of respiration protection in the workplace.       General Objective 10.0: Understand the essential role of respiration protection in the workplace.     Carry out CPR using marker, PPE (Respiratory protective programs.     Demonstrate to student how to carry out CPR using mannequin     Demonstrate to student how to carry out CPR using mannequin       10.2 Describe the respiratoryhealth risks associated with exposure in the workplace.     10.3 Describe the benefits of respiratory equipment     Image: Constrate to student how to carry out CPR using mannequin     Describe how respiratory equipment can be properly used       10.4 List the various pieces of respiratory equipment     Image: Constrate to student how and the second second the various pieces of respiratory equipment     Image: Constrate to student how to carry out CPR using mannequin     Image: Constrate to student how to carry out CPR using mannequin     Image: Constrate to student how to carry out CPR using mannequin		headbody protection.					
9.2. Describe safety featuresrequired in safety belts, body harnesses and lanyards.       Image: Constraint of the sesential role of respiration protection in the workplace.         General Objective 10.0: Understand the essential role of respiration protection in the workplace.       Image: Constraint of the sesential role of respiration protection in the workplace.         10.1 Explain the purpose andgoals of respiratory protective programs.       Explain items 10.1 -10.6       magnetic board, marker, PPE (Respiratory Equipment) etc       Demonstrate to student how to carry out CPR using mannequin       Describe how respiratory equipment can be properly used         10.2 Describe the respiratoryhealth risks associated with exposure in the workplace.       Image: Constraint of the sesential role of respiratory equipment       Image: Constraint of the sesential role of respiratory equipment       Image: Constraint of the sesential role of respiratory equipment         10.4 List the various pieces of respiratory equipment       Image: Constraint of the sesential role of respiratory equipment       Image: Constraint of the sesential role of respiratory equipment       Image: Constraint of the role of the sesential role of respiratory equipment       Image: Constraint of the role of the of the rol							
readination       readin       readin       readination		9.2. Describe safety					
Safety berls, body harnesses and lanyards.       Explain items       magnetic board, marker, PPE       Carry out CPR using mannequin       Demonstrate to student how to carry out CPR using mannequin       Describe how respiratory equipment can be properly used         10.1 Explain the purpose andgoals of respiratory protective programs.       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         10.2 Describe the respiratoryhealth risks associated with exposure in the workplace.       Imagnetic board, marker, PPE (Respiratory Equipment) etc       Imagnetic board, marker, PPE (Respiratory Equipment) etc       Demonstrate to student how to carry out CPR using mannequin       Describe how respiratory equipment         10.3 Describe the benefits of respiratory equipment       Imagnetic board, in the various pieces of respiratory equipment available,       Imagnetic board, marker, PPE       Imagnetic board, marker, PPE		safaty balta body					
Intrinsices and intrinsices         General Objective 10.0: Understand the essential role of respiration protection in the workplace.         10.1 Explain the purpose and goals of respiratory protective       Explain items       magnetic board, marker, PPE       Carry out CPR using mannequin       Demonstrate to student how to carry out CPR using mannequin         10.2 Describe the respiratoryhealth risks associated with exposure in the workplace.       0.2 Describe the benefits of respiratory equipment       Image: Carry out CPR using mannequin       Demonstrate to student how to carry out CPR using mannequin         10.4 List the various pieces of respiratory equipment available.       10.4 List the various pieces of respiratory       Image: Carry out CPR using mannequin       Image: Carry out CPR using mannequin		harnesses and lanvards					
10.1 Explain the purpose andgoals of respiratory protective programs.       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         10.2 Describe the respiratoryhealth risks associated with exposure in the workplace.       .       (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         10.3 Describe the benefits ofrespiratory equipment       10.4 List the various pieces ofrespiratory equipment available.       Imagnetic board, marker, PPE (Respiratory Equipment) etc       Imagnetic board, marker, PRE (Respiratory Equipment) etc	General	<b>Objective 10 0:</b> Understand t	he essential role of resp	iration protection in the v	vorknlace		<u> </u>
10.1 Explain the purpose andgoals of respiratory protective programs.       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         10.2 Describe the respiratoryhealth risks associated with exposure in the workplace.       .       Image: Comparison of the properly used       Image: Comparison of the properly used       Image: Comparison of the properly used         10.3 Describe the benefits of respiratory equipment       Image: Comparison of the properly used         10.4 List the various pieces of respiratory equipment available.       Image: Comparison of the properly used       Image: Comparison of the properly used       Image: Comparison of the properly used	Utiltiai	Objective 10.0. Onderstand t	ne essential fole of fesp	nation protection in the v	vorkpidee.		
andgoals of respiratory protective programs.10.1 – 10.6marker, PPE (Respiratory Equipment) etcmannequinstudent how to carry out CPR using mannequinrespiratory equipment can be properly used10.2 Describe the respiratoryhealth risks associated with exposure in the workplace.10.3 Describe the benefits ofrespiratory equipment10.4 List the various pieces of respiratory equipment available.10.4 List the various piece		10.1 Explain the purpose	Explain items	magnetic board,	carry out CPR using	Demonstrate to	Describe how
protective programs.PPE (Respiratory Equipment) etccarry out CPR using mannequinequipment can be properly used10.2 Describe the respiratoryhealth risks associated with exposure in the workplace.10.3 Describe the benefits ofrespiratory equipment10.3 Describe the benefits ofrespiratory equipment10.4 List the various pieces ofrespiratory equipment available.10.4 List the va		andgoals of respiratory	10.1 –10.6	marker,	mannequin	student how to	respiratory
programs(Respiratory Equipment) etcusing mannequinproperly used10.2 Describe the respiratoryhealth risks associated with exposure in the workplace.Image: Constraint of the second		protective		PPE		carry out CPR	equipment can be
10.2 Describe the respiratoryhealth risks associated with exposure in the workplace.       Equipment) etc         10.3 Describe the benefits ofrespiratory equipment       Image: Comparison of the compariso		programs.		(Respiratory		using mannequin	properly used
10.2 Describe the         respiratoryhealth risks         associated with exposure         in the workplace.         10.3 Describe the         benefits ofrespiratory         equipment         10.4 List the various         pieces ofrespiratory         equipment available.				Equipment) etc			
respiratoryhealth 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.		10.2 Describe the					
associated with exposure in the workplace. 10.3 Describe the benefits of respiratory equipment 10.4 List the various pieces of respiratory equipment available.		respiratoryhealth risks					
in the workplace. 10.3 Describe the benefits of respiratory equipment 10.4 List the various pieces of respiratory equipment available.		associated with exposure					
10.3 Describe the benefits of respiratory equipment         10.4 List the various pieces of respiratory equipment available.		in the workplace.					
10.3 Describe the benefits of respiratory equipment 10.4 List the various pieces of respiratory equipment available.							
benefits of respiratory equipment 10.4 List the various pieces of respiratory equipment available.		10.3 Describe the					
10.4 List the various pieces of respiratory equipment available.		benefits of respiratory					
10.4 List the various pieces of respiratory equipment available.		equipment					
pieces of respiratory equipment available.		10.4 List the verieus					
equipment available.		10.4 List the various					
		aquipment available					
		equipinent available.					
10.5 Describe the		10.5 Describe the					
essentialmaintenance		essentialmaintenance					

	requirements					
	10.6 Describe the					
	proper useof					
	respiratory equipment.					
General	Objective 11.0: Know the p	urpose and benefits of ir	ncident reporting, investig	gation and analysis.	1	
	· · ·	1	1 0, 0		1	
	11.1 Describe incident,	Explain incident,	Marker,	-	-	Describe how
	nearmiss and accident.	nearmiss and	magnetic board,etc			incidence canbe
		accident,				investigated and
	11.2 Describe the	reporting and				reported
	reportingand	investigation				
	investigation	requirements of				
	requirements of the	the Occupational				
	Occupational Health	Healthand				
	and Safety Act.	Safety Act.				
		List the uses and				
	11.3 List the uses	limitations of an				
	and limitations of an	incident report and				
	incidentreport.	how incident				
		reportingis used to				
	11.4 Explain how	prevent recurrence				
	incident reporting is	of similar				
	used to prevent	incidents.				
	recurrence of similar					
	incidents.	Explain how				
		incident				
	11.5 Describe the	investigations are				
	content and	usedto determine				
	maintenance of records	the contributing				
	and documents	factors and causes				

	<ul> <li>11.6 Explain how incidentinvestigations are used to determine the contributing factors and causes of an incident.</li> <li>11.7 Describe a standard incident investigation form.</li> <li>11.8 Explain why a standard incident investigation form isan essential part of a safety investigation.</li> <li>11.9 Describe how incident analysis and hereard acentral offect</li> </ul>	of an incident. Describe a standard incident investigation form. Explain why a standard incident investigation form isan essential part of asafety			
	hazard control affect management of the				
Conoral	Workplace performance	e handle and transport	of dangerous goods in ac	cordance with the Transn	 Goods regulations
General	Objective 12.0. Know the us	e, nanoie, and transport			
	12.1 Describe process of handling and transporting dangerous goods in safety andlegality.	Explain safe procedures of handling dangerous goods.	Marker, magnetic board, etc	-	Describe how to handle and transport dangerous goods safely andlegally
	12.2 Describe the proper procedure to follow in case of an incident with				ygany

dangerous goods.					
12.3 State two sources					
they can use or contact					
for further					
assistance.					
<b>ASSESSMENT:</b> The continuous asse for the remaining 60% of the total score	ssment; tests and quizzer	s will be awarded 40% of	f the total score. The end of	of the Semester Exami	nation will make up

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

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

10.0Understand the various groundwater contaminants, their sources and transport processes.

PROGE	PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
<b>Course</b> :	Introduction to Hydrology	0	Course Code: ESM 124	Credit Unit: 3.0		<b>Contact Hours:</b> 3	
GOAL: rehabilit	<b>GOAL:</b> This course is designed to expose students to practical hydrology and groundwater development, including an overview of construction, maintenand rehabilitation and monitoring techniques for water investigation and supply, and investigations of contaminated sites						
Course	Specification:	THE	ORETICAL CONTENT	PRACTICAL CO	NTENT		
General	Objective 1.0: Understand hydro	ology					
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation	
1-2	1.1 Define hydrology	Explain the hydrologic cycle, the branches and	Multi-media Whiteboard, Internet	Demonstrate the roleof the	Guide students to:	Define hydrology	
	hydrologic cycle.	scope of hydrology and the field of applications of hydrology.	link Materials, etc.	hydrologist in integrated development	the roleof the hydrologist	List the field of application of hydrologic al knowledge	
	1.3 Explain the branches and scope of hydrology			Show concept of contaminants	in integrated development		
	1.4 Explain the field of applications of hydrology,the techniques of hydrology and the problems of appliedhydrology			hydrology	show concept of contaminants hydrology		

General	Objective 2.0: Understand the co	oncept of runoff					
4-5	2.1 Explain the meaning of	Explain the meaning	Multi-media	Show the	Guide students to	State the fac	ctors
	runoff and the componentsof	of surface runoff	Whiteboard, Internet	characteristics of	show the concept	affectingrunoff	
	runoff or stream flow		link Materials, etc.	estimating surface	of surface runoff,		
	2.2 Explain the components	State the factors		runoff and the	its components		
	of runoff and the methods of	affecting surface		factorsaffecting	and the factors		
	estimatingsurface runoff.	runoff		runoff.	affecting run off		
	2.3 State the factors				and the method		
	affecting runoff	Explain the concept			of surface runoff		
	2.4 Explain the types of	ofsurface water			of sufface Tuffor		
	runoff	estimation			estimation.		
General	<b>Objective 3.0:</b> Understand Precip	pitation and the mechanism	ns that drive it				
	3.1 Define precipitation	Describe the mode of	Multi-media	Draw the mode	Guide the	Define	
6-7	and state its different forms	Precipitation formation.	Whiteboard, Internet	of formation of	students to:	Precipitation	
0-7	3.2 Explain the mode of	Describe the methodand	link Materials, etc.	precipitation	draw the mode		
	formation of the different	instrument of measuring			of formation of	Describe themode of	F
	types of precipitation	precipitation		Use instruments	precipitation	presente themode of	- 0 <b>n</b>
	3.3 Explain the method and			to measure		precipitationiormatio	Л
	instruments used in measuring			different forms of	-use instruments		
	precipitation			bow they are	to measure		
	3.4 Explain the drivers of			now mey are	different forms		
	precipitation			useu.	of precipitation		
					and how they are		
Comment	Objections 4.0. Underster 1.1				used.	L	
General	<b>Objective 4.0:</b> Understand the u	nit of nydrograph					

8-10	<ul> <li>4.1 Explain the different components of hydrograph and its application</li> <li>4.2 Explain the systematic unit of hydrograph</li> <li>4.3 Explain how the streamflow components can be separated</li> </ul>	<ul> <li>Explain the different components of hydrograph and its application</li> <li>Explain the systematic unit of hydrograph and how the stream flow components can be separated</li> </ul>	Multi-media Whiteboard, Internet link Materials, etc.	Identify the components of hydrograph and its applications	Guide students to identify the components of hydrograph and itsapplications	Explain the meaning of hydrograph.
General	<b>Objective 5.0:</b> Understand the m	easurement of stream flow				
11	<ul> <li>5.1 List the different methods of measuring stream flow.</li> <li>5.2 Explain stage discharge rating curve and the procedures in establishing rating curves on logarithmic paper.</li> <li>5.3 Explain the relationship between slopestage discharges.</li> <li>5.4 Explain the relevance of keeping streamflowrecords (useful in evaluating total water supply, forecasting flooding events, designing hydraulics structures, computing sediments loadsof streams)</li> </ul>	Explain the different methods of measuring stream flow and stage discharge rating curve and the procedures in establishing rating curves on logarithmic paper. 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	Multi-media Whiteboard, Internet link Materials, Current meterFloat Velocity rod	Identify the methods of measuring streamflow Demonstrate the use of current meter, floatand velocity rod in measuring stream flow.	Guide students to demonstrate the use ofcurrent meter, float and velocity rod in measuring stream flow.	List the different types of gauges usedin recordingstream flow

	5.5 List the different typesof gauges used in recording stream flow	sediments loads of streams.				
General	Objective 6.0: Understand the va	arious drilling technologies c	ommonly used in the en	vironmental and wat	er well industries.	
12-13	6.1 Describe types of typical drilling methods used for water supply, rockcoring and environmental site assessments	• 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	r	1		
14	<ul> <li>7.1 Explain the meaningof flood</li> <li>7.2 List the different types of flood</li> <li>7.3 Explain the causes of flood</li> <li>7.4 Explain the approachesto floods and flood hazard management</li> <li>7.5 Explain soil conservation measures</li> <li>7.6 Explain flood control</li> <li>Approaches</li> </ul>	<ul> <li>Explain the meaning of flood</li> <li>Explain the socioeconomic impacts of flood as well as the methods offlood control</li> </ul>	Multi-media Whiteboard, Internet link Materials, etc.	Identify flood sites Show the possible impacts of flood Determine the methods of flood control	Guide students to: -identify flood sites -show the possible impacts of flood determine the methods of floodcontrol	Explain the socioeconomicimpacts of flood as well as the methodsof flood control
General	<b>Objective 8.0:</b> Know how to inte	erpret pumping test data and	the reasons for completing	ng pumping tests.		

General	<ul> <li>8.1 Explain the following terminology associated with pumping tests such as: cone of depression, recharge boundaries, no-flow boundaries and vertical leakage.</li> <li>8.2 Explain the analyses of pumping test data.</li> <li>1 Objective 9.0: Know how to complete the second second</li></ul>	Explain cone of depression, recharge boundaries, no-flow boundaries and vertical leakage. Explain the analyses of pumping test data.	Multi-media Whiteboard, Internet link Materials, etc. g and well completion lo	- - - -	-	Explain the terminology associated with pumping tests
	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.	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 • water supply wells.	Multi-media Whiteboard, Internet link Materials, etc.	• -	• -	List types of information that is required on a borehole log and well completion
General	<b>Objective 10.0:</b> Understand the	various groundwater contam	inants, their sources and	transport processes		I
	<ul> <li>10.1 Explain the different types of common groundwater Contaminants and their sources.</li> <li>10.2 Describe Common groundwater contaminants such as:( light non-aqueous phase liquids (LNAPLs),</li> </ul>	Explain groundwater Contaminants and their sources such as: light non-aqueous phase liquids (LNAPLs), dense non-aqueous phase liquids phase (DNAPLs),	Multi-media Whiteboard, Internet link Materials, etc.	• -	■ _	Explain the different types of common groundwater Contaminantsand their sources.

dense non- aqueous phase	hydrocarbons,		
liquids phase (DNAPLs),	petroleum		
hydrocarbons, petroleum	hydrocarbons,		
hydrocarbons, chlorinated	chlorinated solvents,		
solvents,	nitrates, metals, salt,		
nitrates, metals, salt, coaltar,	coal tar, creosote,		
creosote, herbicides,	herbicides, pesticides,		
pesticides, radionuclides,	radionuclides, volatiles		
volatiles and semi-	and semi-		
volatiles, coliform bacteria,	volatiles, coliform		
E.coli, Giardia and	bacteria, E.coli, Giardia		
Cryptosporidium.)	and Cryptosporidium.)		
10.3 Describe Common	Give examples of		
sources of groundwater	Common sources of		
Contamination such as:	groundwater		
(landfills, service stations,	contamination such as:		
bulk fuel facilities, septic	(landfills, service		
tanks, mine tailings, salt	stations, bulk fuel		
storage yards, wood	facilities, septic tanks,		
preserving facilities,	mine tailings, salt		
manufacturing	storage yards, wood		
facilities, high technology	preserving facilities,		
industry.)	manufacturing		
	facilities, high		
10.4 Explain the	technology industry.)		
fundamentals of			
contaminant transport and			
provide an overview on the			
processes involved, which			
include: advection,			
dispersion, diffusion and			

	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								
<b>COURSE:</b> Introduction to Geographic	CODE: ESM 125	Credit Unit: 3.0	<b>CONTACT HOURS:</b> 3 HOURS/WEEK					
Communication								
<b>GOAL:</b> This course is designed to expose the stu	dents to an introductio	n to GIS technology require	d in the environmental field					
YEAR: ONE (1), SEMESTER: TWO (2)	PRE-	<b>PRACTICAL:</b> 1 HOUR	/WEEK					
<b>REQUISITE:</b>								
	none							
GENERAL OBJECTIVES								
On completion of this course, the Student should be	e able to:							
1.0 Know how to determine angles between set of points.								
2.0 Understand the determination of Horizonta	l Distance and Vertica	l Difference between 2 point	ts					
3.0 Understand the determination of Coordinate	es of a point relative to	another point						
4.0 Understand the determination of topograph	ic survey using a total	station						
5.0 Understand how to collect Mapping data us	ing a handheld GPS R	eceiver.						
6.0 Understand how to deliver a class presentat	ion on a Specific GIS <sub>I</sub>	project that relates to Enviro	nmental Management Technology					
7.0 Know how to Input various datasets in a GI	S							
8.0 Know how to Manage GIS data								
9.0 Know how to Produce a GIS map using Ma	pping and Survey data							
10.0 Know how to Produce a cartographic correc	t map using mapping a	and survey data						
11.0 Know how to Produce a metadata file for th	e GIS Project							

12.0 Know how to Interpret GIS data.

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
COURS	E: Introduction to Geographic Co	ommunication (	CODE: ESM 125	Credit Unit: 3.0		<b>Contact Hours:</b> 3	
<b>GOAL:</b>	This course is designed to expo	se the students to an introd	uction to GIS technology re	quired in the enviror	mental field		
Course	Specification:	THE	CORETICAL CONTENT	PRACTICAL CO	NTENT		
General	Objective 1.0: Know how to dete	ermine angles between set of	of points				
Week	Specific Learning Outcome	<b>Teachers' Activities</b>	Learning Resources	Specific Learning	Teachers'	Evaluation	
				Outcome	Activities		
1-2	<ul> <li>1.1 Describe parts of a total station</li> <li>1.2 Describe how to set up and level a total station over a point</li> <li>1.3 Explain how to measure horizontal angles by repetition</li> <li>1.4 Describe how to record observations in standard field notes format</li> </ul>	Explain in details Parts of a total station Measure horizontal anglesusing total station.	Lab Coat,coveralls	Identify the parts of a total station Set up and level a total station over a point Measure horizontal anglesby repetition Record observations in standard field notesformat	Guide students to: -identify the partsof a total station -set up and level a total station over a point -measure horizontal anglesby repetition -record observations in standard field notes format	Describe parts of a total station	
General	<b>Objective 2.0:</b> Understand the de	etermination of Horizontal	Distance and Vertical Diffe	rence between 2poir	nts		

4-5	2.1 Explain EDM	• Explain items2.1-2.4	EDM	Use the total	Guide students	Explain EDM theory
	(electronic distance	1	Equipment Total Station	Station to	to:	
	measurement) theory			measure the	-use the total	
	2.2 Describe how to use			zenith angle	Station to	
	the total Station to			and the slope	measurethe	
	measure the zenith			distance	zenith angle	
	angle and the slope			between 2	and the slope	
	distance between 2			points	distance	
	points			1	between 2points	
	2.3 Describe how to			Record the	record the	
	record the			observations ina	observations	
	observations in a			standard field	in astandard	
	standard field notes			notes format	field notes	
	format				format	
	2.4 Describe how to			Calculate the	-calculate the	
	calculate the			horizontaldistance	horizontal	
	horizontal distance			and vertical	distanceand	
	and vertical			difference	vertical	
	difference				difference	
GENE	RAL OBJECTIVE: 3.0. Understa	and the determination of Co	pordinates of a point relative	e to another point	Γ	1
	3.1 Describe procedure used	Explain procedure	Theodolite Ranging Poles	Perform traverse	Guide students	Describe procedure used
6-7	to survey a closetraverse	used tosurvey a close		adjustment	to:	to survey a close
0 /	3.2 Calculate directions	traverse			-perform	traverse
	from field angles	• Explain how to		Perform a traverse	traverse	
	3.3 Calculate latitudesand	Calculate directions		survey	adjustment	
	departures	fromfield angles,				
	3.4 Calculate traverse	latitudes and			Perform a	
	precision and accuracy	departures			traverse survey	
	3.5 Perform traverse					
	adjustment					
	3.6 Calculate northingsand					

	eastings									
	5.7 Perform a traverse									
GENER	<b>GENERAL OBJECTIVE:</b> 4.0. Understand the determination of topographic survey using a total station									
8-10	<ul> <li>4.1 Describe trigonometric elevation determination</li> <li>4.2 Describe the procedures for gathering topographical data</li> <li>4.3 Measure and record horizontal angles, vertical angles and slope distance</li> </ul>	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				
GENER	AL OBJECTIVE: 5.0. Understan	nd how to collect Mapping of	lata using a handheld GPS	Receivers						
11	5.1 Describe how to operate the receiver.	Explain how to operate the receiver, use mapping	HandheldGPS Receivers	Operate the receiver	Guide students to:- operate the	Explain howto use mapping coordinates to locate land features				
	5.2 Describe how to use mapping coordinates to	coordinates to locate land features and		Use mapping coordinatesto	receiver					
	iocateranti reatures.	coordinates of land features		features	mapping coordinate					
	5.3Explain how to collect mapping coordinates of			Collect mapping coordinates of	s tolocate land features					
		Explain how torecord and coordinates in acomputer		landreatures						
	5.4 Explain how to record the coordinates in a computer spreadsheet	spreadsheet		Record the coordinates ina computer spreadsheet	-collect mapping coordinates of landfeatures					

	5.5 Explain how to determine the accuracy of the data			Determine the accuracy of the data	record the coordinates in a computer spreadsheet	
GENER	AL OBJECTIVE: 6.0. Understa	nd how to deliver a Class Pre	esentation on a Specific G	IS project that relate	s to Environment	Fechnology
12-13	<ul> <li>6.1Explain how to Perform a research ona GIS project that relates to EnvironmentalTechnology.</li> <li>6.2 Explain how to Perform a research that highlights the major components of the project.</li> <li>6.3 Explain how to Present the results of a research</li> </ul>	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 resultsof a research	HandheldGPS 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 aresearch	Guide students to: carry out a research on a GIS project that relatesto Environmenta 1 Technology -carry out a research that highlights the major componentsof the project -present the resultsof a	Explain howto perform a research on a GIS project that relates to EnvironmentTechnology
GENER	AL OBJECTIVE: 7.0. Know ho	w to Input various data sets i	in a GIS	I	Teseuren	1
14	<ul> <li>7.1 Describe georeferenced maps, aerial photographs and orthophotos</li> <li>7.2 Explain Import digitial data ina GIS</li> </ul>	•Explain items7.1-7.3	HandheldGPS Receivers	Use georeferenced maps,aerial photographs and orthophotos.	Guide students to: -use georeference dmaps, 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 digitial data in aGIS input non-spatial and spatial data (survey and GPS) in the standard fieldnotes format	photographs and orthophotos. -import digitial data in a GIS -input non- spatialand spatial data (survey and GPS) in the standard field notes format	
GENERAL OBJECTIVE: 8.0. Know ho	w to Manage GIS data				
<ul> <li>8.1 Explain how to transform GIS data between various map projections</li> <li>8.2 Describe how to edit non-spatial and spatial GIS data</li> <li>8.3 Explain how to manage GIS data</li> </ul>	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	Explain data management

GENERAL OBJECTIVE: 9.0 Know how to Produce a GIS map using Mapping and Survey data							
	<ul><li>9.1 Explain GIS Data analysis</li><li>9.2 Explain how to Perform the analysis on the data</li></ul>	•Explain GIS dataanalysis	HandheldGPS Receivers	Carry out GIS dataanalysis Perform the analysis onthe data	Guide students to: -carry out GISdata analysis -perform the analysis on the data	Explain GISdata analysis	
GENER	AL OBJECTIVE: 10.0. Know h	now to produce a cartographic	c correct map using mapp	ing and survey data			
	<ul> <li>10.1 Explain how to insert all map surround information</li> <li>10.2 Explain how all points, lines, area and raster features on the map</li> <li>10.3 Describe how to present on the map information that are cartographically correct</li> <li>10.4 Explain how to Plot draft copy(ies)of the map</li> <li>10.5 Explain how to Perform quality control of the map</li> <li>10.6 Explain how to Produce the final</li> </ul>	•Explain procedures of GISdata presentation	HandheldGPS Receivers	Plot draft copy(ies) of the map Perform quality control ofthe map Produce the final map	Guide students to: -plot draft copy(ies) of themap -perform quality control of the map produce the finalmap	Explain procedures of GIS data presentation	

	map					
GENER	AL OBJECTIVE: 11.0. Know h	now to Produce a metadata fi	le for the GIS Project	I	I	
	<ul> <li>11.1 Explain how to determine the accuracy of various map features</li> <li>11.2 Describe how to compare the accuracy of the various mapping features and Produce the metadata records.</li> </ul>	Explain the procedure for producing metadata of the •GIS project	HandheldGPS Receivers	Determine the accuracy of various map features Produce the metadatarecords.	Guide students to: determine the accuracy of various map features	Explain the procedure forproducing metadata of the GIS
GENER	AL OBJECTIVE:12.0 Interpret	GIS data				
			HandheldGPS Receivers	<ul> <li>12.1 Interpret GIS</li> <li>data for air monitoring andprediction.</li> <li>12.2 Interpret GIS</li> <li>data for water monitoring andprediction.</li> <li>12.3 Interpret GIS</li> <li>data for land monitoring andprediction.</li> <li>12.4 Interpret GIS</li> <li>data for vegetation monitoring and</li> </ul>	Guide students to carry out activities12.1- 12.4	Interpret GIS data for land monitoring and prediction.

				prediction.		
ASSESSMENT: 7 make up for the re	The continuous assessme maining 60% of the tota	ent; tests, quizzes, field work l score.	ks etc. will be awarded 409	% of the total score.	The end of the Ser	nester Examination will

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	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	<b>PRACTICAL:</b> 1 HOUR	WEEK						
GENERAL OBJECTIVES									
On completion of this course, the Student should be abl	e to:								
1.0 know how to evaluate the composition of complex	sample matrices								
2.0 Know the properties of organic and inorganic polle	utants								
3.0 Know the determination of appropriate sampling s	trategy to employ in a	given situation.							
4.0 know how to develop a comprehensive sampling p	lan, given a particular	scenario.							
5.0 know how to implement the correct preservation te	echnique for a given sa	mple							
6.0 know how to evaluate the general considerations o	f sampling surface and	ground water.							
7.0 know how to evaluate general considerations for the	ne sampling of soils.								
8.0 Understand the different categories of air pollutant	ts and the collection of	a representative air sample f	from a target population/environment						
9.0 Understand the principles of common field analy	ses.								
10.0 know how to incorporate correct quality assura activities.	nce and quality control	practices into action in the f	field during environmental sampling						
11.0 know how to collect samples of air, water and so	oil that are defensible u	nder legal scrutiny							
12.0 Understand the main principles of operation for	different types of chem	nical instrumentation							

PROGRAMME: NATIONAL DIPLOMA ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY								
Course	: Environmental Sampling and	d Analysis	Course Code: ESM 126	Credit Unit: 3.0	<b>Contact Hours:</b> 3			
GOAL	: This course is designed to e	expose the students to sat	mpling techniques that are	e accurate, precise and ma	intain sample integrity	7		
Course	Specification: T	<b>Theoretical Content:</b> 2	hrs	<b>Practical Content:</b> 1 h	ır			
GENERAL OBJECTIVE 1.0: Know how to evaluate the composition of complex sample matrices.								
Course	Specification:	THEC	RETICAL CONTENT	PRACTICAL CONTE	NT	1		
Week	Specific Learning	<b>Teachers' Activities</b>	Learning Resources	Specific Learning	Teachers'	Evaluation		
	Outcome			Outcome	Activities			
1-2	<ul> <li>1.1 List the main components of the environment</li> <li>1.2 Describe interdependency of the main components of the environment.</li> <li>1.3 Describe the physicaland chemical composition of various matrices encountered in the activity of environmental samplingand analysis</li> </ul>	List out the components of the environment. Explain the physical/chemical composition of chosen samples • Explain interferences andtheir effects on analyses	Visual aids, calculator, marker, etc. .A bound laboratory notebook with numberedpages, a laboratorycoat, disposablelatex laboratorygloves Safety glassesand etc.	Identify types of interferences that are present in sample matricescollected 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 interferencee that are present in sample matrices		

	1.4 Explain how to identify types of interferences that are present in sample matrices collected fromthe environment and their effects on analyses				
GENE	RAL OBJECTIVE 2.0: Kno	ow the properties of organ	ic and inorganic polluta	nts	
3-4	<ul> <li>2.1 Describe pathways, conditions and mechanisms that influence the migrationpath of a pollutant.</li> <li>2.2 Explain with examples of organic and inorganic chemicals that are potentially hazardous toliving Organisms</li> </ul>	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 organicand inorganic chemicalsthat are potential hazards

	2.3 Describe the concept and significance of bio magnification					
GENEI	RAL OBJECTIVE 3.0: Know	v the determination of ap	propriate sampling strate	egy to employ in a given si	tuation	
5-6	<ul> <li>3.1 Describe the purpose ofdata quality objectives (DQA)</li> <li>3.2 State example of a quantitative and a qualitative DQO Distinguish between thethree types of sampling strategies</li> <li>3.3 Explain the advantagesof each.</li> </ul>	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 strategyfor a given situation	Visual aids, Gas chromatograp h Mixtures Hydrocarbon Chromatogram, etc. Computer	Choose the best samplingstrategy for a given situation	Guide students to choose the best sampling strategy for a given situation	Distinguish between the three types of sampling strategies
Genera	l Objectives 4.0: Know how t	o develop a comprehensi	ve sampling plan, given	a particular scenario		
7-9	<ul> <li>4.1 Compare three types of sampling programs.</li> <li>4.2 Determine the type of sampling plan required ina given situation.</li> <li>4.3 Differentiate between local and area controlsites.</li> <li>4.4 Describe the types of samples commonly</li> </ul>	Explain three types of samplingprograms and differentiate between local and area control sites,the types of samples commonly collected and the benefits of grab verses automated sampling.	Magnetic Board,Markers Etc. IEC, Solvent Mixtures, IEC Chromatogra m,	Determine the type of sampling plan required ina 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 verses automated sampling.					
Genera	l Objective 5.0 Know how to i	implement the correct pr	reservation technique for a	a given sample		
10-11	<ul> <li>5.1 Describe the factors thataffect an unpreserved sample</li> <li>5.2 Select the correct preservation technique and holding time for given a water sample.</li> <li>5.1 5.3 Select the correct preservation technique and holding time for a given a soil sample</li> </ul>	<ul> <li>Explain factors affecting</li> <li>unpreserved sample with good illustration</li> </ul>	Magnetic Boards,, Markers,etc.	Select the correct preservation technique and holding time for givena 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 forgiven a water sample. -select the correct preservation technique and holding time fora given a soil sample	List the factors that affect an unpreserved sample
Genera	l Objective 6.0 Know how to	evaluate the general con	siderations of sampling su	urface waters and ground		
12-14	<ul> <li>6.1 Discuss the unique properties of ground water and how they can interfere with the collection of a representative ground water sample.</li> <li>6.2 Distinguish between themany types of</li> </ul>	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 waterand how they can interferewith the collection of a representative ground water sample. Identify the appropriate sampling	Guide students to: -identify the unique propertiesof ground water and how they caninterfere with the collection of a representative ground water sample.	Distinguish between themany types of water samples thatmay be encounteredand indicate the type of water to collect for agiven situation.

	<ul> <li>water samples that may be encountered and indicate the type of water to collect for a given situation.</li> <li>6.3 Describe the individualprocedure steps and types of sampling equipment that are usedfor water sampling.</li> <li>6.10 Explain how to identify the appropriate</li> </ul>	Explain how to distinguish between the many types of water samples ofwater. Explain the individual procedure steps and types of sampling equipment that are used for water sampling. Identify		location for the collection of water	identify the appropriate sampling location for the collection of water	
	sampling location for the collection of water.	<ul><li>sampling location for the collection</li><li>of water</li></ul>				
Genera	<b>l Objective 7.0</b> Know how to	evaluate general conside	erations for the sampling of	of soils		I
	<ul> <li>7.1 Classify soils based onparticle size.</li> <li>7.2 Explain the decisions thatare made for a soil sampling program</li> <li>7.3 Explain how to choose the proper sampling equipment andcontainers to use for soil Sampling</li> </ul>	• Explain the classification of soils based on particle size.	Soil sampleSoil sieve	Choose the proper sampling equipment and containers to use for soilsampling Perform soil analysis	Guide students to demonstrate use ofsoil sieve for soil particle size Guide Students to analyze soil samples	List physical characteristics of soil

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

and categories of air			equipment to			
pollutions that exist	Explain the four		collect individual			
according to their vapour	types of air		air pollutants or			
pressure	samples collected		categories from the			
8.6 Explain particulatematter	in environmental		environment			
(PM)	studies and					
8.7 Classify PM into thesix	categories of air					
different types and	pollutions that					
according to particle size	exist according to					
8.8 Explain the different	their vapour					
modes that are used for	pressure					
air sample collection	Explain					
including area, direct or	particulate matter					
indirectsampling and	(PM)					
passive or active	Classify PM into					
sampling	the six different					
8.9 List differentmechanisms	types and					
of operations used in air	according to					
sample collection	particle size.					
equipment to collect	Explain the					
individual air pollutants	different modes					
or categories from the	that are used for					
environment	air sample					
8.10 Describe the	collection					
significance of	including area,					
environmental conditions	direct or indirect					
on the collection of air	sampling and					
samples	passive or active					
8.11 Explain	sampling					
conditionsthat can						
interfere with the	<b>T</b> 1 1 11 1					
collection of a	Explain conditions					
	representative air sample	that can interfere				
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	8 12 List examples of	of arapresentative				
	air sampling equipment	or arepresentative				
	8 13 Describe air	givenenvironment				
	sampling equipment and	L ist examples of				
	their method of operation	air sampling				
	and the mechanism	equipment				
	employedto collect air	Describe air				
	pollutants	sampling				
	8.14 Explain	equipment and				
	precautionsto take in the	their method of				
	handling and	operation and the				
	preservation of air	mechanism				
	samples	employed to				
	1	collect air				
		pollutants Explain				
		precautions to				
		take in the				
		handling and				
		<ul> <li>preservation of air</li> </ul>				
		samples				
~		sumpres				
Genera	<b>Objective 9.0</b> Understand the	e principles of common f	field analyses			
	9.1 Give reasons	Explain reasons	Whiteboard	Measure the	Guide the students	Identify the
	for measuring	for measuring	Immunoassaykits	concentrationof	to measure the	purpose of
	some physical	some physical		pollutant in a given	concentration of	turbidity,
	and chemical	and chemical		environmental sample	pollutant in a given	conductivity and
	propertiesof	properties of			environmental	residual chlorine
	environmental	environmental			sample	measurement
	samples in the	samples in the				
	field	field				

	9.2 Describe the model of immunoassay kitsuse to measure the presence and/or	Explain the model of immunoassay kits use to measure the presence and/or concentration of pollutant in				
	concentration of	<ul> <li>environmental</li> </ul>				
	pollutant in	samples				
	environme					
	ntal					
	samples					
	9.3 Explain the purposeof					
	turbidity,					
	residual chlorine					
	measurement.					
Genera	<b>I Objective 10.0</b> Know how to	incorporate correct qua	lity assurance and quality	control practices into act	ion in the fieldduring	environmental
samplin	g activities.	incorporate contect qua	inty assurance and quanty	control practices into act		
•	10.1 Describe how to	Explain how to	Whiteboard	Minimize the	Guide students to:	Distinguish
	obtain quality in	obtain quality in		amount oferror in	-minimize the	between various
	field activities and	field activities and		measurements	amount of error	terms that are
	the collection of	the collection of		through the	inmeasurements	used to identify
	laboratory data.	laboratory data.		application and	through the	aspects of
	10.2 Distinguish between			execution of	application and	quality
	various terms that are			qualitycontrol	execution of	assurance
	used toidentify	Explain ways to		practices.	quality control	and qualitycontrol
	aspects of	minimize the amount		Acquire data that is	practices.	
	quality assurance and	of error in		validand legally	acquire data that	
	quality control.	measurements		defensible	is valid and	
	10.3 Explain how to	through the			legally	

minimize the amount of error in measurements through the application and execution of quality control practices. 10.4 Explain acquire data thatis valid and legally defensible General Objective 11.0 Know how to	application and execution of quality control practices.	water and soil that are de	fensible under legal scruti	defensible	
	, concer sumples of un,	, all and bon that are de	tensiole under legui selui		
<ul> <li>11.1 List the documentation required when obtaining samples for legal purposes 11.2 Describe the special precautionsthat must be followed during the transport and storage of legal samples.</li> <li>11.3 Explain what a chain of custody is,its importance and the correct procedure that mustbe followed to correctly fill out a chain of custody report</li> </ul>	Explain the documentation required when obtaining samples for legal purposes Describe the special precautions that must be followed during the transport and storage of legal samples. Explain what a chain of custody is, its importance and the correct procedure that must be followed	Whiteboard	Identify what a chain ofcustody is	Guide students to identify what a chain of custody is	Define chain of custody

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## YEAR TWO, SEMESTER ONE COURSES

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY								
COURSE: Man And Environment	<b>CODE:</b> ESM 211	Credit Unit: 3.0	<b>CONTACT HOURS:</b> 2 HOURS/WEEK					
<b>GOAL:</b> 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-	<b>PRACTICAL:</b> 0 HOUR	S/WEEK					
<b>REQUISITE:</b>								
	none							

GEN	ERAL OBJECTIVES					
On co	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					

PROGR	RAMME: NATIONAL DIPLOM	IA IN ENVIRONMENT	AL SCIENCE AND MA	NAGEMENT TECH	INOLOGY	
Course:	Man and Environment		Course Code: ESM 211	Credit Unit: 2.0		<b>Contact Hours:</b> 2
GOAL:	This course is designed to enable	e the student know the im	pact of man's activities on	the environment		
Course	Specification:	THE	CORETICAL CONTENT	PRACTICAL CO	NTENT	
General	<b>Objective 1.0:</b> Understand Man <sup>3</sup>	's Impact on Vegetation	-	T	T	-
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	<ul> <li>1.1: Define impact of manon environment.</li> <li>1.2 Describe man's impact on vegetation</li> <li>1.3 Describe the environmental impact of man's use of fire</li> <li>1.5 Distinguish between natural and man-made fires</li> <li>1.6 Describe the role offire in suppressing vegetation</li> <li>1.7 Explain some of the consequences of fire suppression of vegetation</li> <li>1.8 Describe the role of grazing in suppression of vegetation</li> <li>1.9 Describe the role manin deforestation</li> </ul>	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.

	1.10Describethesecondary rain-forest					
	1.13 Describe the effects of air pollution on plants					
	<ul><li>1.14 Explain the role of man in vegetal decline</li><li>1.15 Explain the role of man in changing the genetic diversity in plants</li></ul>					
General	Objective 2.0: Understand Man's	s Impact on Animals				
4-5	<ul> <li>2.1: Explain man's impacton animals</li> <li>2Explain the environmental impact of man's domestication of animals</li> <li>2.3 Explain the environmental impact of man's dispersal of animal populations</li> <li>2.4 Explain the environmental impact of man's inversion of animal populations</li> </ul>	Explainsman'sdomesticationofanimals,theenvironmentalimpactofman'sdispersalofanimalpopulations,impactofman'sinversioninversionofanimalpopulationsAndthe role ofasanagentofanimalpopulationscontractions,theroleofmanasanagentofmanasanagentof	-projection -textbooks - internet - lecture notes tutorial	-	-	Explains the meaning and significance of man activities on animals

Explain the expansion of animalpopulations under man's influence				
's Impact on The Soil				
<ul> <li>Explains the meaning and significance of – man activities on soil.</li> <li>Explain soil salinity brought by man, how the spread of soil salinity occurs.</li> <li>Describe the methods of reclamation of salt- affected lands</li> <li>Explain the role of man in laterization of soil and explain the role of man in soil structure alteration and acidification of soil</li> </ul>	-projection -textbooks - internet - lecture notes tutorial			Explains the meaning and significance ofman activities on soil
	SectionExplain the expansionof animalpopulationsunder man's influence's Impact on The SoilExplains the meaningand significance of –man activities on soil.Explain soil salinitybrought by man, howthe spread of soilsalinity occurs.Describe the methodsof reclamation of salt-affected landsExplain the role of manin laterization of soiland explain the role ofman in soil structurealteration andacidification of soil	Explain the expansion of animalpopulations under man's influence         's Impact on The Soil         's Impact on The Soil         Explains the meaning and significance of – man activities on soil.         Explain soil salinity brought by man, how the spread of soil salinity occurs.         Describe the methods of reclamation of saltaffected lands         Explain the role of man in laterization of soil and explain the role of man in soil structure alteration and acidification ofsoil	decrifie       Explain the expansion of animalpopulations under man's influence         's Impact on The Soil       -         Explains the meaning and significance of – man activities on soil.       -projection - textbooks - internet - lecture notes tutorial         Explain soil salinity brought by man, how the spread of soil salinity occurs.       - internet - lecture notes         Describe the methods of reclamation of saltaffected lands       Explain the role of man in laterization of soil and explain the role of man in soil structure alteration and acidification ofsoil	define       Explain the expansion of animalpopulations under man's influence         's Impact on The Soil       -         Explains the meaning and significance of – man activities on soil.       -projection -textbooks - internet - lecture notes tutorial         Explain soil salinity brought by man, how the spread of soil salinity occurs.       - lecture notes tutorial         Describe the methods of reclamation of salt-affected lands       Explain the role of man in laterization of soil and explain the role of man in soil structure alteration and acidification of soil

	in acidification ofsoil 3.9 Explain the impacts ofsoil drainage methods employed by man	• Explain the impacts of soil drainage methods employed byman.				
	3.10 Describe the environmental impact of synthetic fertilizer on soil					
	3.11 Describe the impact of man-made fire on thesoil					
	<ul><li>3.12 Explain the role of man</li><li>in soil erosion</li><li>3.13 Explain human</li><li>attempts at soil and land</li><li>conservation</li></ul>					
General	Objective 4.0: Understand Man'	s Impact on The Soil				
8-10	<ul> <li>4.1 Explain the various aspect of man's deliberate modifications of rivers</li> <li>4.2 Describe the effects of urbanization on river flow</li> <li>4.3 Describe the effects of deforestation on river flow</li> </ul>	Explains the various aspect of man's deliberate modifications ofrivers, urbanization and flow deforestation on river flow	-projection -textbooks - internet - lecture notes tutorial	• -	• -	Explains the meaning and significance ofman activities on water.
	4.4 Explain the changes in lake levels brought about by man	Explain the roleof man in water pollution Explain the				

4.5 und bro	Describe the changes in derground water conditions bught aboutby man	process of chemical pollution by agriculture		
4.6 in v 4.7] che agri 4.8 che mai 4.9 defe 4.10 th	<ul> <li>b Explain the role of man water pollution</li> <li>2 Explain the process of emical pollution by triculture</li> <li>3 List other sources of emical pollution ofwater by an</li> <li>9 Describe the effect of forestation on water quality</li> <li>9 Explain the problem of thermal pollution ofwater by man</li> </ul>	List other sources of chemical pollution of water by man 4.9 Describe the effect of deforestation on water quality 4.10 Explain the problem of thermal pollution of water by man		

## **PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY**

<b>COURSE:</b>	Environmental	and	Social	Risk	CODE: ESM 212	Credit Unit: 2.0	<b>CONTACT HOURS:</b> 2 HOURS/WEEK
Communicat	tion						
GOAL: This course is designed to acquaint students to communication theory and principles, its application in various corporatestakeholders of							

communication setting **PRACTICAL:** 0 HOURS/WEEK

YEAR: TWO (2), SEMESTER: ONE (1)

PRE-**REQUISITE:** none

## **GENERAL OBJECTIVES**

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

- 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 tobe 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.
- Know the new collection process from the viewpoint of different news media and the elements of a good story. 10.0
- Understand successful engagement of a media representative in crisis or planned interviews. 11.0
- Understand effective strategies for engaging regulatory or government representatives 12.0

PROGI	PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
<b>COURSE:</b> Environmental and Social Risk Communication		Risk C	CODE: ESM 212	Credit Unit: 2.0	<b>Contact Hours:</b> 2			
GOAL: commun	This course is designed nication setting	to acquaint students to	communication theory a	nd principles, its appl	ication in various corp	ooratestakeholders of		
Course Specification:			Theoretical Content:         2         Practical Content:         0 hrs					
GENE	RAL OBJECTIVE 1.0: Know	w risk communication pr	ocess	1				
Course	Specification:	THEO	RETICAL CONTENT	PRACTICAL CONT	TENT	Γ		
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learnii Outcome	ng Teachers' Activities	Evaluation		
1-2	<ul> <li>1.1 Describe the general process and elements of riskcommunication.</li> <li>1.2 Describe, using examples, the three types ofrisk communication.</li> <li>1.3 Explain the role of audiences in the risk communication process.</li> </ul>	Explain risk communication process with examples Compare and contrast scientific riskand • perceived risk	White board Multi- media			Describe the general process and elements ofrisk communicatio n.State the 3 typesof risk communicationExplain the roleof audience in risk communication		
	1.4 Describe the differences between scientific risk (i.e.,							

	hazards) versus perceived 1.1 risk (i.e., outrage).									
GENE	GENERAL OBJECTIVE 2.0: Understand the key principles and elements of the risk communication process.									
3-4	<ul><li>2.1 List the components of community outrage.</li><li>2.2. Describe the components of communityoutrage using examples.</li></ul>	Explain the components of community outrage its elements that could be implemented when trust is low.				• -	Describe the components ofcommunity outrage with examples.			
	<ul><li>2.3 State the elements that could be implemented whentrust is low.</li><li>2.4 Describe the various means by which corporatetrust and credibility can be damaged.</li></ul>	Describe the various means by which corporate trustand credibility can be damaged. Explain verbal and Nonverbal communicationand the differences between verbaland	Whiteboard mediaChart	Multi-			Explain the various means by which corporate trust and credibility can be damaged			
	2.5 Analyze a case study and describe why the resultsoccurred and recommendations for improving the situation.	nonverbal communication List out types of nonverbal communication;and • role of nonverbal					Differentiate between verbaland nonverbal communicatio n			
	2.5 Describe nonverbal communication in terms	communication in					Describe role of nonverbal			

	of:a definition;	interpersonal				communication in
	differences between	communication.				interpersonal
	verbal and nonverbal					communication.
	communication; types of					
	nonverbal					
	communication; and					
	role of nonverbal					
	communication in					
	interpersonal					
	communication.					
	2.6 Define interpersonal					
	communication.					
	2.7 Define listening and					
	hearing as they relate to					
	the					
	perception process					
GENE	RAL OBJECTIVE 3.0: Und	lerstand the potential inter	nal and external corpora	te environmental stakehol	ders and their	
potentia	l influence on corporate activi	ties	1			
5-6	3.1 List the possible	Give an overview	Whiteboard	■ _	■ _	Explain the
	internal and external	of corporate	Multi-mediaChart			relationship
	stakeholders of an	Stakeholdersthe				between
	organization.	relationship of				internaland
		internal and				external stake
	3.2 Describe the	external				holders to the
	relationship of the	stakeholders to				organization
	internal and external	the organization.				-
	stakeholders to the	Describe the				
	organization.	relationships of				
		the internaland				
		external				Explain the

	<ul> <li>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.</li> <li>3.4 Describe the role each stakeholder plays, using examples, in the risk communication process.</li> <li>3.5 Describe the potential influence each stakeholder has, using examples, on the</li> </ul>	stakeholders to each other and how it influences overall and their relationship tothe organization. Explain the roleeach stakeholder plays, using examples, in the risk communication process.			role stakeholders in risk Communication process
	activities of the				
GENER	RAL OBJECTIVE 4.0: Unde	erstand the key element of	stakeholder communica	tion processes.	
7-9	<ul> <li>4.1 Describe the process fordetermining communicationpurpose and objectives.</li> <li>4.2 Describe the factors thatwill influence the purpose and objectives.</li> <li>4.3 Explain how to preparea communication purpose and</li> </ul>	Explain the key element of stakeholder communication process	Whiteboard Multi-mediaChart	■ _	Explain the factors that will influence the purpose and Objectives of communication processes

	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					
GENE	RAL OBJECTIVE 5.0: Un	derstand how corporate	environmental communic	cations could be managed	and the necessary syst	tems that are
require	d for it to be managed effective	ely	en in onnientar communi	eurons coura se managea	und the necessary syst	
10-11	<ul> <li>5.1 Describe the elements of an effective communications plan.</li> <li>5.2 Assess the communications plan and make recommendations for improvements of a given a scenario.</li> <li>5.3 Describe the elements and interrelationships of an effective corporate environmental communications system.</li> <li>5.4 Describe how an</li> </ul>	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	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
	5.4 Describe how an effective corporate	system.				

	<ul> <li>environmental communications systemshould be implemented.</li> <li>5.5 Assess the corporate environmental communications system andmake recommendations for improvements of a given a</li> <li>5.2 scenario,</li> </ul>	Discuss how an effective corporate environmental communications system should be implemented. 5.5 Assess the corporate environmental communications system and make recommendation for improvements				
		• scenario				
General	Objective 6.0: Know how to	plan and prepare an ora	l technical presentation.			
12-14	<ul> <li>6.1 Name three common types of oral presentation.</li> <li>6.2 Explain the rational for choosing an oral presentation to convey information.</li> <li>6.3 Define topic, message, and objective as related to an oral presentation.</li> <li>6.4 Analyze the audience forknowledge and attitude.</li> <li>6.5 Critique an oral presentation to determine why it was or was not</li> </ul>	• Explain three common types of oral presentation. and the rational for choosing an oral presentation to convey information	Multi-media MagneticBoard	• -	• -	Explain three common types oforal presentation. Assist students toplan a presentation Explain the basic delivery skills required for an oral presentation.

Genera	effective. 6.6 Plan a presentation with visual aids. 6.7 Describe the basic delivery skills required for an oral presentation. 6.8 Critique an oral presentation using a standard evaluation form	e fundamentals of conf	lict management			
Jeneral	a sojecute not enderstand in		not management			
	<ul> <li>7.1 Define conflict.</li> <li>7.2 Identify common causes of conflict in the workplace.</li> <li>7.3 List the benefits of conflict</li> <li>7.4 Describe defensiveness, its causes, types and effects.</li> <li>7.5 Describe five conflict resolution styles.</li> <li>7.6 Choose appropriate conflict resolution styles for a particular situation.</li> </ul>	• Explain the fundamentals of conflict management and negotiation	Whiteboard Multi- mediaChart			Describe and explain the common causesof conflicts. Explain thebenefits of conflicts Explain the appropriate conflict resolution styles
Genera	al Objective 8.0: Understand t	the key elements and str	rategies required to effecti	vely engage the public dur	ring	
consulta	9 1 Define consultation	Explain maaning	Multi modio Magnetia		_	Evaluin the
	and interaction.	of consultation and	Board	-	• -	methods of

8.2 Recognize the	interaction.			interaction
afferentmethods in				with the public
which consultation and	Explain the			
interactions with	different			<b>T</b> 1 1 1
members of public can	methods in			Explain the
take place.	which			elements
8.5 Describe the methods	consultation and			thatmust be
by which a shapshot of	interactions with			explained with
achieved	membersof			regards torisk
8 4 List the types of	public can take			data.
questions that may be	place.			
asked				
8 5 Define data	Describe the			
8 6 Describe the	methods by which			
elementsthat must be	a "snapshot" of			
explained in regards to	people's concerns			
risk data	can beachieved.			
Hok dutu.	List the types of			
8 7Explain and	questions thatmay			
illustratehow	be asked during			
language must be	consultations/inter			
simplified	actions.			
simplified.	Explain the			
8.8 Describe the process	elements that			
of dealing with	must be			
uncertainty.	explained in			
	regards to risk			
8.9 Prepare a technical	• Data			
presentation to a general				
public audience.				
1			1	

Genera	General Objective 9.0: Know different types of ENGOs, and the roles they play in addressing corporate environmental issues						
and prob	olems.						
	9.1 Define an	Explain	Whiteboard	■ _	■ _	Explain the	
	environmentalnon-	environmentaland	Multi-mediaChart			rolesof ENGO	
	governmental organization	non- governmental					
	(ENGO).	organization				Describe the	
	9.2 List the different types	(ENGO).				primary activities	
	of ENGOs and provide	List the different				of ENGO	
	examples of each.	typesof ENGOs and					
	9.3 Describe the primary	provide examples of					
	activities of each type of	each.					
	ENGO and provide						
	examples of each.	• Explain the					
	9.4Compare and contrast	primary activities					
	the different types of	ofeach type of					
	ENGOs.	ENGO and					
		provide examples					
	9.5 Analyze a hypothetical	ofeach.					
	situation and provide an						
	ideaof the ways different						
	types of ENGOs might						
	potentiallyrespond.						
	9.4 Describe methods by						
	which ENGOs could be						
	worked with.						
Genera	al Objective 10.0: Know the n	new collection process fr	om the viewpoint of diffe	rent news media and the e	elements of a good	1	
story.		I	1		C		
	10.1 Describe the	• Explain the	Multi- media Magnetic	■ _	■ _	Describe the	
	different types of news	different types of	Board			different types	
	media (television, radio,	news media and				ofnews media	
	newspapers, magazines,	the processes of				(television,	

andinternet) and the processes by which they collect and disseminate the news.10.210.2List the elements of agood news story.10.3Analyze elements of agiven news story.	collection and dissemination of news.				radio, newspapers, magazines, and internet) Explain the importance of news media
General Objective 11.0: Understand	successful engagement of	of a media representative i	in crisis or planned intervi	ews.	
<ul> <li>11.1 Describe the differences between a crisis and a planned interview and the potential responses to these interviews</li> <li>11.2 List the key aspectsnecessary in helping reporters understand a technical story.</li> <li>11.3 Describe how a source can protect and maintain their credibility.</li> <li>11.4 Analyze potential media situations and recommend appropriate</li> </ul>	Explain 11.1- 11.4 Given a simulated situation, guide the learner with 15 minutes of preparation time respond to questions ina mock interview situation. Given a simulated situation, guide the learner with1	WhiteboardMulti- media Chart			Explain differences between a crisis and a planned interview Explain how a source can protect and maintain their credibility.

	communication techniques.	week's preparation time, respond to questions in a mock interview						
		situation						
Genera	General Objective 12.0: Understand effective strategies for engaging regulatory or government representatives.							
	<ul> <li>12.1 Describe the role of regulatory agencies and government representatives in the environmental risk communication process.</li> <li>12.2 Describe the type of information regulatory agencies and government representatives require and why they require it.</li> <li>12.3 Describe the consequences of not providing this information or providing inadequateor misleading information.</li> <li>12.4 Describe thebenefits of providing the necessary information.</li> <li>12.5 Describe strategies for working with regulatory and government</li> </ul>	Explain the typeof information regulatory agencies and government representatives require and why they require it. Explain the consequences of not providingthis information or providinginadequate or misleading information.	Whiteboard Multi-mediaChart			Describe the roleof regulatory agencies and government representatives inthe environmental risk communication process. Describe the type of information regulatory agencies and government representatives require		

	representatives. 12.6 Analyze the situation and provide a strategy for addressing agiven a scenario.						
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 r	emaining 60% of the total score	e.				_	

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY									
COURSE: Environmental Law	CODE: ESM 213	Credit Unit: 2.0	<b>CONTACT HOURS:</b> 2 HOURS/WEEK						
<b>GOAL:</b> This course is designed to provide studer	<b>GOAL:</b> This course is designed to provide students with basic knowledge of environmental laws that govern environmental practices								
YEAR: TWO (2), SEMESTER: ONE (1)	PRE-	PRACTICAL: 0 HOU	URS/WEEK						
	REQUISITE: none								
GENERAL OBJECTIVES	<u> </u>								
On completion of this course, the Student should	be able to:								
1.0 Know the overview of the history and deve	lopment of law in Nig	eria and how law is admir	nistered						
2.0 Understand the constitution that shaped the de and Freedoms	evelopment of environ	mental law in Nigeria and	the fundamentals of the Charter of Rights						
3.0 Understand the development of Environment	al Law and different ty	pes of regulatory offences	s in Nigeria.						
4.0 Understand the background for the developm	ent of the current feder	al environmental legislati	on						
5.0 Understand the NESREA Regulations and the	eir applications.								
6.0 Understand the federal jurisdictional responsi	bilities related to Nige	rian oceans and inland wa	terways						
7.0 Understand the federal agencies with legislati	on that provides for pr	otection of the environme	ent through monitoring toxic						
substances, regulating Nigerian energy sector	and through the emerg	gency management of haz	ardous substances/releases.						
8.0 Understand the background for the current pr	ovincial environmenta	l legislation and provide a	n overview of the general purpose of						
NESREA and its relationship to environment	al protection.								
9.0 Understand Environmental Impact Assessment	nt and the principles ar	nd guidelines of the Water	act and Regulations.						
10.0 Know the basis for fairs and consistent comp	pliance and enforceme	nt process, administrative	roles and assessment of the development of						
environmental performance measures.									
<b>11.0</b> Understand the respective federal and state e	nvironmental enforcen	nent programs and how th	ese programs are administered.						

PROGR	PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
COURS	E: Environmental Law	(	Course Code: ESM 213	Credit Unit: 2.0		Contact Hours: 2-0-0		
<b>GOAL:</b>	This course is designed to provid	le students with basic know	wledge of environmental la	aws that govern envir	conmental practice	S		
Course S	Specification:	THE	ORETICAL CONTENT	PRACTICAL CO	NTENT			
General	<b>Objective 1.0:</b> Know the overview	ew of the history and deve	lopment of law in Nigeria	and how law is admi	nistered			
Week	Specific Learning Outcome	<b>Teachers' Activities</b>	Learning Resources	Specific Learning	Teachers'	Evaluation		
				Outcome	Activities			
1-2	<b>1.1</b> Explain the history and	Explain the history	Whiteboard	• -	• -	Explain the history and		
	development of law in	and development of	Multi-mediaChart			development of law in		
	Nigerian.	law in Nigerian				Nigerian		
	1.2 Explain the	Explain common						
	development of Nigerian	law constitutional						
	Law.	law and statute law.						
		Explain the legal						
	<b>1.3</b> Describe common	process incivil and						
	law, constitutional law and	criminal proceedings.						
	statute law.							
		Describe the						
	<b>1.4</b> Describe the legal	administration of law						
	processin civil and criminal	through the						
	proceedings.	government						
	1.5 Describe the	and the courts.						
	administration of law							
	the courts							
	the courts.							

Genera	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 Freed	loms.		1			
4-5	2.1 Explain the history	Explain the	Whiteboard	• -	-	Explain the history and	
	anddevelopment of	Nigerian	Multi-mediaChart			development of law in	
	Nigerian constitution.	constitution Vis-à-				Nigerian	
	2.2 Describe the division of	vis theenvironment.					
	powers between the federal						
	and provincial	Explain the					
	governments.	division of powers					
	2.3 Explain the Charter	between the Federal,					
	orRights and Freedoms.	State and Local					
	2.4 Describe how the	governments					
	constitution has shaped						
	environmental law.						
General	<b>Objective 3.0:</b> Understand the de	evelopment of Environmen	tal Law and different type	s of regulatory offen	ces in Nigeria.		
	3.1 Describe the	Narrate the history of	Whiteboard	• •	• •	State the different	
<b>C7</b>	backgroundand history of	Nigeria	Multi-mediaChart			common law remedies	
0-/	Nigeria environmental law.	environmentallaw in				available as they apply	
	-	Nigeria.				to environmentalmatters	
	3.2 Describe the role of the					to environmentalmatters	
	federal government in the	Explain therole of					
	application of	the federal					
	environmentallaw in	governmentand					
	Nigeria.	the role of the					
	3.3 Describe the role of the	provincial government					
	provincial government in	in the application of					
	theapplication of	environmental law in					
	environmentallaw in	Nigeria. Also describe					
	Nigeria.	the role of local					
	3.4 Describe the role of	municipalgovernments					
	localmunicipal governments	inthe					
	in theapplication of	application of					

	<ul> <li>environmental law in Nigeria.</li> <li>3.5 State the different common law remedies available as they apply toenvironmental matters.</li> <li>3.6 List the three different classification</li> </ul>	environmentallaw in Nigeria. Exemplify common law remedies available as they apply to environmental matters. List the three different				
	of regulatory offences	classification of regulatoryoffences				
General	<b>Objective 4.0:</b> Understand the ba	ackground for the developm	ent of the current federal	environmental legis	lations.	
8-10	<ul> <li>4.1 Explain the backgroundfor the development of NESREA</li> <li>4.2 Describe the basicpurpose of the ACT.</li> <li>4.3 Describe the differentparts of NESREA.</li> </ul>	• Explain items4.1 – 4.3	Whiteboard Multi-mediaChart	• -	• -	Describe the basic purposeof the ACT
General	<b>Objective 5.0:</b> Understand the N	ESREA Regulations and the	eir application.			
11	<ul> <li>5.1 Develop an overview of federalregulations.</li> <li>5.2 Explain how theyare deriving and their statutory authority.</li> <li>5.3 Describe the NESREA powers related to the regulation of fuels, fuel</li> </ul>	Explain overview of federal regulations, how they are derive and their statutory authority. Explain the NESREA	WhiteboardMulti- mediaChart	• -	• -	Describe Nigeria's environmentregulations related to thecontrol of toxic substances.

	components and vehicle					
	emissions.					
	5.4 Describe Nigeria's	Describe the federal				
	environment regulations	regulations related to				
	related to the control of toxic	the movement and				
	substances.	identification				
	5.5 Describe the federal	Hazards substances				
	regulations related to the	andwaste throughout				
	movement and identification	thecountry.				
	hazards substances and waste					
	throughout the country.	Describe the federal				
	5.6 Describe the federal	regulations related to the				
	regulations related to the	authorized release of				
	authorized release of toxic	toxicsubstances from				
	substances from industrial	industrialactivities.				
	activities					
General	<b>Objective 6.0:</b> Understand the feature	deral jurisdictional responsil	bilities related to Nigeria	n oceans and inland	waterways	
12-13	6.1 Develop an overview of	Explain the geography	WhiteboardMulti-	• -	• •	Describe the
	the legislative protection of	of Nigeria and usesketch	media			miscellaneousfederal
	Nigeria oceans and inland	to show the oceans and	Chart			legislation related
	waterways	sea ways				to the environmental
	6.2 Describe the habitat	sea ways				protection of Nigerian
	protection provisions of the	• Explain items 6.1 6.4				
	Fisheries Act.	• Explain Itemso.1 – 0.4				waterways.
	6.3 Describe the regulations					
	associated with the Fisheries					
	Act.					
	6.4 Describe the					
	miscellaneous federal					
	legislation related					
	to the environmental					

	protection of Nigerian					
	waterways.					
	General Objective 7.0: Unders	tand the federal agencies wit	h legislation that provide	es for protection of th	e environment three	ough monitoring
	toxic substances, re	gulating Nigerian energy sec	tor and through the emer	rgency management of	of hazardous subst	ances/releases.
14	<ul> <li>7.1 Provide an overview of Nigerian health and its relationship to environmentalprotection.</li> <li>7.2 State the federally administered legislation related to the environment andthe energy sector.</li> <li>7.3 Describe the federallegislation related to environmental emergencies and the movement of hazardousmaterial.</li> <li>7.4 Describe some of</li> </ul>	<ul> <li>Explain Nigerian health and its relationship to environmental protection.</li> <li>by the federally administered legislation related to the environment and the energy sector.</li> <li>Describe the federal legislation related to environmental emergencies and the movement of hazardous material.</li> </ul>	Whiteboard Multi- mediaChart		• -	Describe the federal legislation related to environmental emergencies and the movement of hazardous material.
	theother federal					
	legislation related to					
	environmental					
	protection					

General Objective 8.0: Understand the background for the current provincial environmental legislation and provide an overview of the						
	general purp	ose of NESREA and its rela	tionship to environmenta	al protection.		
Genera	<ul> <li>8.1 Describe the history and development of the Nigerian.Environmental protection andEnhancement Act.</li> <li>8.2 Explain the guiding principles of the Nigeria environmental protection andenhancement Act</li> <li>8.3 Describe the important concepts of the Nigerian environmental protection andenhancement Act.</li> <li>8.4 Describe an awareness of the Nigeria Environmental protection and enhancement Act.</li> <li>8.4 Describe an awareness of the Nigeria</li> <li>Environmental protection and enhancement Act.</li> </ul>	Explain Environmental Protection and enforcement • act and its the guiding principles of the Nigeria environmentalprotection and enhancementAct.	WhiteboardMulti- media Chart	• -	• -	Describe the federal legislation related to environmental emergencies and the movement of hazardousmaterial.
	Regulations.					
	<ul> <li>9.1 Explain the history anddevelopment of the EIA process.</li> <li>9.2 Describe the basic principles of conducting anEIA.</li> <li>9.3 Describe the federal EIAprocess.</li> <li>9.4 Describe the EIA</li> </ul>	Explain Environmental Impact Assessment, the basic principles, andthe process. as it applies in Nigerian. Describe the history and development of Nigerian	WhiteboardMulti- mediaChart	• -	• -	Describe thefederal EIA process.

	<ul> <li>processas it applies in</li> <li>Nigerian.</li> <li>9.5 Describe the history</li> <li>anddevelopment of Nigerian</li> <li>Water Act</li> <li>9.6 Explain the principles</li> <li>and application of the</li> <li>WaterAct.</li> </ul>	WaterAct •Explain the principles andapplication of the Water Act.and Water Act Regulations				
	an awareness of the Water					
	Act Regulations.					
General	<b>Objective 10.0:</b> Know the bas assessment of the developm	is for fairs and consistent nent of environmental perfor	compliance and enforce mance measures.	cement process, adr	ninistrative roles	and
	<ul> <li>10.1 Describe the basis for compliance and enforcementof environmental laws.</li> <li>10.2 Describe the factorsaffecting compliance</li> <li>10.3 Obtain an understanding of development measures.</li> </ul>	Explain environmental compliance and enforcement • Explain items 10.1 – 10.3	Whiteboard Multi-mediaChart	• -	• -	Describe thefactors affecting compliance
Genera	<b>I Objective 11.0:</b> Understand the administered.	respective federal and state	environmental enforcement	ent programs and ho	w these programs	are
	11.1 Describe the federal enforcement program for NESREA.	Highlight Federal and state environmental Programmes inNigeria	WhiteboardMulti- mediaChart	• -	• -	Explain the provincial compliance the enforcement program for NESREA and the <i>Water</i>
	11.2 Explain the provincial compliance the enforcement	List the various activities ofstates and NESREA in				Act.

	program for NESREA and the <i>Water Act</i> .	• Nigeria				
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 tota	al score.				

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY								
<b>COURSE:</b> Environmental Pollution and Control	CODE: ESM 214	Credit Unit: 3.0	CONTACT HOURS: 3 HOURS/WEEK					
<b>GOAL:</b> This course is designed to expose the students to the problems of pollution and the roles of organization and individuals incontrolling t.								
YEAR: TWO (2), SEMESTER: ONE (1)	PRE-REQUISITE: none	PRACTICAL: 1 HOUR/WEEK						
General Objectives:								
On completion of this course, the student should be	be able to:							
1.0 Understand the causes, sources and effects of	Environmental Polluti	on						
2.0 Understand roles of organization and individu	uals in preventing pollu	ition						
<b>3.0</b> Understand the need for controlling pollution								
<b>4.0</b> Understand the different types of environment	tal pollution							
5.0 Know the petroleum processes from petroleum	m exploration to refinit	ng						
6.0 Understand the major area of environmental of	concern in the explorat	ion, drilling and production J	phases of petroleum products.					
7.0 know how to suggest mitigation measures for	common petroleum re	lated environmental concern	s.					
8.0 Understand the general processes carried out	in typical exploration,	mining and milling-smelting	g operations for base metaloperations.					
9.0 Understand the common sources of environmental concern in the exploration and mining industry								
<b>10.0</b> 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.

PROGR	PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
COURS	E: Environmental Pollution and C	Control (	CODE: ESM 214	Credit Unit: 3.0		<b>Contact Hours:</b> 3		
<b>GOAL:</b>	This course is designed to expose	e the students to the proble	ems of pollution and the ro	bles of organization a	nd individuals inco	ontrolling it.		
Course	Specification:	THE	ORETICAL CONTENT	PRACTICAL CO	NTENT			
General	<b>Objective 1.0:</b> Understand the ca	auses, sources and effects	of Environmental Pollution	n.				
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation		
1-2	1.1 Define Environmental Pollution	Explain Environmental Pollution, point	WhiteboardMulti- media Chart	• -	• •	Define Environmental Pollution		
	1.2 Distinguish between point sources and non-point sources of pollution	sources and non-point sources of pollution among degradable andnon- degradable						
	1.3 Distinguish among degradable and non- degradable pollutants.	pollutants, the causes and effects of pollution control measures for pollution.						
1.4 Explain the causes and effects of pollution 1.5 State control measures	<ul><li>1.4 Explain the causes and</li><li>effects of pollution</li><li>1.5 State control measures</li></ul>	Define Environmental Pollution						
	forpollution.	Distinguish between point sources and non-point sources of						

		pollution				
		Distinguish among degradable andnon- degradable pollutants.				
		State control measures for pollution.				
General	<b>Objective 2.0:</b> Understand roles	of organization and individ	luals in preventing pollution	on		
4-5	<ul><li>2.1Explain pollution control.</li><li>2.2 State the benefits of controlling pollution such as Ecological balance, aestheticvalue, food etc.</li></ul>	<ul> <li>Explain the roles of organization and individualsin preventing environmental pollution</li> <li>Distinguish pollution prevention and pollution cleanup.</li> </ul>	Whiteboard Multi-mediaChart			Distinguish pollution prevention and pollution clean-up.
General	Objective 3.0 Understand the nee	ed for controlling pollution				
6-7	<ul> <li>3.1 Explain the roles of organization and individualsin preventing environmentalpollution</li> <li>3.2 Distinguish pollutionprevention and pollutionclean-up.</li> <li>3.3 Explain the limitations of pollution clean-up strategies.</li> </ul>	Explain pollution andpollution control and the benefits of controlling pollution such as Ecological balance, aesthetic value,food	Whiteboard Multi-mediaChart	• -	•	State the benefits of controllingpollution.

	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 pollutionstated 4.1 above.	• Explain items4.1-4.3	Whiteboard Multi-mediaChart	Visit local polluted sites	Accompany student to visit local polluted sites	List types of environmentalpollution
General Objective 5.0: Know the petroleum processes from petroleum exploration to refining.						
11	<ul> <li>5.1 Explain the major constituents found in the raw oil and gas mixtures.</li> <li>5.2 Describe the steps involved in the exploration for oil and gas deposits in Nigeria.</li> <li>5.3 Describe the processes involved in the production of raw oil and gas mixture.</li> </ul>	Explain the raw oil and gasmixtures. Explain the process involve in the exploration ofoil and gas deposits in Nigeria at a gas plant and fuelrefinery to convert raw hydrocarbon mixtures into products.	Lab coat, coveralls, safety glasses with solid sideshields	Identify the major constituents found in the rawoil and gas mixtures.	Guide students to identify the major constituents found inthe raw oil and gas mixtures.	Describe the steps involvedin the exploration foroil and gas deposits in Nigeria.
	5.4 Describe the processes used at a gas plant and					
fuel refinery to convert raw hydrocarbon mixtures into products. 5.5 Describe the processes involved in the extraction of unconventional petroleum mixtures such as tar sands and its conversion into useable products	5					
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General Objective 6.0: Understand	the major area of environmental	concern in the exploration	on, drilling and produ	iction phases of		
petroleum products.			1	1	1	
<ul> <li>12-13</li> <li>6.1 Describe the environmental problems associated with the exploration of oil and gas.</li> <li>6.2 Explain the environmental concerns associated with produced waters.</li> <li>6.3 Describe the major atmospheric contaminantsassociated with the processing of oi and gas and the burning of hydrocarbons.</li> <li>6.4 Explain the environmental concerns</li> </ul>	Explain the environmental problems associated withthe explorationof oil and gas. and the environmental concerns associated with • produced waters, contaminants associated withthe processing of oil and gas and the burning of hydrocarbons.	Lab coat, coveralls, safety glasses with solid sideshields	Identify videos on oil exploration, drilling and petroleum phase production	Demonstrate to student using videos on oil exploration, drilling and petroleum phase production	Describe the environmentalproblems associated with the exploration ofoil and gas.	

	associated with solid wastes produced from refinery operations, gas plant operations and tarsands operations.					
General	<b>Objective 7.0:</b> know how to sugg	gest mitigation measures for	common petroleum relat	ed environmental con	ncerns.	
14	<ul> <li>7.1 Explain the various industrial control measuresused to control waster effluents. (This includes: catalytic converters, scrubbers, bag houses, cyclones, electrostatic precipitators, incinerators andstacks).</li> <li>7.2 List methods for wastewater treatment used byindustry.</li> <li>7.3 Describe the processes used for the removal of sulfurfrom petroleum mixtures including the Claus Process for sulfur recovery from natural gas.</li> </ul>	Explain the various industrial control measures usedto control Waster effluents. (This includes: catalytic converters, scrubbers, bag houses, cyclones, electrostatic precipitators, incinerators and stacks).	Lab coat, coveralls, safety glasseswith solid sideshields			List methods for wastewater treatment used by industry.
Genera	d Objective 8.0: Understand the g	general processes carried out	in typical exploration, n	nining and milling-sr	nelting operations	for base metal operations.
	8.1 List the types of ore mined in Nigeria and the basemetals obtained from	Explain items8.2 – 8.5	Lab coat, coveralls, safety glasseswith solid sideshields	• -	• -	Describe the process of crushing, milling and

	these ores.					concentration in the
	8.2 Describe the various					mining process.
	ranks of coal found in					81
	Nigeria.					
	8.3 Explain the various					
	methods of ore extraction					
	including underground					
	andopen-pit mining.					
	8.4 Describe the process					
	of crushing, milling and					
	concentration in the mining					
	process.					
	8.5 Describe the various					
	processes of extracting base					
	metal from their ore,					
	including the use of					
	cyanideand the carbon-in-					
	pulp					
	process (CIP).					
General	Objective 9.0: Understand the co	ommon sources of environme	ental concern in the expl	oration and mining in	ndustry	
	9.1 Describe the	Explain items 9.1 –	Lab coat, coveralls,	• -	• •	Describe the
	environmental concernsarising	9.3	safety glasseswith			environmental concerns
	from the extraction of ore and		solid sideshields			arisingfrom the
	the					extraction of oreand the
	abandonment of a mine site.					abandonment of a mine
	9.2 State the problems					cita
	associated with the processing					site
	of ore such as the problems of					
	Acid Mine Drainage (AMD)					
	and leaching.					
	9.3 Explain some of the					

	problems associated with metals in the environment.								
Genera explorati	General Objective 10.0: Know the basic measures for mitigation for some of the common environmental concerns associated with exploration and mining activity.								
	<ul> <li>10.1 Describe methods used to contain mining wastes</li> <li>Such as dykes, holding pondsand lagoons.</li> <li>10.2 Describe aspects of thereclamation of a mining sitefollowing abandonment.</li> <li>10.3 Describe the environmental importance ofrecycling and the mining industry.</li> </ul>	Explain items10.0 - 10.3	Lab coat, coveralls, safety glasseswith solid sideshields	• -	• -	List some reclaimed mining sites inNigeria Explain the recycling process.			
Genera	I Objective 11.0: Know the basic	environmental concerns fro	m the agriculture industr	ry, and have a genera	l idea of why they	are a concern.			
	<ul> <li>11.1 Describe the environmental problems associated with large-scale "Factory Farm" operations inNigeria.</li> <li>11.2 Describe the waste contaminants produced by agricultural practices and founding water, air, and soil.</li> <li>11.3 Explain the health concerns associated withwaste produced from theagricultural industry.</li> </ul>	Explain items11.1 – 11.5	Lab coat, coveralls, safety glasses with solid side shields	• -	• -	Explain environmental concerns in the agricultural industry			

11.4 Describe the problems			
associated with the use of			
pesticides in the agricultural			
industry.			
11.5 Describe the problems			
associated with the use of			
fertilizers in the agricultural			
Industry			

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
COURSE: ENVIRONMENTAL ASSESSMENT	CODE: ESM 215	Credit Unit: 2.0	<b>CONTACT HOURS:</b> 2 HOURS/WEEK				
<b>GOAL:</b> This course is designed to enable students ha	ve knowledge of the en	vironmental assessment.					
YEAR: TWO (2), SEMESTER: ONE (1)	PRE-	<b>PRACTICAL:</b> 1 HOUR	S/WEEK				
	<b>REQUISITE:</b>						
	none						
GENERAL OBJECTIVES							
On completion of this course, the Student should be abl	le to:						
1.0 Understand the Concept of Environmental Assessment	nent						
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							

PROG	PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY								
COUR	SE: ENVIRONMENTAL AS	SESSMENT C	<b>ODE:</b> ESM 215	Credit Unit: 2.0	<b>Contact Hours:</b> 2				
GOAL	: This course is designed to e	enable students have know	vledge of the environmen	ital assessment.					
Course	Specification:	TI	neoretical Content: 1	Practical Contant, 1hr					
hr									
GENE	RAL OBJECTIVE 1.0: Unde	erstand the Concept of En	vironmental Assessment						
Course	Specification:	THEO	RETICAL CONTENT	PRACTICAL CONTE	NT	1			
Week	Specific Learning	<b>Teachers' Activities</b>	Learning Resources	Specific Learning	Teachers'	Evaluation			
	Outcome			Outcome	Activities				
1-2	1.1 Define the	Define the term	Board. Audio- Visual	• -	• -	Describe			
	term	Environmental	Systems.			Environmental			
	"Environment	assessment.				assessment as			
	al					contained in the			
	Assessment".	Describe				National			
		Environmental				Environmental			
	1.2 Describe	assessment as				Policy act.			
	Environmental	contained in the							
	Assessment as	National							
	contained in the	Environmental							
	national	<ul> <li>Policy act.</li> </ul>							
	environmental Policy								
	Act								
GENE	RAL OBJECTIVE 2.0: Und	derstand Environmental W	Vorking Documents						
3-4	2.1 Explain various types	Explain types of	Board. Audio- Visual	Prepare samples of	Guide students to:	Explain various			
	of environmental working	environmental	Systems.	E.I.A.,	-prepare	types of			
	documents such as	working		E.A. document	samplesof	environmental			
	Environmental Impact	documents, legal		formats.	E.I.A., E.A.	working			
	Assessment,	conditions on			document	documents such			
	Environmental Auditing.	preparing E.I.A.,			formats.	as Environmental			

	2.2 Explain the legal	E.A.			Prepare samples of		Impact
	conditions and regulations				environmental contract	prepare samples of	Assessment,
	on preparing E.I.A. E.A.	• Describe			documents.	environmental	
	etc.	environmental				contract	
	2.3 Prepare samples of	contract documents				documents.	
	E.I.A., E.A. document	and prepare same.					
	formats.	Explain the general					
	2.4 Describe	process					
	Environmental Contract	requirements.					
	Documents + legal and	-					
	technical aspects.						
	2.5 Prepare samples of						
	environmental contract						
	documents.						
	2.6 Explain the general						
	processing requirements: -						
	• Notice of Intent						
	<ul> <li>Environmental</li> </ul>						
	Assessment						
	• Draft E.I.S.						
	• Finding of No.						
	Significant impact.						
GENER	RAL OBJECTIVE 3.0: Unde	erstand Public Participation	n				
5-6	3.1 Explain the following:	Explain public	Charts	Public	Organise the	Guide students	Explain hindrance
	- Effective public	participation public	meetings	and visual	following:	toorganise the	to public
	participation	information and	aids		- Effective public	following:	participation,
	- Public information and	involvement benefits			participation	- Effective	public
	involvement	of effectivepublic			- Public information	public	participation.
	- Participation as agroup	participationetc.			andinvolvement	participation	
	member				- Participation as a	- Public	
	- Benefits from an	• Explain hindrance			group member	information	
	effective public	to public				and	

	<ul><li>participation programme.</li><li>3.2 Explain hindrances to</li><li>3.1 above.</li><li>3.3Organise 3.1 above.</li><li>3.4 Evaluate 3.1 above.</li></ul>	participation, public participation.		Benefits from an effective public participation programme	involvement - Participation asa group member Benefits from an effective public participation programme	
GENE	RAL OBJECTIVE 4.0: Unde	rstand Environmental Im	pacts and Resource Factor	ors		
7-9	4.1 Classify the	Explain various	Charts Publicmeetings	• -	• -	Identify the
	differenttypes of	impacts and	andvisual aids			various impacts
	impacts, viz: - direct	theirclasses.				
	impacts - indirect	Give examples and				
	impacts - cumulative	measures of				
	impacts 4.2 Describe the	variousimpacts				
	variousimpacts	Explain categories of				
	4.3 Explain the	resource factorssuch				
	measure of the various	as water, atmosphere				
	impact	land human aspects				
	4.4 List examples	etc.				
	ofimpacts					
	4.5 Explain categories					
	ofresource factors					
	namely:					
	- atmosphere					
	- water - land					
	- biologica					
	lenvironment					
	- sound					

human aspects Economic								
aspects								
SENERAL OBJECTIVE 5.0: Understand Assessment Preparation and Review								
AL OBJECTIVE 5.0: Under 5.1 Define the scope of the environmental assessment project. 5.2 Explain the need for the following: - Interdisciplinary team - Baseline studies - Scoping, i.e. identification of the important issues that require full analysis. 5.3 Describe assessment methodologies. 5.4 Prepare an environmental assessment (EA) document from results of the impact analysis. 5.5 Explain document review e.g. Internal andinter Agency reviews. 5.6 Prepare a document review of an 5.3 environmental Assessment Project.	<ul> <li>erstand Assessment Pre Specify the scope of the environmental assessment projectand assessment methodologies.</li> <li>Explain the need for inter- disciplinary team,scooping and baseline studies.</li> <li>Prepare environmental assessment (EA) document from results of the impact analysis and review an environmental assessment</li> </ul>	paration and Review Charts Graphsetc.	Prepare an environmental assessment (EA) document from results of the impact analysis. Prepare a document review of an environmental Assessment Project.	Guide students to -prepare an environmental assessment (EA) document from results of the impact analysis. prepare a document reviewof an environmental Assessment Project.	Explain the need for inter- disciplinary team, scoopingand baseline studies.			
	human aspects Economic aspects AL OBJECTIVE 5.0: Und 5.1 Define the scope of the environmental assessment project. 5.2 Explain the need for the following: - Interdisciplinary team - Baseline studies - Scoping, i.e. identification of the important issues that require full analysis. 5.3 Describe assessment methodologies. 5.4 Prepare an environmental assessment (EA) document from results of the impact analysis. 5.5 Explain document review e.g. Internal and inter Agency reviews. 5.6 Prepare a document review of an 5.3 environmental Assessment Project.	human aspectsAL OBJECTIVE 5.0:Understand Assessment Pre5.1 Define the scope of the environmental assessment project.Specify the scope of the environmental assessment project ad assessment methodologies.5.2 Explain the need for the following: - Interdisciplinary team - Baseline studies - Scoping, i.e. identification of the important issues that require full analysis.Specify the scope of the environmental assessment methodologies.5.3 Describe assessment methodologies.Explain the need for inter- disciplinary team,scooping and baseline studies.5.4 Prepare an environmental assessment (EA) document from results of the impact analysis. 5.5 Explain document review of anPrepare environmental assessment (EA) document from results6. Prepare a document review of an 5.3 environmental Assessment Project.Prepare environmental assessment environmental assessment environmental assessment environmental assessment environmental assessment environmental assessment environmental assessment environmental assessment environmental assessment project.	human aspectsAL OBJECTIVE 5.0:Understand Assessment Preparation and Review5.1 Define the scope of the environmental assessment project.Specify the scope of the environmental assessment projectand assessment methodologies.Charts Graphsetc.5.2 Explain the need for the following: - Interdisciplinary team - Baseline studies - Scoping, i.e. identificationof the important issues that require full analysis.projectand assessment methodologies.Charts Graphsetc.5.3 Describe assessment methodologies.projectand assessment methodologies.Explain the need for inter- disciplinary team,scooping and baseline studies.Prepare environmental assessment (EA) document from results of the impact analysis.Prepare environmental assessment (EA) document from results of the impact analysis.5.6 Prepare a document review of an 5.3 environmental Assessment Project.Prepare environmental assessment assessment (EA) document from results of the impact analysis and review an environmental assessment project.Prepare environmental assessment (EA) document from results of the impact analysis and review an environmental assessment project.	human aspectsSeconomic aspectsAL OBJECTIVE 5.0:Unterstand Assessment Preparation and Review5.1 Define the scope of the environmental assessment project.Specify the scope of the environmental assessmentCharts Graphsetc.Prepare an environmental assessment (EA) document from results of the impact analysis.5.2 Explain the need for the important issues that require full analysis.Specify the scope of the environmental assessmentCharts Graphsetc.Prepare an environmental assessment (EA) document from review of an environmental assessment5.3 Describe assessment methodologies.Explain the need for inter- disciplinary team, scooping and baseline studies.Prepare a document review of an environmental assessment (EA) document from results5.4 Prepare an environmental assessment review e.g. Internal andinter Agency reviews. 5.5 Explain document review of an 5.3 environmental Assessment Project.Prepare environmental assessment (EA) document from results of the impact analysis5.3 environmental Assessment Project.Prepare environmental assessment (EA) document from results of the impact analysis	human aspects Economic aspectsSeconomic aspectsGiven Seconomic aspectsSeconomic aspectsGiven Seconomic aspectsCharts Graphsetc.Prepare an environmental assessment (EA) document from results of the assessment (EA)Given seconomic assessment (EA) document from results of the important issues that require full analysis.Specify the scope of the environmental assessment methodologies.Charts Graphsetc. environmental assessment assessment to -prepare an environmental assessmentGivide students to -prepare an environmental assessment environmental assessmentGovernmental assessment environmental assessmentGivide students to -prepare an environmental assessment environmental assessmentGivide students to -prepare an environmental assessment environmental assessmentGivide students environmental assessment environmental assessment5.4 Prepare an environmental assessment of the impact analysis. 5.5 Explain document review of an 5.6 Prepare a document review of an 5.6 Prepare a document review of an 5.3 environmental Assessment Project.• Prepare environmental assessment (EA) document from results of the impact analysis and review an environmental assessment project.• Prepare environmental assessment environmental assessment environmental assessment environmental assessment environmental assessment environmental assessment environmental assessment environmental assessment environmental assessment environmental assessment environmental assessment environmental assessment environmental <br< td=""></br<>			

PRO	PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
COU	<b>RSE:</b> Environmental Monitoring	CODE: ESM 216	Credit Unit: 3.0	<b>CONTACT HOURS:</b> 3 HOURS/WEEK				
GOA	<b>GOAL:</b> 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							
techno	technologies							
YEAI	YEAR: TWO (2), SEMESTER: ONE (1)       PRE-       PRACTICAL: 1 HOUR/WEEK							
		<b>REQUISITE:</b>						
		none						
GEN	ERAL OBJECTIVES							
On c	ompletion of this course, the Student should l	be able to:						
1.0	Understand environmental monitoring, pur	pose of environmental	monitoring. and the key en	vironmental indicators				
2.0	Understand the fundamentals of environme	ntal monitoring.						
3.0	Know the various sources of water, air and	land pollution						
4.0	Know the effect of environmental monitori	ng on human health an	d ecosystem					
5.0	Understand environmental monitoring proc	edures						
6.0	Know the methods of preventing/controllin	g environmental pollut	ion					
7.0	Know the roles of various agencies charged	l with pollution control	/ monitoring					
8.0	Understand the legislations governing pollu	ition.						

PROGE	ROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
COURS	E: Environmental Monitoring	(	CODE: ESM 216	Credit Unit: 3.0		<b>Contact Hours:</b> 3		
GOAL:	This course is designed to provid	le students with the fundat	mental knowledge of obser	ving the environmer	nt, collection of dat	a andderiving required		
knowled	ge on environmental pollution, eff	fect of the pollution, the in	nportance of environmenta	l monitoring and cor	ntrol technologies			
Course	Specification:	THE	ORETICAL CONTENT	PRACTICAL CO	NTENT			
General	Objective 1.0: Understand envir	onmental monitoring, pur	pose of environmental mor	nitoring. and the key	environmental indi	cators		
Week	Specific Learning Outcome	<b>Teachers' Activities</b>	Learning Resources	Specific Learning	Teachers'	Evaluation		
				Outcome	Activities			
1-2	1.1 Define environmental	Explain items 1.1 -1.6	projector	• -	• -	Define environment al		
	monitoring		-textbook			monitoring		
	1.2 Describe the process and		-internet					
	activities in 1.1		-lecturenote			List the importance of		
	1.3 Explain the importance		-tutorial			monitoring		
	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							
	environmentalmonitoring							
	1.6 Describe the 5 global –							

	<ul> <li>scale key environmental monitoring indicators:</li> <li>biological diversity</li> <li>food production</li> <li>average global</li> </ul>					
	<ul> <li>carbon dioxide</li> <li>carbon dioxide</li> <li>concentrationin the</li> <li>atmosphere</li> <li>resource depletion</li> </ul>					
General	<b>Objective 2.0:</b> Understand the Fu	Indamentals in Environme	ntal Monitoring			
4-5	<ul> <li>2.1 Define the following items</li> <li>Environmental Hazards</li> <li>Environmental</li> <li>pollution/pollutants</li> <li>Contamination/ contaminants</li> <li>Environmental Media</li> <li>Eutrophication</li> <li>Eco System/ Eco Friendly</li> <li>2.2State the importance of EnvironmentalMonitoring</li> </ul>	• Explain the meaning of wholesome water and unwholesome water	-projector -textbook -internet -lecturenote -tutorial	• -	-	State the importance of Environment al Monitoring
General	<b>Objective 3.0:</b> Know the various	sources of water, air and l	and pollution	1	1	1
6-7	<ul> <li>3.1 Explain the sources of air, water and landpollution in municipal estate, institutional agricultural and industrial set up</li> <li>3.2 List sources of air, water and soil</li> <li>pollutions</li> </ul>	Explain items 3.1- • 3.5	projection -textbooks - internet - lecturenotes tutorial	Identify indicators of water pollution - BOD 20°C - COD <sup>5</sup> - nitrates -phosphates	Guide students to identify indicators of water pollution - BOD 20°C - COD <sup>5</sup>	Explain the sources of air, water andland pollution in municipal estate, institutional agricultural and industrialset up

-physi	cal			-total	- nitrates	
-chem	ical			coliforms	-phosphates	
-biolog	gical			faecal strep	-total	
-micro	biological			1	coliforms	
3.3 Ider	ntify indicators of water				faecal strep	
poll	ution				_	
- BOD	0 20°C					
- COD	<b>)</b> <sup>5</sup>					
- nitrat	tes					
-phosp	ohates					
-total o	coliforms					
-fecal	strep					
3.4 Clas	ssify					
Enviror	nmental Hazard					
underpł	nysical e.g. Noise,					
vibratio	on, pressure,					
radiatio	n, heat etc.					
3.5 Exp	lain the types of					
hazards	arisingfrom:					
- indus	stries					
- autor	nobiles					
- waste	es and its disposal					
- farm	ing activities					
- com	nercial activities					
General Objectiv	ve 4.0: Know the effects	of Environmental Monitor	ing on Human Health and	l Ecosystem		

	4.1 Describe simple	Explain items 4.1-	Projection	• -	■ _	State the relationship
8-10	chemical and	•4.8	-textbooks			between environment al
0-10	microbiological		- internet			pollution, human health
	methods of		- lecturenotes			eco-system and the
	measuringpollutants		tutorial			general environment
	in air, water and					general environment
	land.					
	4.2 Explain the					
	relationship between					
	environmental pollution,					
	human health eco-system					
	and the general					
	environment.					
	4.3 Explain the terms:					
	<ul> <li>ecological disruption</li> </ul>					
	<ul> <li>ecotoxicology</li> </ul>					
	• pathogen					
	<ul> <li>carcinogen</li> </ul>					
	• mutagen					
	• teratogen					
	4.4 Explain ionizing radiation					
	4.5 Explain alpha and beta					
	particles, x-ray andgamma					
	rays					
	4.6 Define non-					
	ionizing radiation and					
	listexamples					
	• ultraviolet radiation (UV)					
	• nera UV					
	<ul> <li>midrange UV</li> </ul>					
	• far UV					
	• infrared rays (R)					

	<ul> <li>near infrared rays (IR)</li> <li>Radio waves</li> <li>4.7 Define and list particulate matter</li> <li>dust</li> <li>mist</li> <li>goot</li> <li>smog</li> <li>fume</li> <li>smoke</li> <li>4.8 State the effect of environmental pollution: nuisance and aesthetic insult property damage damage to plants and animals damage to human health</li> <li>damage to human genetic and reproductivesystems</li> </ul>					
GENER	AL OBJECTIVES 5.0 Understan	nd Environmental Monitorin	g Procedures			
11	<ul> <li>5.1 Describe why effective monitoring is important</li> <li>5.2 State keys to</li> <li>implementing an effective environmental monitoring</li> <li>5.3 Determine what the monitoring strategywill be such as:</li> <li>-Limits and acceptance</li> </ul>	Explain items 5.1 -5.7	projection -textbooks - internet - lecturenotes tutorial	Determine the following monitoring strategy: -Limits and acceptance level(often based on the products type) -Decide what specifically	Guide students to determine the following: -Limits and acceptance level(often basedon the products type) Decide what specifically	Describe why effective monitoring isimportant

level(oftenbased on the		should be	should be	
products type)		monitored	monitored Guide	
-Decide what specifically		-Evaluate the	students to	
should bemonitored		frequency of	determine the	
Determine the		monitoring	monitoring	
frequency of		Identify problem	Guide students to	
monitoring		areas	identify problem	
			identity problem	
-Discuss problem areas			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				

GENER	GENERAL OBJECTIVES 6.0 Understand Methods of Preventing/ Controlling Environmental Pollution					
12-13	6.1 Explain how to	Explain items	-	Carry out	Guide	Explain the best option
	carry out awareness	awareness campaigns	projection	awareness	studentsto:	inpreventing or
	campaigns on the	on the effects of	-textbooks	campaigns on the	carry out	controlling air, water or
	effects of pollution.	pollution Carry out	- internet	effects of pollution	awareness	soil pollution
		inspection visits	lecturenotes – tutorial	Carry out	campaigns on	son ponution
	6.2 Explain how to carry	(monitoring) to remind		inspection	the effects of	
	out inspection visits	potential pollutants of		visits	Pollution	
	(monitoring) toremind	theirobligation to		(monitoring)to		
	potential pollutants of their	society and the		remind	-carry out	
	obligation	existence of air, water		potential	inspection	
	to society.	or soil pollution		pollutants of	visits	
	6.3 Explain the existence of air, water or soil pollution.	Explain the best option in preventing or controlling air,		their obligation to society	(monitoring) to remind potential pollutants of	
	6.4 Explain the best option in preventing or controlling air, water or soil pollution.	water or soil pollution 6.5 Describe appropriate solutions to environmental pollution problems in urbanand rural areas		Identify the existence of air, water or soil pollution	their obligation to society -identify the existence of air,	
	6.5 Describe appropriate	• and in temporary			water or soil	
	solutions to	settlement			pollution	
	environmental pollution					
	problems in urban and					
	rural areas and in					
	temporary settlement					
GENER	AL OBJECTIVE: 7.0 Know the	roles of various agencies ch	arged with pollution con	trol / monitoring		
14	7.1 list environmental	list environmental	projection	• -	• -	list environment al
	pollution organizationsand	pollution organizations	-textbooks			pollution organizations
	agencies at local, state,	andagencies at local,	- internet			

national and international	state, national and	- lecturenotes			and agencies at local and
levels.	international levels.	tutorial			state level
	e.g. National andState				
	Environmental				
7.2 Explain the role of	Protection Agencies.				
organizations in 5.1 above	. UnitedNations				
Environmental pollution	Environmental				
control e.g. National and	Programme				
State Environmental	•(UNEP)				
Protection Programme					
(UNEP)					
Agencies. United Nations					
Environmental					
<b>GENERAL OBJECTIVES: 8.0</b> Km	ow the Legislation Governing Po	llution			
		I		1	
8.1 list environmental	Explain environmental	projection	• -	■ -	list environmental
pollution control laws in	pollution control laws in	-textbooks			pollution control lawsin
Nigeria.	Nigeria and how to	- internet			Nigeria
8.2 Explain how to inform	informenvironmental	- lecturenotes			C
environmental pollution	pollution control laws	tutorial			
control laws regulation,	regulation, guidelines				
guidelinesand standards.	and standards.				

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCEIENCE AND MANAGEMENT TECHNOLOGY								
COURSE: Environmental Chemistry II	<b>CODE:</b> 217	Credit Unit: 3.0	<b>CONTACT HOURS:</b> 3 HOURS/WEEK					
Goal: This course is designed to provide students with knowledge on how to apply stoichiometry, thermodynamics, and kinetics tophysical and								
chemical changes that affect water quality, the toxid	city of metals, as well a	as solid wastes and contamin	ated soils.					
YEAR: TWO (2), SEMESTER: ONE (1)	PRE-	PRACTICAL: 1 HOUR	WEEK					
	<b>REQUISITE:</b>							
	none							

## **GENERAL OBJECTIVES**

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

1.0 Know how to use Stoichiometry, thermodynamics and kinetics to describe the greenhouse effect and global warning

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.

PROGR	PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCEIENCE AND MANAGEMENT TECHNOLOGY						
<b>Course:</b>	Environmental Chemistry II	(	Course Code: ESM 217	Credit Unit: 3.0		<b>Contact Hours:</b> 3	
GOAL: This course is designed to provide students with knowled changes that affect water quality, the toxicity of metals, as well as Course Specification:THGeneral Objective 1.0: Know how to use Stoichiometry, thermoWeekSpecific Learning OutcomeTeachers' Activities			on how to apply stoichion lid wastes and contaminate ORETICAL CONTENT namics and kinetics to dese Learning Resources	netry, thermodynami ed soils. <b>PRACTICAL CO</b> cribe the greenhouse <b>Specific Learning</b>	cs, and kinetics top NTENT effect and globalw Teachers'	bhysical and chemical varning <b>Evaluation</b>	
1-2	<ul> <li>1.1 Describe black body radiation.</li> <li>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</li> <li>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.</li> <li>1.4 Describe sources and</li> </ul>	Explain black body radiation. Describe the earth's energy balance in termsof sources. Describe the greenhouse effectand the enhanced greenhouse effectin terms of energy transfer from the sun's input to the earth's output, thermal infra- ray (IR) scattering, and subsequent heating. Describe sourcesand sinks of atmospheric CO <sub>2</sub> (g) and H <sub>2</sub> O (g). Explain sources and	White Board, Journals, Marker, Multimedia Projector, Laptop, Internet and Textbooks Lab Coat, coveralls safety Glasseswith solid sideshields Audio Visual	Outcome         Carryout         experiment on         1.1 using black         substancesand         some materials         Visit greenhouse         sites andrecord the         effect of sun on         the earth surface.	Activities Guide students to: -carryout experiment on 1.1using 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 <sub>2</sub> and H <sub>2</sub> O (g)	

sinks of atmospheric CO <sub>2</sub> (g) and H <sub>2</sub> O (g). 1.5 Describe sources and sinks of atmospheric gases contributing to the enhanced greenhouse effect. 1.6 Compare the importance of atmospheric molecules that contribute to the green house and enhanced greenhouse effects. 1.7 Describe sources and sinks of atmospheric	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 sourcesand sinks of atmospheric aerosols.		
<ul> <li>green house and enhanced greenhouse effects.</li> <li>1.7 Describe sources and sinks of atmospheric aerosols.</li> <li>1.8 Describe the effect of</li> <li>1.7 on global warming and compare their effectto the effects of greenhouse gases</li> </ul>	greenhouse effects. Describe sourcesand sinks of atmospheric aerosols. Describe the effect of 1.7 on global warming and compare theireffect to the effects of greenhouse gases		

GENER	GENERAL OBJECTIVE: 2.0 Understand the use of Stoichiometry, thermodynamics and kinetics to describe CarbonDioxide Emission				ion	
4-5	2.1 Define global warming	• Explain the potential	White Board, Journals,	Quantify (using	Guide students	State potential
	2.2 List potential	consequences of	Marker, Multimedia	the value of Q)	to Quantify	consequence of global
	consequences of global	global warming.	Projector, Laptop,	global energy	(using the	warming
	warming.	Quantify (using the	Internet and Textbooks	use for	value of Q)	
	2.3 Quantify (using the value	value of Q) global	Audio Visual	developed and	global energy	List the advantages
	of Q) global energy use	energy usefor		developing	use for	and
	for developed and	developed and		countries,	developed and	disadvantages of
	developing countries,	developing countries,		compare proven	developing	hydrogenas a fuel
	compare proven and	compare provenand		and estimated	countries,	
	estimated energy reserves	estimated energy		energy reserves	compare	List the advantages and
	from different sources	reserves		from different	proven and	disadvantages of
	(including ethyl			sources	estimated	radioactive materials as
	hydrates), and relate this			(including ethyl	energy	fuel.
	information to			hydrates), and	reserves from	
	estimates of global			relate this	different	
	releases of carbon			information	sources	
	dioxide			To estimates of	(including	
	2.4 Describe variety of			globalreleases of	ethyl	
	schemes for reducing the			carbon dioxide	hydrates), and	
	amount of carbon dioxide				relate this	
	emitted.				information to	
	2.5 Explain advantages and				estimates of	
	disadvantages of each				global	
	scheme stated in 2.3.				releases of	
	2.6 Compare the various				carbondioxide	
	forms of solar energy					
	currently contributing to					
	the energy grid giving					
	advantages and					
	disadvantages of each					
	Types					

	2.7 Describe the production					
	and properties of the					
	mixture called gasoline,					
	explain why the different					
	components are added to					
	it					
	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.					
	2 9 Explain the advantages					
	and disadvantages of					
	hydrogen as a fuel					
	2 10 Explain the					
	advantages and					
	disadvantages of					
	radioactive materials as					
	fuel.					
GENER	AL OBJECTIVE: 3.0. Understar	nd the Toxicity of heavy m	etals paying particular atte	ention to the changes	thatoccur as specia	ation changes.
	3.1 Explain common features	List heavy metals	White Board,	Identify hazardous	Guide students to	List common features
67	of the toxicity of heavy		Journals, Marker.	wastesas ignitable,	identify	of the toxicityof
0-7	metals including	Explain their	Multimedia	corrosive, toxic or	hazardous wastes	heavy metals
	speciation, transport, and	proportion and	Projector.	radioactive.	as ignitable,	
	bioaccumulation.	relate them to	Laptop,		-	

3.2 Explain the toxicity,	their toxicity	Internet and	corrosive, toxic	List examples of
sources, sinks and	<ul> <li>potentials</li> </ul>	Textbooks	or radioactive.	hazardous waste under
abatement of elemental	-	Audio Visual		the following sections
mercury, mercury				Ignitability, corrosivity,
amalgams, mercury from				toxic or Radioactive
the chloralkaline process,				
ionic mercury and methyl				
mercury.				
3.3 Explain the sources,				
sinks, abatement and				
health effects of lead in				
the 0, +2, and +4				
oxidation states				
3.4 Explain the sources,				
sinks, abatement, and				
health effects of				

General	General Objectives: 4.0 Understand the basic chemistry of soil.							
	4.1 List the organic matter	Explain organic matter	White Board,	Carry out a test	Guide	List the factors		
8-10	present in the soil.	present in the soil,	Journals, Marker,	of organic	students to	affecting		
0-10	4.2 Explain factors affecting	factors affecting	Multimedia	matter in the	Carry out	decomposition of		
	decomposition of organic	decomposition of	Projector, Laptop,	soil.	test of	organic matter in the		
	matter in the soil.	organic matter inthe	Internet and		organic	soil		
	4.3 Explain the benefits of	soil.	Textbooks	Test soil	matter in the			
	organic matter in the soil.			samples for	soil.	Identify thecauses of		
	4.4 Define cation exchange	Explain the benefits of	Audio Visual	acidity,		deficiencies in the soil		
	capacity of soil.	organic matter in the	DIL	alkalinity	Guide	<b>T</b> • 4		
	4.5 Explain the origin of	soil.	PH meter,	and	students to	L1St		
	4.6 Define Base Saturation	Define cation	colorimeter,flame	Determine soil	samples for	elements present in the		
	of soil	soil	Photometer, Atomic	elements	acidity	S011.		
	4.7 Explain the significance	the origin of charges in	Absorption,	$e \sigma Ca++ P K$	alkalinity			
	of Base Saturation of soil.	the soil.	Spectrophotometer.	$Z_{n}A_{13+}N_{a++}$	and element.			
	4.8Explain the origin and	Define Base Saturation		etc.	Determine			
	nature of soil acidity and	of soil			soil			
	alkalinity.	Explain the			elements			
	4.9 List elements presents in	significance of Base			e.g. Ca++,			
	the soil.	Saturation of soil.			P, K, Zn,			
	4.10 Explain the benefits of	• Explain theorigin and			Al3+ Na++ etc			
	elements listed in 4.9 above.	nature of soil acidity						
	4.11 Identify causes of	and alkalinity						
	4 12 Describe methods for							
	remedving 4.11 above							
	A 13 Classify fertilizers in							
	accordance with soil							
	requirement, experimentally.							

	4.14 Describe method of applying fertilizers in the soil.					
General	<b>Objectives:5.0</b> Understand the ap	plication of Chemistry to th	e solution of Environmen	ntal pollution		
11	<ul> <li>5.1 Define the term environment.</li> <li>5.2 List the constituents of ecosystem.</li> <li>5.3 Describe the uses to which man puts water, air and land.</li> <li>5.4 Explain the effects of the activities of man on the quality of the environment.</li> <li>5.5 Explain the on-set (threshold) of environmental pollution.</li> <li>5.6 Define environmental pollution.</li> <li>5.7 List sources of environmental pollution</li> <li>5.8 Explain the uses to</li> </ul>	Explain the term environment. Define: -ecosystem. -water, air andland. Explain the effects of the activities of manon the quality of the environment. Explain the on-set (threshold) of environmental pollution. Explain environmental pollution, sourcesof environmental pollution, water quality, water uses.	White Board, Journals, Marker, Multimedia Projector, Laptop, Internet and Textbooks Audio Visual PH meter, TDS- meter, Dissolved oxygen meter. COD meter	Visit various ecological areas around the school. Report your findings with reference to pollution, effects of activities of man on the environment etc. Determine dissolved oxygen (DO), PH, Acidity and alkalinity ofwater. Determine pH, suspendedsolid, BOD 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. -determine dissolved oxygen(DO), PH, Acidity and alkalinity of water.	List the constituents of ecosystem.List sources of environme ntal pollution List majorsources of water pollution collect andidentify water.
	which the aquatic	Explain the parameters		Carry out		

environment is put by	that are used to assess	BOD test and	determine	
man and aquatic	water quality e.g.	list important	pH,	
organisms.	dissolved Oxygen(DO).	uses Of BOD	suspended	
5.9 List sources of	P <sup>H</sup> ,	test.	solid,BOD	
environmental pollution	alkalinity/ acidity,		etc.	
5.10 Explain water	hardness, colour,			
quality.	turbidity, metals, etc.		-carry out	
5.11Explain how water	•		BODtest	
quality standard varies for	Explain on-set of water		•	
the intended water uses.	pollution collect			
5.12 Describe parameters				
that are used to assess	List major sources of			
water quality e.g.	waterpollution collect			
dissolved Oxygen (DO),	and identify water.			
P <sup>H</sup> , alkalinity/acidity,	Explain natural			
hardness, colour,	purification/water			
turbidity, metals, etc.	assimilation capacity of			
5.13 State the units for	a natural body of water,			
expressing values of the	eutrophication,			
Parameters in 5.11 above.	acid minedrainage.			
5.14 Explain the sanitary	Explain the occurrence			
significance of Parameters	of DOin the aquatic			
determined in	environment.			
5.12 above.				
5. 15Explain on-set of water	Explain the termwaste			
pollution collect	water, types and			
5. 16 List major sources of	sourcesof waste water.			
water pollution collect and	effects of controlled			
identify water.	discharge of water into			
5. 17 Describe natural	the environment, e.g.			
purification/water	into a water course.			
assimilation capacity of a				

natural body of water	Explain parameters		
5 18 Explain eutrophication	foranalyzing		
5.10 Explain editophication.	wastewater:		
draina ga	wastewater.		
5 20 List as a stars and a s	e.g. PH, suspended		
5.20 List parameters used as	solids, settle able		
water pollution index.	solids,Biochemical		
5.21 Describe water	oxygen demand		
<ul> <li>pollution measures</li> </ul>	(BOD), chemical		
under theFollowing.	oxygen demand		
Water pollution	(COD), etc.		
controlbody	5.28 Define BOD(i.e		
• Water quality	Biochemical Oxygen		
standards	demand (COD). Etc.		
<ul> <li>Municipal waste</li> </ul>	Describe theprocedure		
• watertreatment	for BOD test		
facilities.	5.30 List important uses		
• Pretreatment of	of		
industrialwater			
5.22 Discuss water			
pollutants.			
5.23 Explain the occurrence			
of DO in the aquatic			
environment.			
5.24 Explain the chemistry			
of DO measure.			
5.25 Explain the term waste			
water.			
5.26 List types and sources			
of waste water.			
5.27 Describe effects of			
controlled discharge of water			
into the environment, e.g. into			

a water course.			
5.28List parameters for			
analyzing wastewater:			
e g PH suspended solids			
settle able solids Biochemical			
oxygen demand(BOD)			
chemical oxygen demand			
(COD) etc			
5.29 Define BOD (i.e.			
Biochemical Oxygen			
demand (COD) Etc			
5 20 Describe the procedure			
for BOD test			
5 31 List important uses of the			
BOD test Apply chemical			
kineticsto the explanation of			
reactions			
5 22 State the formulae for			
5.52 State the formulae for			
ne calculation of			
5 22 Define COD (shemical			
5.55 Define COD (chemical			
oxygen demand).			
5.34 List applications of			
5.35 Calculate chemical			
oxygen demand (COD)			
5.36 Explain the chemistry			
of COD test			
5.3/ State the formulae for			
the calculation of result.			
5.38 Correlate BOD/COD			
values for waste.			

5.39 Define ambient air.			
5.40 Explain effects of high			
undesirable air pollutants on			
man's health.			
5.41List 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.			

## 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 onenvironmental applications PRE PRACTICAL: 2HOURS/WEEK YEAR: TWO (2), SEMESTER: ONE (1) PRE 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

PROG	PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
COURS	SE: Water and Wastewater Tr	reatment	Course Code: ESM 218	Credit Uni	<b>t: 3</b> .0	<b>Contact Hours:</b>	3	
GOAL	<b>GOAL:</b> This course is designed to provide students with knowledge of basic laboratory water treatment course with emphasis onenvironmental							
applicat	applications							
Course	Specification:	r	<b>Theoretical Content:</b> 2	Practical (	<b>`ontent</b> • 1hr			
hrs				Tractical C	ontent. In			
GENEI	RAL OBJECTIVE 1.0: Knov	w the qualities of water		T				
Course	Specification:	THEC	DRETICAL CONTENT	PRACTIC	AL CONTE	NT		
Week	Specific Learning	Teachers' Activities	Learning Resources	Specific	Learning	Teachers'	Evaluation	
	Outcome			Outcome		Activities		
1-2	1.1 Define water	Explain waterand its	Chalk and	•	-	• -	State theuses	
	1.2 Explain the uses of	uses.	Chalkboard				of water	
	water	<b>T 1 1 1 2</b>	Felt pen and					
	1.3 Describe the	List the different	Magnotio				What is	
	differentsources of	sources of water.	heard or dEquinment				potable	
	water.	<b>T</b>	board, and Equipment				water	
	1.4 Explain the	Explain						
	following torms	• Quality					State the	
	• Quality	Quality control	,				WHO	
	Quality     Quality control	Standard					standard for	
	• Quality control,	Operating					potablewater	
	• Standard Operating	Procedure,						
	Procedure	• Quality						
	<ul> <li>Ouality Assurance</li> </ul>	Assurance using						
	1.5 Explain the	water quality						
	important qualities of	indicators,						
	water	meaning of						
	W 4001	potable water						

	<ul> <li>1.6 Describe the waterquality indicators</li> <li>1.7 Explain the meaning ofpotable water</li> <li>1.8 State the world healthorganization standard forPotable water.</li> <li>1.9 State the Federal Ministry of Environment Standard for potable water.</li> <li>1.10 Describe the water cycles.</li> </ul>	Explain the world health organization standard for Potable water. State the Federal •Ministry of Environment Standard for potable water				
GENE	RAL OBJECTIVE: 2.0 Unde	erstand various methods of	f non-biological effluent	waste treatment	Γ	1
3-4	<ul> <li>2.1 List different types ofinsoluble / solid wastes and describe their effects on the environment and ecosystem.</li> <li>2.2 Estimate total organicmatter waste andwastewater.</li> <li>2.3 Define Biochemical Oxygen Demand (BOD), Chemical OxygenDemand (COD) and Total Oxygen Carbon</li> </ul>	<ul> <li>Explain water quality, demand,usage and sources.</li> <li>Describe the various Chemicalparameters used in water quality control and demonstratestheir determination of such Parameters asBOD, COD,</li> <li>Acidity, Alkalinity, Water hardness colour etc.</li> </ul>	Chalk and Chalkboard Felt-pen and Magnetic board, andEquipment	• -	• -	List the chemical parametersused in water quality

(TOC).			
2.4 Explain methods of			
determining BOD,	Explain the		
CODand TOC of	Principles of chemical		
wastes.	treatment of		
2.5 List the possible	wastewater underthe		
chemical	followingmethods:		
and	coagulation, emulsion		
biochemical	breaking,		
t	neutralization,		
oxicsubstances in	precipitation, chemical		
effluents from food	oxidation (using		
and otherallied	ozone, hydrogen		
industries.	peroxide, chlorineetc).		
2.6 Explain the	Explain theadvantages		
principles of	andlimitations of		
physical treatment of	each of the processes		
wastewater under	studiedin 2.6 and 2.7		
the following:	above.		
flocculation,			
sedimentation,			
centrifugation,			
floatation,			
adsorption, filtration,			
ultra filtration, and			
reverse osmosis,			
electrodialysis.			
2.7 Explain the			
principles of			
chemical treatment			
ofwastewater under			
the following			

General	<ul> <li>methods:coagulation, emulsion breaking, neutralization, precipitation, chemicaloxidation (using ozone, hydrogen peroxide,chlorine etc).</li> <li>2.8 Explain the advantagesand limitations of each of the processes studied in</li> <li>2.6 and 2.7 above.</li> </ul>	ical concepts of water abo	mistry and water treatm	ont			
5-6	<ul> <li>3.1 Describe concepts ofpH, P<sup>OH</sup>, Kw, acidityand causticity</li> <li>3.2 Explain the concept of alkalinity and buffering</li> <li>3.3 Explain the concepts of temporary and permanent hardness</li> <li>3.4 Explain the concept ofturbidity and it units</li> <li>3.5 Differentiate</li> </ul>	Explain concepts of water the Explain concepts of pH, P <sup>OH</sup> , Kw, acidity and causticity, the concept of alkalinity and Buffering and the conceptsof temporary and permanent hardness. Use the concept of turbidity and itunits Differentiate	Samples of Water and waste water Conductivity Meter pH Meter	Use the concept of alkalinity and buffering Use the concepts of temporary and permanenthardness Use the concept of turbidity and it units Use the concepts of conductivity and resistively data for	Guide students to: -use the concept of alkalinity and buffering -use the concepts of temporary and permanent hardness -use the concept of turbidity and it units -use the concepts	Differentiate between solutions that contain dissolved and Suspended solids	
	between dissolved and suspendedsolids 3.6 Explain the concepts of conductivity and resistively data for interpreting and predicting water problems 3.7 Use the concept of colorand its units 3.8 Interpret scale deposition analysis 3.9 Explain how to use Langelier and Stiff-Davis methodsof scale predicting	<ul> <li>between dissolved and suspended solids</li> <li>Explain the concepts of conductivity and resistively data for</li> <li>interpreting and predicting water</li> </ul>		interpreting and predicting water problems Use the concept of colorand its units Interpret scale depositionanalysis Use Langelier and Stiff-Davis methods of scale predicting.	of conductivity and resistively data for interpreting and predicting water problems -use the concept of color and its units -interpret scale deposition analysis -use Langelier and Stiff-Davis methods of scale predicting.		
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GENER	RAL OBJECTIVE: 4.0 Under	rstand the basic water tre	eatment processes.	1			
7-9	<ul> <li>4.1 Explain the desirable standards of water for domestic and other uses – WHO and other standards.</li> <li>4.2 Explain the reasons for establishing these standards sampling techniques.</li> <li>4.3 Explain methods of wateranalysis.</li> <li>4.4 Explain the effect of</li> </ul>	Explain the WHO, NSDWQ standards for drinking water Explain sampling techniques Describe step by step treatment of water Explain chlorination showing residual	White board, marker, slides, chartsand pictures Treatment plant, jar test apparatus, pH meter, DPD tablet, burette,pipette, Atomic absorption spectrophoto meter(AAS),s	Collect effluent water samples from the sedimentation, coagulation, filter and chlorination tank and perform experiments onthe water samples for colour, odour, taste, turbidity, acidity, alkalinity, hardness heavymetals, nitrate, Total suspended solids,	Guide students to Collect effluent water samples from the sedimentation, coagulation, filter and chlorination tank and perform	Distinguish between essential w treatment processes components	all vater and

	pollutants in water.	chlorine and	pectrophotometer,	total dissolved solids,	experiments on	
		breakpoint	filter paper, etc.	total solids.	the water	
	4.5 Explain municipal	chlorination			samples for	
	watertreatment process				colour. odor.	
	4.6 Describe surveillance				taste turbidity	
	and				acidity	
					alkalinity	
					hardness heavy	
					matuless heavy	
					Total suspended	
					alida total	
					solius, total	
					solids, total	
					solids.	
					Guide students to	
					visit a water	
					treatment plant	
GENE	RAL OBJECTIVE: 5.0 Under	stand various methods of	of biological waste treatm	ent, recycling and reuse		[
10-11	5.1 Explain the principles of	Explain the	-projection	Identify the various	Guide the student	List water that
	biological treatment of	principles of	-Text Books	methods of water	in identifying	may need
	wastewater.	ofwastowator	TOAT DOORD	purification	various methods of	purification
		And the	- Internet		water purification	
	5.2 Describe the technology	Technology and	Lastura notas			
	and operation of different	operation of	-Lecture notes			
	aerobic biological	different aerobic	- I utoriais			
	wastewater treatment	biological				
	processes:	wastewater treatment				
	(a) activated studge (b) acreted laccon	processes:				
	(c) stabilization ponds	(a) activated				
	(d) trickling filters	sludge				

(e) oxidation ditches	(b) aerated		
5.3 Describe the technology	lagoon		
and operation of different	• stabilization ponds		
anaerobic biological			
Wastewater treatment			
processes e.g. anaerobi			

## YEAR TWO, SEMESTER TWO COURSES

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

GEN	ERAL 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.		

COURSE: Climate ChangeCourse Code: ESM 211Credit Unit: 3.0Contact Hours: 3GOA:: This course is designed to enable its now thermateds of Climate ChangeTotal Climate ChangeTotal Climate ChangeCourse Course is designed to enable its Understand Atternation its Understand Atternation its Understand Atternation its Other its Understand Atternation its Other its Course is designed to enable its Other its Course is designed to enable its Other	PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY								
GOAL: This course is designed to enable students know the fundamentals of Climate for the students know the fundamentals of the students know the fundamentals of the students know the	COURS	E: Climate Change	С	ourse Code: ESM 211	Credit Unit: 3.0		Contact Hours: 3		
Image     humidity       rainfall     using       usingrain     hydrometer       gauge     -measure       speed and     rainfallusing	PROGR COURS GOAL: Courses General Week 1-2	AMME: NATIONAL DIPLOM E: Climate Change This course is designed to enable Specification: Objective 1.0: Understand Atmo Specific Learning Outcome 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 atmosphereand air density.	A IN ENVIRONMENTA C students know the fundan THEC sphere Teachers' Activities Explain the atmosphere and the composition of the atmosphere Explain the vertical divisionsof the atmosphere, the heat exchange processes of the atmosphere, Explain the effect of gravity on the atmosphere and air density.	AL SCIENCE AND MAN Course Code: ESM 211 mentals of Climate Change DRETICAL CONTENT Learning Resources Projector Text books Internet Barograph Thermometer Thermograph Hydrometer Rain gauge Anemometer	AGEMENT TECH Credit Unit: 3.0 PRACTICAL CON Specific Learning Outcome Take readings of atmospheric pressure using digital and analogue barograph Measure temperature using thermometer andthermograph Measure relative humidity using hydrometer	INOLOGY INTENT Teachers' Activities Guide students to: -take readings ofatmospheric pressure using digital and analogue barograph -measure temperature using thermometer and thermograph -measure relative	Contact Hours: 3 Evaluation Describe the composition of the atmosphere Explain the heat exchangeprocesses of the atmosphere		
Measure wind -measure speed and rainfallusing		air density.			Measure rainfall usingrain gauge	relative humidity using hydrometer			
					Measure wind speed and	-measure rainfallusing			

				direction using anemometer	-measure wind speed and direction using anemometer	
General	<b>Objective 2.0:</b> Understand the co	oncept of Global Warming				
4-5	<ul> <li>2.1 Define : Weather, Climate and Global Warming</li> <li>2.2 Explain the causes of global warming</li> <li>2.3 Explain how global warming is linked with extreme weather</li> <li>2.4 Explain carbon sequestration and carbon trading</li> <li>2.5 Explain the consequences and effects of global warming</li> <li>2.6 Explain measures to control global warming and changing environmental conditions</li> </ul>	<ul> <li>Describe the causes of globalwarming</li> <li>Explain the consequences and effects of global warming</li> <li>Explain how tocontrol global warming and changing environmental conditions</li> </ul>	Projector Text books Internet Tutorial			Define Global Warming Explain thecauses of global warming Explain how to control global warming and changing environmental conditions
General	Objective 3.0: Understand Temp	perature and its Variation		·	·	
6-7	<ul><li>3.1 Define temperature and surface air temperature</li><li>3.2 Explain temperature measuring instrument and its</li></ul>	Explain temperature and surface air temperature, the instrument used for	Projector Text books Internet Thermometer Thermograph	Measure temperature using different types of thermometers	Guide students to measure temperature usingdifferent	Define temperature and surfaceair temperature Explain thediurnal variation ofsurface air

scale of conversion	measuring		types of	temperature
Explain the diurnalvariation of	temperature,		thermometers	
surface air temperature	temperature scale			
3.4 Explain the physical	and its conversion			
processes used in	Explain the diurnal			Describe the working
thermometry	variation of surface			principle of thermograph
diefinionieu y.	air temperature, the			and the horizontal and
3.5 Describe the working	physical processes			vertical variations
principle of thermograph	use inthermometry			
3.6 Explain the				
horizontal and vertical	Explain the working			
variations of air	principleof thermograph			
temperature	and the horizontaland			
-	vertical variations			

GENER	AL OBJECTIVE: 4.0. Understan	nd Air and its Variation				
8-10	<ul> <li>4.1 Define moist air</li> <li>4.2 Explain isobaric and adiabatic processes.</li> <li>4.3 Explain moisture indicators</li> <li>4.4 Describe the elementary theory of the wet-bulb thermometer</li> <li>4.5 Explain the working principles of the psychrometer and the hygrometer</li> <li>4.6 Explain the relationship between dry-bulb, wet-bulb and dew-point</li> </ul>	<ul> <li>Explain moist air</li> <li>Explain isobaricand adiabatic processes.</li> <li>Explain moisture indicators Discussthe elementary theory of the wet-bulb</li> </ul>	Projector Text booksInternet Wet and drybulb thermometer Psychometer Hygrometer	Use wet and dry bulb thermometer to compute the relative humidity	Guide students tocompute relative humidity	Explain isobaric and adiabatic processes. Explain the relationship between dry- bulb, wet- bulband dew-point
General	<b>Objective 5.0:</b> Understand climat	tic change and its relationshi	p with the environment			
11	<ul> <li>5.1 Explain Climate variability</li> <li>5.2. Explain Climate change</li> <li>5.3 Mention Natural and Anthropogenic causes of climate change</li> <li>5.4 Explain Greenhouse gases as major driver of climate change</li> </ul>	Explain the causes of climatechange Describe ocean currents and their effects upon world climate. Describe forests and their roles in climate regulation/mitigation.	Projector Text books Internet Audio visual Charts	• -	• -	Explain Climate Change Mention causes ofclimate change Explain Ocean currents andtheir effectsupon world climate

5 Explain Ocean currents and their effects upon world			
5.6 Explain the environmentand it's relationship with climate			
change			

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY									
COURSE: Solid Waste Management	CODE: ESM 222	Credit Unit: 2	<b>CONTACT HOURS:</b> 2 HOURS/WEEK						
GOAL: This course is designed to introduce stu	<b>GOAL:</b> 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 p	practical management of	of waste management							
YEAR: TWO (2), SEMESTER: TWO (2)	PRE-	PRACTICAL: 1HOUR/	WEEK						
	<b>REQUISITE:</b>								
	none								
GENERAL OBJECTIVES									
On completion of this course, the Student should b	e able to:								
1.0 Know the general principle of Solid Wastes	Management								
2.0 Understand the methods of on –site handlin	g, storage and process	ing of solid waste.							
3.0 Know the methods of solid waste collection	 I.								
4.0 Understand the methods of transfer and tran	sportation of solid wa	ste.							
5.0 Understand the methods and equipment for	5.0 Understand the methods and equipment for solid waste disposal.								
6.0 Understand the sources and utilization of va	6.0 Understand the sources and utilization of various forms of energy from solid waste materials.								
7.0 Understand the principles of solid waste trea	7.0 Understand the principles of solid waste treatment/handling at home.								
8.0 Understand the processes of detection and a	batement of health nui	isances associated with poor	waste management						

PROGR	PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
COURS	E: Solid Waste Management	0	Course Code: ESM 222	Credit Unit: 2.0		<b>Contact Hours:</b> 2	
GOAL: technolo	<b>COAL:</b> This course is designed to introduce students to waste management and how to provide a balance between evolution, management regulation echnology and scientific aspects of the practical management of waste management						
Course	Specification:	THE	ORETICAL CONTENT	PRACTICAL CO	NTENT		
General	<b>Objective 1.0:</b> General Objectiv	e 1.0 Know the General pr	inciple of Solid Wastes Ma	anagement			
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation	
1-2	<ul> <li>1.1 State the need for solid waste management.</li> <li>1.2 Describe sources and types of solid waste.</li> <li>1.3 Explain the composition of solid waste.</li> <li>1.4 Describe the generation rates of 1.3 above.</li> <li>1.5 Classify modes of measurement of 1.4 e.g</li> <li>i) measure of quantity.</li> <li>ii) Statistical analysisof generation rate.</li> <li>1.6 List factors affecting generation rate.</li> </ul>	Explain the need forsolid waste management. Explain sources andtypes of solid waste. Explain the composition of solidwaste. 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 generatedin your area	

		affecting generation rate.											
General	General Objective 2.0: Understand the methods of on –site handling, storage and processing of solid waste												
4-5	2.1 Explain public health and aesthetics.	Explain public health and aesthetics	Magnetic board and felt pen	• -	-	Describe the method of on-sitestorage							
	<ul> <li>2.2 Describe the methodof on-site handling for <ul> <li>i) Residential</li> <li>premises.</li> <li>ii) Commercial</li> <li>premises.</li> </ul> </li> <li>2.3 Describe the method of on-site storage.</li> <li>2.4 Describe the methodsof on-site processing e.g.</li> <li>grinding, compaction,</li> <li>shredding, composting, etc.</li> </ul>	Describe the method of on – site handling for: (i) residential premises (ii)Commercialpremises. Describe the methods of on – site processing e.g. grinding, compaction composting, etc.											
General	Objectives 3.0: Know the metho	ds of solid waste collection	1.										
6-7	<ul><li>3.1 Describe collection services.</li><li>3.2 Describe collection systems, equipment and</li></ul>	Describe collection services Describes collection systems equipment	Felt pen and magnetic board field trips etc.	Analyse solid waste collection systems.	Guide students to: -analyse solid waste collection	List the equipmentused in the collection of waste-							
	<ul><li>labour requirement.</li><li>3.3 List collection systems</li><li>e.g. hauled container</li></ul>	and labour requirement.		Determine solid waste collection routes.	systems. determine solid wastecollection routes.								

	<ul><li>system and stationary container system.</li><li>3.4 Analyse collection systems.</li></ul>	• Analyse collection systems, and determine collection routes				
General	Objective 4.0: Understand the m	ethods of transfer and trans	portation of solid waste			
8-10	<ul> <li>4.1 Explain the need for transfer operations.</li> <li>4.2 Describe transfer stations.</li> <li>4.3 Describe transport means and methods.</li> <li>4.4 Describe location of transfer stations.</li> </ul>	<ul> <li>Explain the need for transfer operations.</li> <li>Describe transfer stations.</li> <li>Describe location of transfer stations.</li> <li>Describe transportation incomesand methods.</li> </ul>	Chalk and chalkboardfelt pen and magneticboard field trips etc	•_	• -	Explain the needfor transfer operations
General	<b>Objectives 5.0:</b> Understand the m	ethods and equipment for s	olid waste disposal.		·	
11	<ul> <li>5.1 Explain solid waste disposal by sanitary landfill method. <ul> <li>Equipment</li> <li>Supervision</li> <li>Process</li> </ul> </li> <li>5.2 Dispose solid waste by incineration.</li> <li>5.3 Describe solid waste disposal by open dumps and its potential health</li> </ul>	Describes solid wastes disposal by sanitary land fill method. a) factors in choice of site b) equipment c) supervision d) process. Describe solid waste disposal by incineration.	felt pen and magneticboard field trips etc	<b>.</b>	■ _	Describe how incinerator is usedfor waste disposal

	<ul> <li>hazard.</li> <li>5.4 Describe deep well disposal.</li> <li>5.5 Describe disposal of radioactive waste.</li> </ul>	Describe solid waste disposal by open dumps and its potential health hazards. Describe deep well disposal. Describe disposal of radioactive waste.				
General	<b>Objective 6.0:</b> Understand the so	urces and utilization of varie	ous forms of energy from	n solid waste materia	ls	
12-13	<ul> <li>6.1 Explain the principles of conservation of energy.</li> <li>6.2 List the forms of energy available in solid wastes.</li> <li>6.3 Explain the process of energy conversions in 6.2 above.</li> <li>6.4 Explain how to identify materials that can be recycled e.g. waste paper, metal scraps, X-raymaterials etc.</li> <li>6.5 Describe land reclamation process.</li> </ul>	Review the principles of conservation of energy. List the forms of energy available in solid wastes. Explain the process of energy conversions in 6.2. Identify the materials that can be recycled e.g waste paper, metal slap X-ray materials etc. Describe land reclamation process	felt pen andmagnetic board and equipment	Identify materials that can be recycled e.g. waste paper, metal scraps, X- ray materials etc. Design a solid wasteutilization process	Guide students to: -identify materials that can be recycled e.g. waste paper, metal scraps, X-ray materialsetc. design a solid wasteutilization process	List the types of energy that can generated through waste Explain the processes involvedin the recycling of waste

<ul> <li>6.6 Describe the processing and recovery system</li> <li>6.7 Explain the process of incineration with heat recovery.</li> <li>6.8 Explain pyrolysis in energy conversions.</li> <li>6.9 Design a solid waste utilization process</li> </ul>	Describe the processing and recovery process. Explain the process of incineration with heat recovery. Describes pyrolysis in energy conversions. Design a solid waste utilization process				
General Objective 7.0: Understand the pr	rinciples of solid waste treat	ment/handling at home.		·	
14       7.1 Describe various methods of waste treatment e.g.         • Household grinding         • Pulverization         • Sorting         • Pyrolysis         • Feed to animal         • Shredding         7.2 Describe nuisances associated with solid waste treatment at home.	Describe how to sort waste List public health nuisance associated with poor solid waste management e.g.odour nuisance, fly infestation presence of vermin and rodent etc. Explain how to detect each of the nuisances.	Felt pen andmagnetic board and equipment	• -	-	Describe how waste can be sortedbefore disposal

8.1 List common nuisances			•	• -	Explain the processof
associated with poor waste		felt pen andmagnetic			detecting nuisances
management.	• Describe and apply the	board and equipment			
8.2 Explain the process of	process of abatement of				
detecting nuisances caused by	such nuisances in a				
8.1.	nameu situation.				
8.3 Describe the process of					
nuisance abatement.					

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY									
COURSE: Renewable Energy and Sustainability	CODE: ESM 223	Credit Unit: 2.0	<b>CONTACT HOURS:</b> 2 HOURS/WEEK						
GOAL: The Course is designed to acquaint students w	vith the role of renewab	le energy in product and ser	vice sectors as well as its importance in the						
energy chain									
YEAR: TWO (2), SEMESTER: TWO (2)	PRE-	<b>PRACTICAL:</b> 0 HOURS	S/WEEK						
<b>REQUISITE:</b>									
	None								

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 IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY									
COURS	SE: Renewable Energy and Su	ustainability	Course Code: ESM 223	Credit Unit: 3.0	<b>Contact Hours:</b> 3				
GOAL	The Course is designed to a inthe energy chain	equaint students with th	y in product and service se	ectors as well as its im	portance				
Course hrs	Specification:	]	<b>Theoretical Content:</b> 2	Practical Content: 1 h	r				
GENEI	RAL OBJECTIVE 1.0: Unde	erstand the basic concep	t of Renewable energy and	l its various sources					
Course	Specification:	THEC	RETICAL CONTENT	PRACTICAL CONTE	NT				
Week	Specific Learning	<b>Teachers' Activities</b>	Learning Resources	Specific Learning	Teachers'	Evaluation			
	Outcome			Outcome	Activities				
1-2	<ul> <li>1.1 Define energy</li> <li>1.2 Explain sources anduses of energy</li> <li>1.3 Explain zero-carbon orlow-carbon energy</li> <li>1.4 State the six most common types of renewableenergy sources; Solar, Wind, Hydro, Tidal etc.</li> </ul>	Explain energy, sources and usesof 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 boardText Books Internet Projector Lecture Notes			Define renewable energy			
GENEI	RAL OBJECTIVE 2.0: Und	derstand the difference b	etween Renewable and N	on-Renewable energy	-	-			
3-4	<ul><li>2.1 Define Renewable and Non-Renewable energy</li><li>2.2 State examples of common types of</li></ul>	Explain Renewable and Non-Renewable energy with examples of common types of	Laptop White boardText 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	• renewable and non- renewablesources				
GENI	ERAL OBJECTIVE: 3.0. Un	iderstand the Construction	of Solar Cells and Fabr	ication of Solar Modules a	and their Applications	
5-6	<ul> <li>3.1 Explain the conceptsof Solar Cells</li> <li>3.2 List Types of SolarCells</li> <li>3.3 Explain Generation of power from solar cells</li> <li>3.4 Explain solar cells fabrication techniques</li> <li>3.5 Explain solar module fabrication</li> <li>3.6 List various types of solar</li> </ul>	Explain conceptsof Solar Cells, Types of Solar Cells, Generationof power from solar cells, solar cells fabrication techniques 3.7 Explain solar module fabrication List various types of solar modules	Laptop White boardText Books Internet Projector Lecture Notes	fabricate solar cells	Guide student to carry out practical to fabricate solar cells	List typesof solar cells List various types ofsolar modules
	types ofsolar modules					

GENEI	GENERAL OBJECTIVE 4.0: Understand the chemistry of biodiesel									
7-9	4.1 Define biodiesel	Explain biodiesel	Lecture notes	Identify the	Guide students to:	Differentiate				
	4.2Explain sources and		Related	various sources of	-identify the	between				
	processing of bio diesel	Explain sources and	Journals and	lipids used for the	various sources of	Biodiesel and				
	4.3Explain the nature of	diesel (fatty acid	Materials	production of	lipids used for the	Petro Diesei				
	lipids especially fattyacids and glycerides 4.4Define fats and oil 4.5State the similarities	methyl ester) Explain the nature of lipids especially	Internet. Reagents such as: potassium	Biodiesel Demonstrate Transesterification	production of biodiesel -demonstrate	Outline the use of biodiesel				
	and differences of fatand oil using the chemical formular and structural	fatty acidsand glycerides Define fats and oil	hydroxide, sodium hydroxide ethanol and	conversion ofbiomass into biodiesel	transesterification process for the conversion of biomass into					
	formular 4.6 State sources and characteristics of lipids for	State the similarities and differences of fat and oil using the	sodium methoxide,		biodiesel					
	use as biodiesel feedstock and conversion	chemical formular and	biomass suchas waste cooking							
	of feedstock into biodiesel	structuralformular	oil, sugar cane							
	(transesterification)		jatrophacurcas							
	4.7Describe the use of vegetable oil (SVO)and		and mill for							
	4.8Describe the use of		grinding the							
	biodiesel		grains and							
	4.9Differentiate between Biodiesel and Petro diesel		seeds, soxhlet							
	Distribute and i etto dieser		extractor							

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

	types of fuel cells	Phosphoric acid				
	Proton exchange	fuel cells (PAFC)				
	membrane fuel	Solid oxide fuel				
	cell (PEMFC)	cells (SOFC)				
	Direct methanol	Molten carbonate				
	fuel cells (DMFC)	fuel cells (MCFC)				
	Phosphoric acid					
	fuel cells (PAFC)	Explain the				
	Solid oxide fuel	differences				
	cells (SOFC)	between batteries				
	Molten carbonate	and fuel cells				
	fuel cells (MCFC)					
	5.8 Differentiate	Explain the types of				
	between batteries	Solar cells				
	and fuel cells	Crystalline silicon				
	5.9 Define solar energy	(Poly silicon or				
	5.10 Describe the types	mono silicon) Thin				
	of Solar cells	film solar cell				
	Crystalline silicon (Poly	Organic photovoltaic				
	silicon or mono silicon)	cell				
	Thin film solar cell					
	Organicphotovoltaic					
	cell					
GENE	RAL OBJECTIVE 6.0: Under	rstand how passive solar	heating, hydro-power an	d wind power works	I	
12-14	6.1 Explain the	Explain passive	Text books Lecture	• •	• -	State the
	following- passive solar	solar heating,	notesRelated Journals			advantagesof
	heating, hydro-power	hydro-power and	and materials Internet.			passive solar
	and wind power	wind power				heating, hydro
	6.2 State how 6.1 works					power and wind
	6.3 Describe the	Describe the				power
	general	general				
	characteristics of	characteristics of				

	solar power, hydro- power andwind power 6.4 List the advantages and disadvantages of passive solar heating, hydro- powerand wind power	solar power, hydro-power and wind power List the advantages and disadvantages of passive solar heating, hydro- • power and wind power				
General	Objective 7.0 Understand t	he fundamentals of ene	ergy sustainability	1		
	<ul><li>7.1 Define energy</li><li>7.2 Define the operation of renewable</li></ul>	Explain energy as the operation of renewable	Journal, Audio visual,	• -	• -	List three (3) factors that determine energy
	<ul> <li>energy.</li> <li>7.3 Explain</li> <li>sustainability interms of</li> <li>basic electrical and</li> <li>physical principles</li> <li>7.4 List three (3)</li> <li>factors thatdetermine</li> <li>energy sustainability</li> <li>7.5 Describe how plant</li> <li>materials (Biomass) are</li> <li>renewable and</li> <li>sustainable inthe</li> <li>following e.g;</li> <li>(a) The conversion of</li> <li>waste plant materials or</li> <li>animal manure to</li> </ul>	<ul> <li>energy.</li> <li>Explain</li> <li>sustainability in</li> <li>terms of basic</li> <li>electrical and</li> <li>physical</li> <li>principles</li> <li>Explain three (3)</li> <li>factors that</li> <li>determine energy</li> <li>sustainability and</li> <li>how plant</li> <li>materials</li> <li>(Biomass) are</li> <li>renewable and</li> <li>sustainable in the</li> </ul>	Related textbooks.			sustainability

	methane gas by	following e.g;				
	anaerobic bacteria, and	(a) The				
	the methane gas is	conversion of				
	burned eitherfor heat or	waste plant				
	to make electricity.	materials or				
	(b)The conversion of	animal manure to				
	grain such as corn to	methane gas by				
	ethanol through sugar	anaerobic				
	fermentation And how	hacteria and the				
	the ethanol is mixed	methane gas is				
	with gasoline or fossil	burned either for				
	fuel before being burned	heat or to make				
	in an automobile	electricity				
	in an automobile.	(b) The				
		(0) The				
		grain such as corn				
		to otherol				
		to ethanol				
		throughsugar				
		termentation.				
		Andhow the				
		ethanol ismixed				
		with gasoline or				
		fossil fuel before				
		being burned in				
		an automobile.				
Genera	<b>Objective 8.0</b> Understand the	e main concepts of susta	inable energy management	nt		
	8.1 Explain	Explain items8.1-	Journal, Audio	■ _	■ _	Explain Energy
	sustainableenergy	8.4				managementand
	management.		visual,			environment
	-		Related textbooks			
	8.2 Explain		iterated textbooks.			

Energy management and environment			
8.3 Differentiate between renewable and sustainableenergy.			
8.4 Describe when is energysaid to be sustainable			

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
COURSE: Pests and Pest Control	CODE: ESM 224	Credit Unit: 3.0	CONTACT HOURS: 3 HOU	RS/WEEK			
<b>GOAL:</b> This course is designed to enable student	s understand Pests and	Pests' Control in environme	ent				
YEAR: TWO (2), SEMESTER: TWO (2)	PRE-	PRACTICAL: 2 HOURS/WEEK					
	<b>REQUISITE:</b>						
	none						
GENERAL OBJECTIVES							
On completion of this course, the Student should b	be able to:						
1.0 Know the agents called pests and di	seases spread by them	in our environment					
2.0 Know how to identify animals, crop	s, persons and environ	ment suffering from pest inf	estations				
3.0 Understand the menace and damage	caused by pests						
4.0 Understand the various ways of cont	rolling pests and pests	' diseases					
5.0 Know agents and techniques of gene	eral pest control in spec	cial environments like airpor	ts, beaches and parks.				
6.0 Understand safety precautions, protective equipment, recognition of the early signs and symptoms of poisoning, first aidresuscitation measures.							

PROGE	PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
<b>Course:</b>	Pests and Pest Control	C	Course Code: ESM 224	Credit Unit: 3.0		<b>Contact Hours:</b> 3	
<b>GOAL:</b>	This course is designed to enable	e students understand Pests	s and Pests' Control in env	vironment			
Course	Specification:	THE	ORETICAL CONTENT	PRACTICAL CO	NTENT		
General	Objective 1.0: Know the agents	called pests and diseases s	pread by them in our envi	ronment			
Week	Specific Learning Outcome	<b>Teachers' Activities</b>	Learning Resources	Specific Learning	Teachers'	Evaluation	
				Outcome	Activities		
1-2	<ul> <li>1.1 Define Pests</li> <li>1.2 List examples of pests and pests' diseases relevant to the environment</li> <li>1.3 Explain internal and external pathogens e.g. bacteria; fungi; viruses.</li> <li>1.4 Explain the role of mice, rodents, birds, snakes, roaches' pests as agentsof diseases.</li> </ul>	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 seaportsetc	Text Books Internet Computer systems Projector Audio VisualsLive 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 ofpests	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	General Objective 2.0 Know how to identify animals, crops, persons and environment suffering from pest infestations						
General 4-5	Objective 2.0 Know how to iden 2.1 List types of pest infestation and diseases in crops and animals.	<ul> <li>tify animals, crops, persons</li> <li>List types of pest infestation and diseases in crops and animals.</li> </ul>	s and environment sufferir Textbooks Internet Audio visuals Specimen ofcrops and animals afflicted with pest infestations and diseases. Farms, ponds	ng from pest infestati Identify types of infestations caused by pests in crops and animals Carry out a case study in an environment infestedwith pest transmitted diseases	ons Guide students to: -identify types of infestations causedby pests in crops and animals -carry out a case study in an environment infested with pest	Describe the appearance of pest infestation in animals	
					Diseases		
GENER	AL OBJECTIVE 3.0: Understar	d the menace and damage	caused by pests	I	I		
	3.1 Describe the life cyclesof	Explain the life	Audio Visuals	Draw the life	Guide students to	Mention damages	
6-7	pests.	cycles of pests.	Internet and	cycles ofvarious pests	draw the life cycles of various	causedby pests of various types	
	3.2 Describe how knowledge	Explain which stage in	computers Farms,		pests		
	of infective stages in the life	life cycles is infective, and cancause damage	ponds,				
	cycles ofpests is important in	to hosts.	projectors, animal				
	pest control.	Explain the menaceand damage causedby pests	treatment centres etc				

	Describe the menaceand damage caused by pests.	Mention damages caused by pests of various types						
GENER	GENERAL OBJECTIVE 4.0 Understand the various ways of controlling pests and pests' diseases							
	4.1 State the control	Explain control	Crop fields,	Carry out	Guide student to:	Mention various factors		
8-10	techniques against pests.	techniques againstpests	livestock and	elimination of alternative host	-carry out elimination of	considered in biological pests control method		
	4.2 Describe how to carryout	Describe how to	environments	using anyone	alternative host	Pesso connormentor		
	elimination of alternative	carry out elimination of alternative host	afflicted with	or combination of techniques	using any one or combination of			
	host plants.	plants	infestation pest	in the control	techniques in the			
	4.3 Describe cultural methods	Explain the various	diseases	of pests	control of pests			
	adopted in controlof various	factors considered in			conduct elimination			
	pests emphasizing their	biological pests control method	Farms using cultural practices. Native	Conduct elimination	experiment in controlled			
	significance.		varieties of	experiment in	environment of the			
	4.4 Mention various factors	Explain various factors	crops/animals	controlled environment of the	Green House to verify the efficacy o	f		
	considered in biological pests	considered inbiological		GreenHouse to	technique.			
	control method	pests control method.		verify the efficacy of technique.				
	4.5 Describe integrated or	Describe biological pests						
	mixed pest control	control method						
	management involving more	• a a vacaines and series						
	than one method, named:	used in controlling pest						
	- biological method	anddiseases						
	- cultural method -etc.							

GENERAL OBJECTIVE 5.0: Know agents and techniques of general pest control in special environments like airports, beaches and							
parks.							
GENEI parks. 11	<b>RAL OBJECTIVE 5.0:</b> Know ag 5.1 Describe the general treatment regimen and procedure for control ofpest diseases in animalsand plants 5.2 Name fumigants and various pesticides used in disinfesting animals, humans and their habitations including churches, mosques, as they taxi on the tarmac, take off or land at the airports. 5.3 Describe the types of dangers that pests and human trespassers cause atairports	Explain pest diseases control programs such asfumigation. Explain the general treatment regimenand procedure for control of pest diseases in animal and plants. Explain fumigantsand various pesticides used in disinfesting animals, humans and their habitations Explain control techniques of pestand diseases in special	ral pest control in specia Videos, projectors and slides, text books, computer systems, internet Organic and inorganic fumigants, insecticides, herbicides, acaricides, used for pests of cropsand animals	l environments like a Practice use of the various techniques in pest control in air travelling Carry out spraying in specified environment using effective remedy fortarget pest	Guide student to: -practice use of the various techniques in pest control in airtravelling carry out sprayingin specified environment usingeffective remedy for target pest	d Describe the general treatmentregimen and procedure for control of pest diseases in animals and plants	
	such as:	diseases in special environments like					
	<ul> <li>physical damage to external body of aircrafts</li> <li>birds and insects are sucked into the engine</li> <li>reduced visibility by large numbers of migratory birds and</li> </ul>	airports, harboursand recreational areas such as beaches and parks Explain various Vertebrate pests in aerodromes.					

insects			
physical occupation of			
tarmacoffices etc.	Enumerate varioustypes		
	of pests and how they		
5.4 Describe ways of	pose danger to aircrafts		
controlling pest in special	and personnel.		
environments like airports,			
harbours and recreational			
areas such asbeaches and			
parks			
5.5 Name vertebrate pestsin			
aerodromes e.g. stray			
animals/livestock (cattle,			
goats and sheep, pets likecats			
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			
5.6 Explain how animals and			
humans constitute huge			
menace to aeroplanes			

General Objective 60: Understand safety precautions, protective equipment, recognition of the early signs and symptoms of poisoning, first aid resuscitation						
measure	es.					
12-13	6.1 Describe process of fumigation to adopt in any given environment.	Explain process of fumigation to adoptin any given environment.	Text books Computer systems Internet	Carry out fumigation of any given	Guide students to: -carry out fumigation of	Explain processof fumigation toadopt in a givenenvironment.
	6.2 Explain choice of fumigant and safety measures put in place in event of misuse by staff	Explain type of chemical and choice of preventive and control methods	Projector Samples of fumigants Sprays, Blowers, Dusters, Bellows	Carryout the	any given environment	
	<ul> <li>6.3 Explain how</li> <li>mishandling of fumigantscan be injurious to staff</li> <li>6.4 Enumerate the precautions necessary for safe use of pesticides.</li> <li>6.5 List the hazards of pesticide use, to man and environment.</li> <li>6.6 Explain the first aid procedures to be adopted in case of pesticide poisoning of humans.</li> </ul>	Explain various ways the choice of chemical in the prevention and control of pests and diseases can become injurious tohandlers Explain process of fumigation to adoptin a given environment. • Explain type of chemical and choice of preventive and control	Samples pesticides formulation	maintenanceof basic pesticides equipment.	carryout the maintenance of basic pesticides equipment	
	<ul><li>6.7 Describe the precautions</li><li>to be taken inpesticide</li><li>transportation and storage.</li><li>6.8 Describe the</li><li>maintenance of pesticide</li><li>equipment</li></ul>	metnous				

PROGRAMME: NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
COURSE: Analytical Laboratory Skills II	CODE: ESM 225	Credit Unit: 3.0	<b>CONTACT HOURS:</b> 3 HOURS/WEEK				
GOAL: This course is designed to expose the stude	ents to laboratory techr	niques that will enable the least	arner to become competent in thefollowing				
areas: solubility test, filtration methods, extraction	techniques and spectro	photometer analysis					
YEAR: TWO (2), SEMESTER: TWO (2)	PRE-	PRACTICAL: 3 HOUR	S/WEEK				
	<b>REQUISITE:</b>						
	none						
CENEDAL ODIECTIVES	•	•					

## **GENERAL OBJECTIVES**

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

- 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 asimple 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							
COURS	SE: Analytical Laboratory Skills I	I	Course Code: ESM 225	Credit Unit: 3.0		<b>Contact Hours:</b> 3	
GOAL	This course is designed to expose	e the students to laborator	y techniques that will enabl	e the learner to becor	ne competent in th	efollowing areas:	
solubili	solubility test, filtration methods, extraction techniques and spectrophotometer analysis						
Course	Specification:	TH	EORETICAL CONTENT	PRACTICAL CO	NTENT		
Gener	al Objective 1.0: Demonstrate sk	tills in separation techniq	ues, solubility test, function	al group analysis, and	l measurement of		
radioact	ivity using counters						
Week	Specific Learning Outcome	<b>Teachers' Activities</b>	Learning Resources	Specific Learning	Teachers'	Evaluation	
				Outcome	Activities		
1-2			Equipment Apparatus PolarimeterLab coat Coverall Practical note, etc.	<ul> <li>1.1 Carry out separation of mixtures for (Determination of total dissolved solids in water samples).</li> <li>1.2 Identification of anions in solution.</li> <li>1.2 Carry out solubilitytest and plot solubility curve.</li> <li>1.4 Determine the levelof hardness in water using Soap solution</li> </ul>	Guide student to conduct items 1.1-1.9	State how solubility test isbeen carried out State how to determine the concentration of optical active compounds usinga polarimeter	

1.5 Carry out acid/base
titration.
1.6 Carry out
redoxtitration
1.7 Determine the
concentration of
opticallyactive
compounds
using a
Polarimeter.
1.8 Carry out
functional
group analysis
(-OH, COOH,
C=), sp, Sp2,
Sp3,etc)
1.9 Carry out
measurement of
radioactivity
using
Counters

General Objective 2.0 Select and use suitable filtration methods to separate solids from liquids, and carry out liquid - liquid extraction						
4-5	•	EquipmentLab	2.1 Carry out a	Guide student to	Describe vacuum	
		coat, Coverall, Practical noteetc.	vacuum filtration apparatus using aBuchner funnel.	conduct items 2.1-2.7	filtration apparatus	
			2 Filter and wash precipitates from solutions using vacuum filtration (Buchner funnel).			
			2.3 Recognize gravity filtrations and syringe filters as being two commonly used methods for separating solids from liquids.			
			<ul><li>2.4 Safely operate a separatory funnel.</li><li>2.5 Choose the correct size of</li></ul>			
						-
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				separatory funnel with respect to the volumeof 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					purities, and	
determin	nation of the boiling points of the r	nain chemical present in th	e mixture by measuring it	s boiling during asin	ple distillation.	
		•	EquipmentLab	3.1 Assemble	Guide student to	Describe distillation
67			coat, Coverall,	laboratory	conduct items	apparatus
0-7				glassware and	3.1-3.5	
			Practical noteetc.	operate a Simple		State how tomeasure
				distillation		atmosphericpressure
				apparatus.		
				3.2 Determine		
				the boiling		
				point of the		
				purified chemical		
				present in an		
				impure organic		
				solution ofter Simple		
				distillation		
				ansumation.		

3.3 Measure atmospheric pressure.
3.4 Create a distillation graph from the data for the Simple distillation of an organic solution. 3.5 Calculate the boiling point of an organic mixture measured by distillation to its
equivalent boiling point at760 mm
Hg.

General Objective 4.0: prepare and label standard solutions for use in chemical analyses.				
General Objective 4.0: prepare and label         8-10	standard solutions for use in chemical analyses.     Practical notes	<ul> <li>4.1 Calculate the amountof chemicals required to prepare various standard solutions.</li> <li>4.2 Prepare weight/volum e standard solutions by serial dilution.</li> <li>4.3 Prepare a % weight/volume standard solution from a primary standard grade chemical.</li> <li>4.4 Label all solutions prepared for use in the laboratory in accordance with WHMIS</li> </ul>	Guide student to conduct items 4.1-4.6	Calculate the weight/volume of a standard solution
		guidelines by completing a worksitelabel		

Ceneral	<b>Objective 5 0:</b> Determine the con	centration of a colored solut	ion using Spectrophotor	for each solution prepared. 4.5 Submit solutions for testing and store solutions for later use. 4.5 Express the amount ofa chemical present in asolution in common units of concentration.		
General	Objective 5.0: Determine the con	centration of a colored solut	ion using Spectrophoton	neter.		
11			Equipment Lab coat, Coverall, Practical note	<ul> <li>5.1 Operate a Spectronic 20D+</li> <li>Spectrophotom eter.</li> <li>5.2 Identify the proper care of cuvettes.</li> <li>5.3 Measure the %T of a solution.</li> <li>5.4 Calculate the Absorbance of</li> </ul>	Guide student to conduct items 5.1-5.6	Describe how to operate a spectronic 20D+ spectrophotometer

a solutionfrom its measured %T value
5. 5 Determine the
concentration of
unknown solutions using
a Spectronic
20D+ instrument.
5.6 Use back
calculationsto determine the
mass of analyte
in the original samples

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

S/N	Description of item	
Α	WATER and WASTE-WATER LABORATORY	
	Toxic gas monitor with accessories for CO, NO, NO2, H2S	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 $150 \times 10^{\circ}$ C, 140mm length of scale, accuracy +5	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
10	1 mbar, Temperature range – 20 to 60oC, Battery Operated	
11	Meteorological station( equip with weather equipment)	1
12	Bio-system kit covering experiments on respiration, Photosynthesis,	1
	transpiration, osmosis, enzymes, And gas analysis	
13	Electric Clinostat, 220 – 240V, 50 - 60 Hz, SW.	2no.(each)
14	Toxic gas monitor with accessories for CO, NO, NO2, H2S	1no.each
15	Sound level indicator with analogue displaymeasuring 40-120Db	2no
16	Water quality meter to measure p , conductivity/Salinity, dissolved	1no.
	oxygen, temperature and turbidity (Conductivitymeter)	
17	Water quality field test kit covering the following tests:-	2no
	<ul> <li>Alkalinity, 0.5 – 8ppm</li> <li>Chloride, 2 – 100 ppm</li> </ul>	

	Hardness, 2 – 100 ppmSulphite, 2 - 50 ppm	
18	Water Colorimetric field test kit covering the following test:-	1no.
	1.0 Ammonia/Nitrogen 0.5 8 ppm	
	2.0 Chloring (DED), $0.1 - 8$ ppm	
	2.0 Chromata 5 $40$ npm	
	4.0 Iron $0.1$ 10 ppm	
	4.0 $101, 0.1 - 10 \text{ ppm}$ 5.0 <b>PH</b> (wide range) 3 10	
	5.0 Phoenhate ortho 0 4 nnm; 5 250 nnm	
	$7$ $z_{10} = 0.5$ $z_{10} = 10$ npm	
10	$\sum_{i=1}^{n} (i, j) = 10 \text{ ppm}.$	1
19	water titrimetric field test kit covering thefollowing test:-	Ino.
	• 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)	
В	ENVIONMENTAL BIOLOGY LABOATORY	
	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( plstic/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 variouscapacities)	
25		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
С	CHEMISTRY LABORATORY	
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	Hydrology Laboratory	
	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:	30NO
	- general purpose grade 2 impact	
		15no.
2	Eye protection goggles:	15no.each
	<ul> <li>grade 2 impact</li> <li>chemical, type C</li> <li>dust, type D</li> <li>gas, type G</li> </ul>	
	molten metal, type M	

3	Face shields:	5 each
	-grade 2 impact. C resistance	
	- grade 2 impact, C and M resistance	
	-grade 1 impact, C and M resistance	
	-Ultraviolet	
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:	Assorted
	sterile types	(1strream of
	- non-sterile types Heat/cold resistance type	30students)
10	Hazard warning labels:	1no symboleach
-		
	- Chemical (corrosive, flammable, irritant, toxic)	
11	- general (laser beam, radiation, radioactive, toxic)	(1, (1, 20)
11	Protective coats:	(1steam of 30
	- flame retardant	students)
	chemical resistant	
12	Dust/mist/fumes masks	5 each
13	Respirators:	
	dust/mist type	2pack
	- uusviinist type	2
	- nuisance odor	3
	- organic vapour	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:-	1
	<ul> <li>Pocket Stereoscope</li> <li>Mirror Stereoscope</li> <li>Dual mirror Stereoscope</li> </ul>	
2.	Densiometer	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:	30NO
	- general purpose grade 2 impact	

		15no.
2	Eye protection goggles:	15no.each
	<ul> <li>grade 2 impact</li> <li>chemical, type C</li> <li>dust, type D</li> <li>gas, type G</li> <li>molten metal, type M</li> </ul>	
3	Face shields:	5 each
	-grade 2 impact, C resistance - grade 2 impact, C and M resistance	
	-grade 1 impact, C and M resistance -Ultraviolet	
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 (1strream of 30students)
10	Hazard warning labels:	1no symboleach
	- Chemical (corrosive, flammable, irritant, toxic) general (laser beam, radiation, radioactive, toxic)	
11	Protective coats:	(1steam of 30students)
	- flame retardant	

	chemical resistant	
12	Dust/mist/fumes masks	5 each
13	Respirators:	
	<ul> <li>dust/mist type</li> <li>mercury vapour type</li> <li>nuisance odor</li> <li>organic vapour</li> <li>acid gas</li> </ul>	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:-	1
	<ul> <li>Pocket Stereoscope</li> <li>Mirror Stereoscope</li> <li>Dual mirror StereoscopeInterpretoscope</li> </ul>	
2.	Densiometer`	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	1. Guide student to carry out practical on	
organism	the identification of short and long-	
	life span organism	
2. carry out practical on plant and	2 Guide the student to carry out	
animals' population density	practical on plant and animals'	
	population density	
3 carry out practical to identify types of	3. Guide student to carry out practical to	
soil profile.	identify types of soil profile	
4 carry out practical to determine	4. Guide student to carry out practical to	
species diversity of a group of	determine species diversity of a group	
organisms using Simpson index	of organisms using Simpson index	
5 Identify different ecological	5. Guide the student on how to identify	
communities	different ecological communities	
COURSE: INTRODUCTION TO GEOGRA	PHY CODE: ESM 113	
6 Identify special featureson igneous	6. Guide students toidentify special	
rocks.	features on igneous rocks	
7 Identify special featureson	7. Guide studentsidentify special	
metamorphic rocks.	features on metamorphic	
8. Identify special featureson	9. Guide students to identify special	
sedimentary rocks.	features on sedimentary rocks.	
9 Determine porosity and permeability	8 Guide students to determine porosity	
of rock	and permeability of rock	
10 Identify recharge and discharge	10. Guide students to:	
areas	- identify rechargeand discharge	
	areas	

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

2.5 Take Inventory of assigned locker and drawer.	
2.6 Identify pieces of common laboratory 17. equipment.	
3.7 Calibrate two differenttypes of electronic analytical balances.	Guide students to perform 3.1-3.8
3.8 Compare the ease and accuracy of weighing on analytical and top loading balances.	
3.9 Compare the weight of the same object measured on two different analytical balances.	
<ul> <li>3.10 Weigh out a sample on an analytical balance using two different techniques:</li> <li>"weigh a sample by tarring the container" and "weigh asample in a weigh boat and quantitatively transfer to a container".</li> <li>3.11 Demonstrate weight loss, over time, due to traceamounts of moisture on</li> <li>3.9 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.</li> </ul>	
3.10 Identify when it is appropriate to use a "top loading" or "analytical" balance to	

weigh objects orsamples.	
<ul><li>3.11 Select the correct type of electronic balance to use for a weighing procedure and calculate the acceptablerange of mass values for an individual sample weighed on an</li><li>18. Electronic balance.</li></ul>	
<ul> <li>4.4 Calibrate a conductivitymeter.</li> <li>4.5 Measure the electrical conductivity of some solutions.</li> <li>4.6 Measure the conductance of brine waterstandards and graphically determine the NaCl concentration of an unknown sample.</li> <li>3.12 Determine The accuracyand precision of the Analyses</li> </ul>	Guide students to perform 4.1-4.4
5.6 Estimate the pH of asolution using $P^{H}$ paper.	Guide students to perform 5.1- 5.5
5.7 Measure the $P^H$ of different solutions at different temperatures and observe the effect of temperature on the $P^H$ value.	
5.8 Perform a "2-point calibration" to calibrate apH meter using 2 buffer solutions, each with a different pH value.	
5.9 Titrate a solution that contains an unknown amount of hydrochloric acidto	

determine its concentration using a and pH meter.	
5.10 Plot a graph of a data of a titration using the "paralleltangent" method to determine the endpoint of the titration and use the value to calculate the concentration of hydrochloric acid in an unknown solution.	
6.1 Interpret the meaning ofmarkings found on examples of common laboratory volumetric glassware.	Guide students to perform 6.1- 6.6
6.2 Examine laboratory glassware for cleanlinessand select the correct method to remove the contamination present.	
6.3 Inspect volumetric glassware for cleanlinessusing the water bead test.	
6.4Transfer an accuratevolume of liquid using avolumetric pipet.	
<ul><li>6.5Precisely Transfer an accurate</li><li>volume of liquidusing a micro-pipet.</li><li>6.6 Prepare a burette and perform acid- base titrations.</li></ul>	
COURSE: ENVIRONMENTAL CHEMIST	<b>TRY ICODE: ESM122</b>
1. Identify fresh water and ground water	Guide students to -identify fresh water and ground water
2. Determine the BOD, COD, DO, pH, and PE of fresh water and ground water etc.	-determine the BOD, COD, DO, pH, and PE of fresh water andground water etc

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

5. Use instruments to measure different forms of precipitation and how they	-use instruments to measure different forms
are used.	of precipitation and now they are used.
6. Identify the components of	Guide students to identify the components of
hydrograph and itsapplications	hydrograph and itsapplications
7. Identify the methods of measuring	Guide students to demonstrate the use of
streamflow	current meter, float and velocity rod in
	measuring stream flow.
8. Demonstrate the use of current meter,	
floatand velocity rod in measuring $\tilde{a}$	
stream flow.	
9. Identify flood sites	Guide students to:
10. Show the massible immedia of flood	-identify flood sites
10. Show the possible impacts of flood	show the possible impacts of flood
11 Determine the methods of flood	-snow the possible inpacts of nood
control	determine the methods of floodcontrol
COURSE: INTRODUCTION TO GEOG	RAPHIC CODE: FSM 125
1 Identify the parts of a total station	Guide students to:
1. Rentify the parts of a total station	-identify the parts of a total station
2. Set up and level a total station over a	
point	-set up and level atotal station over apoint
F	-measure
3. Measure horizontal anglesby repetition	horizontal anglesby repetition
	-record
4. Record observations in	observations instandard field notes format
standard field notesformat	
standard notosionnat	
5. Use the total Station to measure the	Guide students to:
5. Use the total Station to measure the zenith angleand the slope distance	Guide students to: -use the total Station to measure the zenith
<ul> <li>5. Use the total Station to measure the zenith angleand the slope distance between 2 points</li> </ul>	Guide students to: -use the total Station to measure the zenith angle and the slope
<ul> <li>5. Use the total Station to measure the zenith angleand the slope distance between 2 points</li> </ul>	Guide students to: -use the total Station to measure the zenith angle and the slope distance between 2points record the

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

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

35. Interpret GIS	
data for land monitoring andprediction.	
36. Interpret GIS	
data for vegetation monitoring and	
37. prediction.	
COURSE: ENVIRONMENTAL SAMPLIN	NG AND ANALYSIS CODE: ESM 126
1. Identify types of interferences that are	Guide students to identify types of
present in sample matricescollected	interferences that are present in sample
from the environment and their	matrices collected from theenvironment and
effects on analyses	their effects on analyses
2. Choose the best samplingstrategy for	Guide students tochoose the best sampling
a given situation	strategyfor a given situation
3. Determine the type of sampling plan	Guide students to determine the typeof
required ina given situation	sampling plan required in a givensituation
4. Select the correct preservation	Guide studentsto:
technique and holding time for givena	-select the correctpreservation technique
water sample. Select the correct	and holding time forgiven a water sample.
preservation techniqueand holding	-select the correct preservation technique
time for agiven a soil sample	and holding time for a given a soil sample
5. Identify the unique properties of ground	Guide students to:
waterand how they can interfere with the	-identify the unique properties of ground
collection of a representative ground	water and how they caninterfere with the
water sample.	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	Guide students to demonstrate use ofsoil
equipment and containers to use for	sieve for soil particle size
soilsampling	Guide Students toanalyze soil samples
8. Perform soil analysis	

9. Identify examples of natural and	Guide students to:
anthropogenicsources of air pollution	-identify examples of natural and
and some of the effects on the	anthropogenic sources of air pollution and
environment from air pollution.	someof the effects on the environment from
	air pollution.
10. Identify the four types of decisions that	
can be madefrom the study of air	-identify the four types of decisionsthat
pollution and the environment	can be made
	from the study of air pollution and the
11. Identify different mechanisms of	environment
operationsused in air sample collection	
equipment to collect individual air	-identify different mechanisms of operations
pollutants or categories from the	used in air sample collection equipment to
environment	collect individual air pollutants or categories
	from theenvironment
12. Measure the concentration of pollutant in	Guide the studentsto measure the
a given environmental sample	concentration of pollutant in a given
	environmental sample
13. Minimize the amount oferror in	Guide students to:
measurements through the application	-minimize the amount of error in
and execution of qualitycontrol	measurements through the application and
practices.	acquire data that is valid and legally
14. Acquire data that is validand legally	defensible
defensible	
15. Identify what a chain ofcustody is	Guide students to identify what a chain of
FIDST CMESTED VEAD TWO	custody is
FIRST SWIESTER YEAR I WU	ON AND CONTROL CODE, ESM 214
1 Visit local collusted sites	A accompany student to visit local polluted
1. VISITIOCAL POLITICA SILES	sites
2 Guida students to identify the major	Describe the steps involved in the evolution
2. Outlet students to identify the inajor constituents found in the raw oil and gas	foroil and gas denosits in Nigeria
mixtures	toron and gas deposits in Migeria.
matures.	

3. Identify videos on oil exploration,	Demonstrate to student using videos on oil
drilling and petroleum phase production	exploration, drilling and petroleum phase
	production
COURSE: ENVIRONMENTAL ASSESSM	ENT CODE: ESM 215
1 Prepare samples of E.I.A.,	Guide students to:
E.A. document formats.	-prepare samples of E.I.A., E.A.
	document formats.
2. Prepare samples of environmental	
contractdocuments.	prepare samples of environmental contract
	documents.
3. Organise the following:	Guide students toorganize the following:
- Effective publicparticipation	- Effective public participation
- Public information and involvement	- Public information and involvement
- Participation as agroup member	- Participation as a group member
4. Benefits from an effective public	Benefits from aneffective public
participation programme	participation programme
5. Prepare an environmentalassessment	Guide students to -prepare an
(EA) document from results of the	environmental assessment (EA) document
impact analysis.	from results of the impact analysis.
6. Prepare a documentreview of an	prepare a document reviewof an
environmental Assessment Project.	environmental Assessment Project.
<b>COURSE: Environmental Monitoring</b>	CODE: ESM 216
1. Identify indicators of water pollution	Guide studentsto identify indicators of
- BOD 20°C	water pollution
$- \text{COD}^5$	- BOD 20°C
- nitrates	$- \text{COD}^5$
-phosphates	- nitrates
-total coliforms	-phosphates
fecal strep	-total coliforms
	fecal strep
2 Determine thefollowing monitoring	Guide students to determine thefollowing:

strategy:	-Limits and acceptance level (often basedon
-Limits and acceptance level (often based	the products type)
on the products type)	Decide what specifically should be
-Decide whatspecifically should be	monitored Guide students to determine the
monitored	frequency of monitoring Guide students to
-Evaluate the frequency of monitoring	identify problem areas
3. Identify problem areas	
4. Carry out awareness campaigns on the	Guide studentsto:
effects of pollution	carry out awareness campaigns on the effects
5. Carry out inspection visits	of Pollution
(monitoring)to remind potential	
pollutants of their obligation tosociety	-carry out inspection visits(monitoring) to
	remind potential pollutants of their
6. Identify the existence of air, water or	obligation to society
soil pollution	
	-identify the existence of air, water or soil
	pollution
COURSE: ENVIRONMENTAL CHEMIS	-identify the existence of air,water or soil pollution <b>TRY II CODE: 217</b>
COURSE: ENVIRONMENTAL CHEMIST 7. Carryout experiment on	-identify the existence of air, water or soil pollution <b>RY II</b> CODE: 217 Guide students to:
COURSE: ENVIRONMENTAL CHEMIS 7. Carryout experiment on 1.1 using black substances and some	-identify the existence of air, water or soil pollution <b>TRY II CODE: 217</b> Guide students to: -carryout experiment on 1.1using black
COURSE: ENVIRONMENTAL CHEMIS 7. Carryout experiment on 1.1 using black substances and some materials	-identify the existence of air, water or soil pollution <b>TRY II CODE: 217</b> Guide students to: -carryout experiment on 1.1using black substances and some materials
<ul> <li>COURSE: ENVIRONMENTAL CHEMIS</li> <li>7. Carryout experiment on <ol> <li>1.1 using black substances and some materials</li> </ol> </li> <li>7. Visit greenhouse sites and record the</li> </ul>	-identify the existence of air, water or soil pollution <b>RY II CODE: 217</b> Guide students to: -carryout experiment on 1.1using black substances and some materials visit greenhouse sites and record the effect
<ul> <li>COURSE: ENVIRONMENTAL CHEMIST</li> <li>7. Carryout experiment on <ol> <li>1.1 using black substancesand some materials</li> </ol> </li> <li>7. Visit greenhouse sites and record the effect of suns on the earth surface.</li> </ul>	-identify the existence of air, water or soil pollution <b>TRY II CODE: 217</b> Guide students to: -carryout experiment on 1.1using black substances and some materials visit greenhouse sites and record the effect of sunson the earth surface.
<ul> <li>COURSE: ENVIRONMENTAL CHEMIST</li> <li>7. Carryout experiment on <ol> <li>1.1 using black substancesand some materials</li> </ol> </li> <li>7. Visit greenhouse sites andrecord the effect of suns on the earth surface.</li> <li>8. Ouantify (using the value of O) global</li> </ul>	-identify the existence of air, water or soil pollution <b>RY II CODE: 217</b> Guide students to: -carryout experiment on 1.1using black substances and some materials visit greenhouse sites and record the effect of sunson the earth surface. Guide students to Ouantify (using the
<ul> <li>COURSE: ENVIRONMENTAL CHEMIST</li> <li>7. Carryout experiment on <ol> <li>1.1 using black substancesand some materials</li> </ol> </li> <li>7. Visit greenhouse sites andrecord the effect of suns on the earth surface.</li> <li>8. Quantify (using the value of Q) global energy use for developed and</li> </ul>	-identify the existence of air, water or soil pollution <b>TRY II CODE: 217</b> Guide students to:       -carryout experiment on 1.1using black substances and some materials         visit greenhouse sites and record the effect of sunson the earth surface.       Guide students to Quantify (using the value of Q) global energy use for developed
<ul> <li>COURSE: ENVIRONMENTAL CHEMIST</li> <li>7. Carryout experiment on <ol> <li>1.1 using black substancesand some materials</li> </ol> </li> <li>7. Visit greenhouse sites andrecord the effect of suns on the earth surface.</li> <li>8. Quantify (using the value of Q) global energy use for developed and developing countries, compare proven</li> </ul>	-identify the existence of air, water or soil pollution <b>RY II CODE: 217</b> Guide students to:       -carryout experiment on 1.1using black substances and some materials         visit greenhouse sites and record the effect of sunson the earth surface.       Guide students to Quantify (using the value of Q) global energy use for developed and developing countries, compareproven
<ul> <li>COURSE: ENVIRONMENTAL CHEMIST</li> <li>7. Carryout experiment on <ol> <li>1.1 using black substancesand some materials</li> </ol> </li> <li>7. Visit greenhouse sites andrecord the effect of suns on the earth surface.</li> <li>8. Quantify (using the value of Q) global energy use for developed and developing countries, compare proven and estimated energy reserves from</li> </ul>	-identify the existence of air, water or soll pollution <b>RY II CODE: 217</b> Guide students to:       -carryout experiment on 1.1using black substances and some materials         visit greenhouse sites and record the effect of sunson the earth surface.       Guide students to Quantify (using the value of Q) global energy use for developed and developing countries, compareproven and estimated energy
<ul> <li>COURSE: ENVIRONMENTAL CHEMIST</li> <li>7. Carryout experiment on <ol> <li>1.1 using black substancesand some materials</li> </ol> </li> <li>7. Visit greenhouse sites andrecord the effect of suns on the earth surface.</li> <li>8. 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</li> </ul>	-identify the existence of air, water or soll pollution <b>TRY II CODE: 217</b> Guide students to:       -carryout experiment on 1.1using black substances and some materials         visit greenhouse sites and record the effect of sunson the earth surface.       Guide students to Quantify (using the value of Q) global energy use for developed and developing countries, compareproven and estimated energy reserves from different sources (including
<ul> <li>COURSE: ENVIRONMENTAL CHEMIST</li> <li>7. Carryout experiment on <ol> <li>1.1 using black substancesand some materials</li> </ol> </li> <li>7. Visit greenhouse sites andrecord the effect of suns on the earth surface.</li> <li>8. 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</li> </ul>	-identify the existence of air, water or soil pollution <b>RY II CODE: 217</b> Guide students to:       -carryout experiment on 1.1using black substances and some materials         visit greenhouse sites and record the effect of sunson the earth surface.       Guide students to Quantify (using the value of Q) global energy use for developed and developing countries, compareproven and estimated energy reserves from different sources (including ethyl hydrates), andrelate this information

dioxide	releases of carbondioxide
9. Identify hazardous wastesas ignitable,	Guide students to identify hazardous wastes
corrosive, toxic or radioactive.	as ignitable, corrosive, toxic or radioactive.
10. Carry out a test of organicmatter in the	Guide students toCarry out test of organic
soil.	matter in the soil.
11. Test soil samples for acidity,	Guide students totest soil samples for
alkalinity and element.	acidity, alkalinity and element.
12. Determine soil elements	Determine soil elements e.g. Ca++, P, K,
e.g. Ca++, P, K, Zn,Al3+ Na++ etc.	Zn,
	Al3+ Na++ etc
13. Visit various ecological areas around the	Guide students to:
school. Report your findings with	-visit various ecological areas around the
reference to pollution, effects of	school.Report your findings with reference
activities of manon the environment etc.	to pollution, effects of activities of man on
	the environment etc.
14. Determine dissolved oxygen (DO),	
PH, Acidity and alkalinity ofwater.	-determine dissolved oxygen(DO), PH,
	Acidity and alkalinity of water.
15. Determine pH, suspendedsolid, BOD	
etc.	determine pH, suspended solid, BOD etc.
16. Carry out BOD test and list important	-carry out BODtest
uses Of BOD test.	•
COURSE: WATER AND WASTEWATER	<b>TREATMENTCODE</b> : ESM 218
1. Use the concept of alkalinity and	Guide students to:
buffering	-use the concept of alkalinity and buffering
2. Use the concepts of temporary and	-use the concepts of temporary and permanent
permanenthardness	hardness
3. Use the concept of turbidity and	
its units	-use the concept ofturbidity and its units

4. wa 5. 6.	Use the concepts of conductivity and resistively data for interpreting and predicting atter problems Use the concept of colorand its units Interpret scale depositionanalysis	<ul> <li>-use the conceptsof conductivity and resistively data for interpreting and predicting waterproblems</li> <li>-use the concept of color and its units</li> <li>-interpret scale deposition analysis</li> <li>-use Langelier and Stiff-Davis methods of</li> </ul>	
1.	of scale predicting.	predicting.	
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 heavymetals, nitrate, Total suspended solids, total dissolved solids, total solids.	Guide students to Collect effluent water samples from the sedimentation, coagulation, filter and chlorination tank and perform experiments on the water samples forcolour, odor, taste, turbidity, acidity, alkalinity,hardness heavy metals, nitrate, Total suspended solids, total dissolved solids, total solids. Guide students tovisit a water treatment plant	
9.	Identify the various methods of water	Guide the student in identifying various methods of water purification	
YEAR TWO SEMESTER ONE			
COURSE: CLIMATE CHANGECOURSE CODE: ESM211			
1. 2.	Take readings of atmospheric pressure using digital and analoguebarograph Measure temperature using thermometer and thermograph	Guide students to: -take readings of atmospheric pressure using digital and analogue barograph	
	mermometer anumermograph	6 6 - T	

3.	Measure relativehumidity using hydrometer	-measure temperature usingthermometer and
4. 5.	Measure rainfall usingrain gauge Measure wind speed and direction using anemometer	thermograph -measure relativehumidity using hydrometer -measure rainfallusing rain gauge -measure wind speed and direction using
		anemometer
6.	Measure temperature using different types of thermometers	Guide students tomeasure temperature using different types of thermometers
7.	Use wet and dry bulb thermometer to compute the relative humidity	Guide students tocompute relative humidity
COURSE: SOLID WASTE MANAGEMEN		T CODE: ESM 222
1.	Analyse solid wastecollection	Guide students to:
1.	Analyse solid wastecollection systems.	Guide students to: -analyse solid wastecollection systems.
1. 2.	Analyse solid wastecollection systems. Determine solidwaste collectionroutes.	Guide students to: -analyse solid wastecollection systems. determine solid wastecollection routes.
1. 2. 3.	Analyse solid wastecollection systems. Determine solidwaste collectionroutes. Identify materials thatcan be recycled e.g. waste paper, metal scraps, X-ray materials etc.	Guide students to: -analyse solid wastecollection systems. determine solid wastecollection routes. Guide students to: -identify materials thatcan be recycled e.g. waste paper, metal scraps, X-ray materials etc.
1. 2. 3. 4.	Analyse solid wastecollection systems. Determine solidwaste collectionroutes. Identify materials thatcan be recycled e.g. waste paper, metal scraps, X-ray materials etc. Design a solid wasteutilization process	Guide students to: -analyse solid wastecollection systems. determine solid wastecollection routes. Guide students to: -identify materials thatcan be recycled e.g. waste paper, metal scraps, X-ray materials etc.
1. <u>2.</u> <u>3.</u> <u>4.</u>	Analyse solid wastecollection systems. Determine solidwaste collectionroutes. Identify materials thatcan be recycled e.g. waste paper, metal scraps, X-ray materials etc. Design a solid wasteutilization process	Guide students to: -analyse solid wastecollection systems. determine solid wastecollection routes. Guide students to: -identify materials thatcan be recycled e.g. waste paper, metal scraps, X-ray materials etc. design a solid wasteutilization process
1. 2. 3. 4. CO	Analyse solid wastecollection systems. Determine solidwaste collectionroutes. Identify materials thatcan be recycled e.g. waste paper, metal scraps, X-ray materials etc. Design a solid wasteutilization process <b>DURSE: RENEWABLE ENERGY AND</b>	Guide students to: -analyse solid wastecollection systems.determine solid wastecollection routes.Guide students to: -identify materials thatcan be recycled e.g. waste paper, metal scraps, X-ray materials etc.design a solid wasteutilization processSUSTAINABILITYCODE: ESM 223
1. 2. 3. 4. <u>C(</u> 5.	Analyse solid wastecollection systems. Determine solidwaste collectionroutes. Identify materials thatcan be recycled e.g. waste paper, metal scraps, X-ray materials etc. Design a solid wasteutilization process <b>DURSE: RENEWABLE ENERGY AND</b> fabricate solar cells	Guide students to:         -analyse solid wastecollection systems.         determine solid wastecollection routes.         Guide students to:         -identify materials thatcan be recycled e.g.         waste paper, metal scraps, X-ray materials         etc.         design a solid wasteutilization process         SUSTAINABILITY       CODE: ESM 223         Guide student to carry out practical to         fabricate solar cells
1. 2. 3. 4. <u>CC</u> 5. 6.	Analyse solid wastecollection systems. Determine solidwaste collectionroutes. Identify materials thatcan be recycled e.g. waste paper, metal scraps, X-ray materials etc. Design a solid wasteutilization process <b>DURSE: RENEWABLE ENERGY AND</b> fabricate solar cells Identify the	Guide students to: -analyse solid wastecollection systems.determine solid wastecollection routes.Guide students to: -identify materials thatcan be recycled e.g. waste paper, metal scraps, X-ray materials etc.design a solid wasteutilization processSUSTAINABILITYGuide student to carry out practical to fabricate solar cellsGuide students to:

lipids used for the production of Biodiesel 7. Demonstrate Transesterification process for the 8. conversion ofbiomass into biodiesel	various sources of lipids used for the production of biodiesel -demonstrate transesterification process for the conversion ofbiomass into biodiesel 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 differenttypes 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 animalsCarry out a case study in an environment infested with pest transimitted diseases	Guide students to: -identify types of infestations causedby pests in crops and animals
	-carry out a case study in an environment
	infested with pesttransmitted
	Diseases
4. Draw the life cycles of various pests	Guide students todraw the life cycles of variouspests
5. Carry out elimination of alternative host using anyone or combination of techniques in the control of pests	Guide student to: -carry out elimination of alternative host using any one orcombination of techniques in thecontrol of pests

<ul> <li>6. Conduct elimination experiment in controlled environment of the Green House to verify the efficacy of technique.</li> <li>7. Practice use of the varioustechniques in pest control in air travelling</li> </ul>	conduct elimination experiment in controlled environment of theGreen House to verify the efficacy of technique. Guide student to: -practice use of the various techniques in pest control in airtravelling
<ol> <li>Carry out spraying in specified environment using effective remedy for target pest</li> </ol>	carry out sprayingin specified environment usingeffective remedy for target pest
9. Carry out fumigation of any given environment	Guide students to: -carry out fumigation of any given environment
10. Carryout the maintenanceof basic pesticides equipment.	carryout the maintenance of basic pesticides equipment
COURSE: ANALYTICAL LABORATORY	SKILLS II CODE: ESM 225
<ul> <li>1.3 Carry out separation of mixtures for (Determination of total dissolved solids in watersamples).</li> <li>1.2 Identification of anions in solution.</li> </ul>	Guide student to conduct items 1.1-1.9
1.4 Carry out solubilitytest and plot solubility curve.	
1.4 Determine the levelof hardness in water using Soap solution.	
<ul><li>1.10 Carry out acid/basetitration.</li><li>1.11 Carry out redoxtitration</li><li>1.12 Determine the</li></ul>	

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

3.3 Measure atmosphericpressure.	
<ul><li>3.4 Create a distillation graph from the data for the Simple distillation of an organic solution.</li><li>3.5 Calculate the boiling point of an organic mixture measured by distillation to its equivalent boiling point at 760 mm Hg.</li></ul>	
<ul> <li>4.1 Calculate the amount of chemicals required to prepare various standard solutions.</li> <li>4.4 Prepare weight/volume standardsolutions by serial dilution.</li> <li>4.5 Prepare a % weight/volume standard solution from a primary standard grade chemical.</li> </ul>	Guide student to conduct items 4.1-4.6
4.4 Label all solutions prepared for use in the laboratory in accordance with WHMIS guidelines by completing a worksitelabel for each solution prepared.	
<ul><li>4.5 Submit solutions for testing and store solutions for later use.</li><li>4.5 Express the amount of a chemical present in asolution in common units of concentration.</li></ul>	
5.2 Operate a Spectronic 20D+	Guide student to conduct items 5.1-5.6
Spectrophotometer.	
5.2 Identify the proper care of cuvettes.	
5.5 Measure the %T of asolution.	
5.6 Calculate the Absorbance of a solution from its measured %T value.	
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5. 5 Determine the concentration of	
unknownsolutions using a Spectronic 20D+	
instrument.	
5.6 Use back calculationsto determine the	
mass of analyte	
in the original samples	

# CURRICULUM DEVELOPMENT HELD AT NBTE SECRETARIAT, KADUNA FROM 27<sup>TH</sup> SEPTEMBER TO 3<sup>RD</sup> 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 relateddiscipline.

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. TheInstructor 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; bur 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.

#### **10.0ACCREDITIATION**

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	А	4.00
70%-74%	AB	3.50
65% - 69%	В	3.25
60% - 64%	BC	3.00
55% - 59%	С	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	Р	CU	СН
				-		
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
ТОТ	TAL		14	7	21	21

## HND I SEMESTER II

S/N	COURSE	COURSE TITLE		Р	CU	СН
	CODE					
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 Systems2			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
Tota			15	13	28	28

## HND II SEMESTER I

S/N	COURSE CODE	COURSE TITLE	L	Р	CU	СН
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	COURSE TITLE	L	Р	CU	СН
	CODE					
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	0	4	4	4	
TOT	AL		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	<b>CODE:</b> ESM 311	Credit Unit: 3	CONTACT HOURS: 3				
Contingency Response			HOOK5/WEEK				
GOAL: This course is designed to provide the student.							
YEAR: ONE (1), SEMESTER: ONE (1)	PRE- REQUISITE: None	PRACTICAL: 1 HOUR/WEEK					
GENERAL OBJECTIVES							
On completion of this course, the Student should be abl	le to:						
<ol> <li>1.0 Understand house keeping</li> <li>2.0 Know emergency response strategy</li> <li>3.0 Know contingency plan</li> <li>4.0 Understand safety/healthcare management strategy</li> <li>5.0 Understand unsafe condition and act, auditing and r</li> </ol>	reporting						

PROG	PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
Course: House Keeping Emergency			Course Code: 311	Credit Unit: 3 ()	Contact Hours: 3			
	Preparedness/ Contingency	Response		Creat Chit. 5.0	Contact Hours: 5			
GOAI	<b>.:</b> This course is designed to	enable students know th	e fundamentals of Housel	keeping /Emergency/Cont	tingency response as w	ell as		
	Safety/Health care Strategie	es.		1				
Course	Course Specification: Theoretical Content: 2 Prostical Content: 1hr							
h					11			
GENE	RAL OBJECTIVE 1.0: Under	erstand Housekeeping						
Course	Specification:	TH	EORETICAL	PRACTICAL CONTE	ENT			
CONT	ENT							
Week	Specific Learning	<b>Teachers' Activities</b>	Learning Resources	Specific Learning	Teachers'	Evaluation		
	Outcome			Outcome	Activities			
1-2	1.1 Define:	Distinguish	Marker board,	Identify work areas/	Guide students to:	Distinguish		
	(i)Housekeeping	between	Markers,	work space and the	-identify work	between		
	(ii)House	housekeeping and	Documentary	areasneeding	areas/ work	housekeeping		
	cleanin	house cleansing	films, Multimedia	housekeeping	space and the	and house		
	g/sanitation		Projector and		areas needing	cleansing		
	(iii)House keeper	Explain where	Screen, Case	Identify types of	housekeeping			
	1.2 Define	housekeeping is	studies, Power	dirt, litter, garbage		Describe the		
	workplace	done	point slides,	etc	-identify types of	role of the		
	housekeeping		Internet,		dirt, litter,	housekeeping		
	checklist.	Describe the	Textbooks,	Identify	garbage etc	department in a		
	1.3 Describe	importance of work	Computer, Flip			work place.		
	eachcomponent of	place housekeeping	charts Workplace,	tools/equipment's	-identify tools/	Procession Procession		
	work place	checklist	Checklist and		equipment's in	Explain the use		
	housekeeping		PPE	inhousekeeping	housekeeping	of a checklist		
	checklist.	Give example of						

1.4 Explain the	work place	Projector Text books	Identify potential	-identify	
importance of house	housekeeping	Internet Tutorial	hazards in workplace	potentialhazards	Explain
cleaning.	checklist		-	-	housekeeping
1.5 Describe factors				in	auditing and
thatenhances	Mention the			Workplace	reporting.
housekeeping	implement used for			L.	
inworkplace.	house cleaning				
1.6 Mention some of the	purposes				
tools used in house	Describe the type of				
cleaning.	dirty and litters				
List some	commonly found in				
of the	house hold				
product/					
tools used	• Explain the effect of				
in	using house hold				
cleaning:	chemicals on food				
(i)House.	stuff, kitchenutensils				
ESM(ii)Fa	etc.				
ctories/					
industries					
(iii)Offices					
(iv) Labs/					
Workshops					
(iv)Surroundings					
1.8 Explain the					
significance of dirt					
and litter removal in					
house cleaning,					

	<ul> <li>1.9 Describe house hold chemical.</li> <li>1.10 Explain the effectof exposure to potentially household chemicals.</li> <li>1.11 Describe household chores.</li> <li>1.12 Explain unsafecondition auditing.</li> <li>Explain housekeeping auditing and reporting</li> </ul>					
GENER	<b>AL OBJECTIVE 2.0:</b> Knc	w Emergency Response	Strategy			
3-4	2.1 Explain	Describe the steps	Projector Text books		Guide students to:	Explain the
	emergency	to be taken for	Internet Tutorial	Identify escape	: identify escape	importance of
	response plan	evacuation when	Lecture note	route and places of	route and	safety signs in
	regarding fire and	fire outbreak		assembly point.	assemblypoints.	places such as
	evacuation.	occurs.				factory, school,
	2.2 Describe the			Demonstrate the		high way,
	actionplan for			use to radios	- demonstrate the	offices etc
	firefightingand	Describe the action		during emergency	use to radios	Explain the
	evacuation.	plan for firefighting		situations.	during emergency	importance the
	List out different	and evacuation.			situations.	importance of
	types of evacuation			Identify firefighting		safety drills in

strategy.	Explain the	equipment"s.	- identify	workplace
2.4 Explain the	importance of		firefighting	_
importance of	safety signs in	Simulate a safety	equipment"s.	
firealarm in a	places such as	evacuation drill		Describe the role
fire outbreak.	factory, school,		-simulate a safety	and responsibility
2.5 Identify escape	high way, offices		evacuation d	ofa safety officer
routeand places of	etc.			in emergency
assembly point.				response
2.6 Describe five escape	Describe five escape			
plan and personal	plan and personal			
emergency	emergency			
evacuationplan	evacuation plan			
(PEEP).	(PEEP).			
2.7 Describe five				
fightingtraining	Describe the role			
procedure;	and responsibility			
2.8 List out	of a safety officer			
the	in emergency			
firefightin	response.			
g				
equipmen	Describe different			
t.	ways of			
2.9 State the	communication			
importanceof radio	used in an			
communication in	emergency			
anemergency.				
2.10 Enumerate the	Describe response			
necessary facilities	action in case of spill			

no avring d for	amanganaiag Dagariha			
required for	emergencies.Describe			
medical	the procedure /			
emergency.	process			
2.11 Explain	/ steps for			
responseaction in	emergency			
case of spill	response drills.			
emergencies.				
2.12 State the	List out the personal			
purposeof	protectiveequipment			
emergency	/ safety wears			
response drill.	needed in an			
Describe the	emergencyresponse.			
procedure /				
process steps for				
emergency				
response drills.				
2.14 List out the				
personal protective				
equipment/safety wears				
needed in an emergency				
response				
		1		

GENERAL OBJECTIVE 3.0: Know contingency plan						
5-6	<ul> <li>3.1 Defined contingencyplan.</li> <li>3.2 Describe how to develop a contingencyplan.</li> <li>3.3 Describe contingencyplan process</li> <li>3.4 State the benefit derived from the preparation of a contingency responseplan.</li> </ul>	Define a contingency plan Describe how to develop a contingency plan State the usefulnessof 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 theindustry

GENE	RAL OBJECTIVE 4.0: Under	stand Safety/Healthcare	e Management Strategy			
7-9	4.1 Explain safety and	Describe the	Projector Text books	Identify	Guide students to:	Describe a
	healthcare	component	Internet Tutorial	safety and	-prepare a	safety and
	management	ofsafety and	Lecture note	healthcare	safetyand	healthcare
	system.	management		systems	healthcare	management
	4.2 Describe the general	system			plan	system
	environmental and					
	safety guide line for	Explain				Describe the
	industries in terms of	environmental and		Identify the general	- identify the	general safety
	Environmental	safety guideline		environmental and	general	guide line for
	Occupational Health	usein the industries		safety guide line for	environmental	Occupational
	and Safety			industries interms	andsafety guide	Health and Safety
	• Community health	Distinguish between		of:	line for	
	and safety	construction		• Environmental	industries in	
	Construction and	commissioning and		Occupational	terms of:	
	Decommissioning	decommissioning		Health and	Environmental,	
				Safety	Occupational	
				• Community	Uccupational	
				healthand	Sofety	
				safety	Community	
				• Construction	healthand	
				and	safety	
				Decommissio	Construction and	
				mng	Decommissioning	
GENE	RAL OBJECTIVE 5.0: Und	erstand unsafe condition	n and act, auditing and rer	porting.	8	1

		1	1			1	
10-11	5.4 Describe an	Explain an	Workplace, Checklist	Identify an unsafe	Guide students	Describe an	
	unsafe	unsafecondition	template, Accident	condition in work	tocarry out a	unsafe	
	condition		reporttemplate and	place.	safetyaudit for	condition	
	5.5 Explain unsafe act.	Explain unsafe act	PPE		a case study.		
	5.6 Explain	Explain		Identify an unsafe act		Explain safety	
	safety	safety			Guide students to	auditing	
	auditing	auditing		Identify the main	prepare an accident		
	5.7 Explain safety/	Explain the steps		factorsto be	report fora case	Explain safety/	
	accident report	incarrying out an		investigated in an	study.	accident report	
		safety audit		unsafe condition			
		Explain steps in					
		writing an accident					
		report					
	<u> </u>	-					
ASSES	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 r	emaining 60% of the total scor	re.					

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE						
COURSE:	ENVIRONMENTAL	CODE: ESM 312	Credit Unit: 2.	CONTACT HOURS: 2 HOURS/WEEK		
BIOTECHNOLOGY						
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 environm	iental management techno	ology.				
YEAR: ONE (1), SEMESTE	<b>R:</b> ONE (1)	PRE-	<b>PRACTICAL:</b> 1 HOURS/WEEK			
		<b>REQUISITE:</b>				
GENERAL OBJECTIVES						
On completion of this course,	the student should be able	e to:				
8.0 Understand the significant	ce of environmental Biote	echnology				
9.0 Understand the fundamental principles, functions and application of industrial product.						
10.0 Understand environmenta	l biotechnology intervent	ions				
11.0 Understand waste treatme	nt strategies					

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE TECHNOLOGY						
COURS	SE: ENVIRONMENTAL BIO	DTECHNOLOGY Co	ourse Code: 312	Credit Unit: 2.0	<b>Contact Hours:</b> 2	
GOAL	This course is designed to p	provide the student with in	dept knowledge in envi	ronmental biotechnology	as it relates to importa	nce and the working
principl	e of environmental manageme	ent technology.		Γ		
Course Specification: Theoretical Content:			eoretical Content:	Practical Content: 1	hr	
1hr						
12.0 <b>GE</b>	NERAL OBJECTIVE 1.0: 1	Understand the significand	ce of environmental Biot	technology		
Course	Specification:	THEOR	RETICAL CONTENT	PRACTICAL CONTI	ENT	
Week	Specific Learning	<b>Teachers'</b> Activities	Learning Resources	Specific Learning	g Teachers'	Evaluation
	Outcome			Outcome	Activities	
1-2	1.3 Define Biotechnology	• Explain the 1.1 − 1.4	Marker board,			Narrate the
	1.4 Explain		Markers,			historical
	environmental		Documentary films,			background
	Biotechnology		Multimedia Projector			
	1.5 applain the basic		and Screen, Case			
	component of the		studies, Power point			
	environment		sindes, Internet,			
	chvironment		Computer Flip charts			
	1.6 Discuss the concept of		etc			
	biotic and abiotic		cic.			
	components of the eco					
	system					
GENEI	RAL OBJECTIVE 2.0: Und	lerstand the fundamental	principles, functions and	application of industrial	product	1

3-4	2.1 Explain Biological Processes in relation to biotechnology	Explain 2.1 – 2.3		•	•	
	2.2 Explain the industrial fundamental principle:					
	Biological     processes					
	Quality control					
	• Safety					
	• Regulations and compliance					
	2.3 Discuss the functions and application of industrial product to environmental biotechnology					
13.0 <b>GE</b>	NERAL OBJECTIVE 3.0:	Understand environmental	biotechnology interven	tions		

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

4.4 explain the economics			
and special aspect of waste			
treatment			

PROG	<b>PROGRAMME:</b> HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL AND SAFETY MANAGEMENT TECHNOLOGY						
COU	<b>RSE:</b> Water Supply and Wastewater Treatment	CODE: ESM 313	Credit Unit: 3.0	CONTACT HOURS: 3HOURS/WEEK			
GOAI	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							
GENE	GENERAL OBJECTIVES						
	inpletion of this course, the Student should						
1.0	Know the wholesome water.						
2.0	Know various sources of water supply in a	a community.					
3.0	Understand various methods of water puri	fication.					
4.0	Know Industrial Wastewater Treatment						
5.0	Know Municipal Wastewater Treatment						
6.0	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			Course Code: 313	Credit Unit: 3.0		<b>Contact Hours:</b> 3		
GOAL:	<b>GOAL:</b> This course is designed to enable the students understand municipal and industrial wastewater and water treatment techniques							
Course Specification: 7		TH	EORETICAL	PRACTICAL CO	NTENT			
CONTE	INT							
General	<b>Objective 1.0:</b> Know the wholes	ome water.						
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation		
1-2	<ul> <li>1.1 Define the terms wholesome water andun wholesome water</li> <li>1.2 Differentiate between wholesome water and unwholesome water and unwholesome water such as: turbidity, - colour, - taste , odour, - pathogens</li> <li>1.4 List water pollutant toxic chemicals, radioactive substances, pathogens, and solid waste.</li> <li>1.5 Explain sources of water pollutant in :</li> <li>Industry</li> <li>Sewage</li> </ul>	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 studentsin identifying wholesome water and unwholesome water	Differentiate between wholesome water and unwholesome water		

<ul> <li>Agricultural activities</li> <li>Institutions like hospit</li> <li>School.</li> <li>Transportation</li> <li>Automobile fumes, maritime activity</li> </ul>	als,				
General Objective 2.0: know variou	is source of water supply in a co	mmunity	I		1
<ul> <li>4-5</li> <li>2.1. List possible sourceso water supply in a community such as : <ul> <li>Rain water</li> <li>Driven wells</li> <li>Bored tube well</li> <li>jetted tube well</li> <li>springs</li> <li>Hand dug wells</li> <li>Bore holes</li> <li>pipe borne water</li> <li>Steam water</li> </ul> </li> <li>2,2 Describe the hydrologicycle.</li> <li>2.3 Classify the source of water listed on 2.1 aboveo</li> </ul>	f Explain water supply in a community such as : • Rain water • Driven wells • Bored tube well • jetted tube well • jetted tube well • springs • Hand dug wells • Bore holes • pipe borne water • Steam water n the varioussources of	-projection -Text Books - Internet -Lecture notes -Tutorials -Disinfectants	Identify possible sourcesof water supply to community. Disinfect well	Guide the studentsin identifying various sources of water supply to community. Guide students todisinfect well	Describe thehydrologic cycle

- Surface water	contaminations: shallow		
- Underground water	well and deep well		
Rain water 2.3 Describe the characteristics of a community sanitary well. 2.5 Explain how to protectthe various	Give the disadvantages of shallow well and deep well. 2.8 Describe how to disinfect wells		
sources of water from contaminations			
2.6 Explain the terms shallow well and deep well			
<ul><li>2.7 .list the</li><li>disadvantagesof shallow</li><li>well and deepwell.</li><li>Describe how todisinfect</li><li>wells. categories:</li><li>Surface water</li><li>Underground water</li><li>Rain water</li></ul>			
2.8 Explain the characteristics of a community sanitary well.			

General Objective 3.0: Understand various methods of water purification							
	3.1 Explain how to	Explain the various		Visit a	Guide student	Explain theobjective of	
67	improvise water filters forthe	steps in water		conventionalwater	to identify the	water purification	
0-7	home	treatment in a		treatment plant	characteristics	1	
	3.2 Explain how to	conventional plant:			of awater		
	disinfect and	-Source			treatment		
	Sedimentwater for	-Aeration			Condiment		
	domestic andrural	-Sedimentation			plant area.		
	use.	-Screening					
	3.3 Explain how to store	-Coagulation			-Visit a		
	domestic water to	-Disinfection			conventional		
	reduce/prevent	-Filtration			watertreatment		
	contamination	-Storage			plant		
	3.4 Describe the outlay of	-Distribution					
	a water treatment						
	plant						
	3.5 Explain the various						
	steps in water						
	treatment ina						
	conventional plant:						
	• -Source						
	<ul> <li>-Aeration</li> </ul>						
	<ul> <li>-Sedimentation</li> </ul>						
	<ul> <li>-Screening</li> </ul>						
	<ul> <li>-Coagulation</li> </ul>						
	• -Disinfection						
	• -Filtration						

	•	-Storage					
	•	-Distribution					
	3.6 I	Explain the					
	C	characteristics of a					
	۷	watertreatment					
	(	Condiment plant area.					
	3.7 I	Explain Biological					
	(	Oxygen Demand (BOD)					
General	Obje	ctive 4.0: know industrial v	vastewater treatment	1		1	
	4.1	Explain how the	Explain how the	-projection	Visit industrial	Guide	Explain the principles of
8-10		regulatory requirements	regulatory	-Text Books	wastewater	student to	chemical coagulation
		impact industrial	requirements impact	- Internet	treatment plant.	visit	andprecipitation forthe
		wastewatertreatment	industrial wastewater	-Lecture notes		industrial	removal of suspended
		and municipal facilities	treatment and	-Tutorials Water		wastewater	solids and heavy metals
	4.2	Explain the impact of	municipal facilities	sampleChemicals		treatment	and phosphorus.
		the key industrial			Design	plant.	
		wastewater	Explain the impact of		chemical feed		
		contaminants (heavy	the key industrial		systems that		
		metals, other inorganic	wastewater		will allow the	Guide	
		constituents, synthetic	contaminants (heavy		estimation of	students to	
		organic compounds,	metals, other inorganic		chemical sludge	design	
		etc) on the receiving	constituents, synthetic		production	chemical	
		environment,	organic compounds, etc)		production.	feed systems	
	4.3	State the techniquesof	on the receiving			thatwill	
		industrial wastewater	environment.			allow the	
		survey.				estimation of	

4.	<b>4</b> Assess the economic	Explain the principles of	Plot adsorption	chemical	
	benefits of waste	chemical coagulation	isothermsand	sludge	
	minimization by	and precipitation for the	breakthrough	production.	
	evaluating industrial	removal of suspended	curves (adsorption		
	wastewater treatment	solids	and ion exchange		
	options	and heavy metalsand		Guide students	
	Explain the need for	phosphorus. Explain		to plot	
	quality equalization,	the key design criteria		adsorption	
	neutralization, and oil-	forsizing treatment		isotherms and	
	water separation.	system components.		breakthrough	
4.	6 Explain the key design	And Design chemical		curves	
	parameters tosize	feed systems that will		(adsorptionand	
	equalization,	allow the estimation		ion exchange	
	neutralization, and oil-	of chemical sludge			
	water separation	production.			
1	Tacilities.				
4.	7 Explain the principles	Explain the			
	of chemical coagulation	principal of ion			
	and precipitation for the	exchange.			
	solids and heavy metals				
	and phosphorus	Describe now to Plot			
4	8 Describe key design	adsorption isotherms			
	criteria for sizing	and breakthrough			
	treatment system	ion exchange)			
	components	ion exchange).			
4	9 Design chemical	Take students through			
	feed systems that	the calculation of			
will allow the	adsorption and ion				
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estimation of	exchange capabilities				
chemical sludge	and categorize the				
production.	principles of membrane				
<b>4.10</b> Explain the principalof	processes.				
ion exchange.					
<b>4.11</b> Plot adsorption	Explain the concepts of				
isotherms and	breakpoint chlorination				
breakthrough curves	based on chemical				
(adsorption and ion	oxidation and how it				
exchange).	impacts ammonia				
Calculate adsorption	removal.				
and ion exchange					
capabilities.					
<b>4.13</b> Categorize the					
principles of					
membrane					
processes.					
<b>4.14</b> Describe the concepts					
of breakpoint					
chlorination based on					
chemical oxidation and					
how itimpacts					
ammonia removal.					
4.15 Explain the					
principles of gas					
transfer and its					
application in air					

	stripping.							
General	Seneral Objective 5.0: know municipal wastewater treatment							
11	<ul> <li>5.1 Quantify the municipal wastewater problem based on the analysis of various sources of municipal wastewater and factorsthat affect wastewater flow and the comparison between types of sewer system.</li> <li>5.2 Explain how to measure municipal wastewater strength based on the physical and chemical characteristics of the wastewater.</li> <li>5.3 Explain the need for wastewater treatmentas defined in provincial and/or federal legislation taking into consideration the effect of discharging wastewater into the environment.</li> <li>5.4 Describe municipal</li> </ul>	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, measure municipal wastewater strength based on the physical and chemical characteristics of the wastewater. Explain the need for wastewater treatment as defined in provincial and/or federal legislation taking into	-projection -Text Books - Internet -Lecture notes -Tutorials Water sampleChemicals	Visit municipal wastewater treatment plant. Measure municipal wastewater strength basedon 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.	Describe municipal wastewater treatment unit operations including onsitedisposal (septictanks) system and central collection treatment systems.		

wastewater treatment unit	consideration the effect		
operations including	of discharging		
onsite disposal (septic	wastewater into the		
tanks)system and central	environment.		
collection treatment			
systems.	Explain municipal		
5.5 Describe preliminary	wastewater treatment unit		
treatment processes	operations including		
including screening	onsite disposal (septic		
comminution (grinding)	tanks) system and central		
and grit removal	collection treatment		
5.6 Analyze the design of	systems		
nrimary wastewater	systems		
treatment with focus on	Explain the preliminary		
the principles of	treatment processes		
5.7 primary addimentation	including screening,		
5.7 primary sedimentation	comminution		
Explain the basic	(grinding) and grit		
fundamentals of five-day	removal.		
biochemical oxygen			
demand (BOD5), the	Explain how to analyze		
BOD5 test and	the designof primary		
limitation.	wastewater treatment		
5.8 Analyze the design of	with focus on the		
suspended growth	principles of primary		
systems such as activated	sedimentation.		
sludge and its variants			
and their application to			
secondary wastewater			

	treatment including the			
	hogic kinetics of			
	suspended growth			
	biological treatment.			
	5.9 Analyze secondary			
	clarification in			
	biological treatment			
	systems			
	5.10 Evaluate			
	wastewater			
	disinfection			
	alternatives.			
	5.3 Evaluate sludge			
	processing options fora			
	given application,			
	considering the cost			
	effectiveness of the			
	processing techniques.			
General	Objective 6.0: know drinking wate	er treatment		
1				

12-13	6.1 Discuss the significance	Explain item the	-projection	Visit	Guide	Explain the significance
	of waterdemand (based on	significance of water	-Text Books	drinking	student to	of source water
	water consumption	demand (based on	- Internet	water	visit	protection to minimize
	statistics) and the	water consumption	-Lecture notes	treatment	drinking	waterquality risks
	characterization of water	statistics) and the	-Tutorials Water	plant.	water	waterquarty risks.
	quality in relation to	characterization of	sampleChemicals		treatment	
	treatment system design.	water quality in			plant.	
	6.2 Explain how to assess	relation to treatment		Measure key		
	key bacteriological water	system design and		bacteriological	Guide students	
	quality parameters to	assess key		waterquality	to measure the	
	ensure the production of	bacteriological water		parameters	key	
	potable water according	quality parameters to			bacteriological	
	to criteria established	ensure the production			water quality	
	under the Guidelines for	of potable water			parameters	
	Nigerian Drinking Water	according to criteria				
	Quality and the Nigerian	established under the				
	Safe Drinking Water	Guidelines for				
	Regulation.	Nigerian Drinking				
	6.3 Compare the water	Water Quality and the				
	treatment philosophies	Nigerian Safe				
	practiced in Africa and	Drinking Water				
	other parts of the world,	Regulation.				
	including explanation of	Explain the				
	standards set by the WHO	principles of				
	and AU.	coagulation				
	6.4 Explain the significance	/flocculation, the				
	of source water protection	principles of filtration				
	tominimize water quality	and the principles of				

risks	clarification as they		
6.5 Explain the principles of	pertain to water		
coagulation	treatment plant design		
/flocculation as they	and		
pertain to water	analyze the		
treatment plant design.			
6.6 Explain the principles of	Describe conventional,		
clarification as they	direct, diatomaceous		
pertain to water treatment	earth, slow sand and		
design.	membrane processes.		
6.7 Describe the principles			
of filtrationas they	Explain filter		
pertain to water	operation, defining the		
treatment plant design.	concept of headloss		
6.8 Describe	and the relationship to		
conventional, direct,	backwash requirements		
diatomaceous earth,	and media types.		
slow sand and	Explain the application		
membrane processes.	of the principles of		
6.9 Explain filter operation,	water softening to the		
defining the concept of	removal of hardness		
headloss and the	from scaleforming		
relationship tobackwash	waters, including the		
requirements and media	calculation of dosage		
types.	requirements for		
6.10 Explain the principles	various water softening		
of watersoftening to the	scenarios.		
removal of hardness from			

				1
scale forming	waters,			
including theca	alculation Explain the principles			
of dosagerequi	rements of corrosion control an	1		
for various wat	ter the principles of			
softening scena	arios. primary and secondary			
6.11 Explain the	principles disinfection as they			
of corrosionco	ntrol as pertain to water			
they pertainto	water treatment process			
treatment proc	ess design. design.			
6.12 Explain the	principles			
of primaryand	secondary Explain chlorine-based			
disinfection as	they treatment and other			
pertain to wate	er treatment alternative technologie	3		
process design	including ozone and			
6.13 Explain chlo	orine-based ultraviolet light.			
treatment and o	other			
alternative tech	hnologies Explain the formation			
includingozone	e and potential of disinfection	1		
ultraviolet ligh	it. by- product and			
6.14 Explain the	formation microbial regrowth in			
potential of dist	infection distribution systems an	d l		
by- product and	d microbial the riskof their			
regrowth in dis	stribution associated			
systems	exposure.			
and their associ	iated			
exposure risks				
General Objective 7.0: know	w water analysis			

14	7.1 Explain the	Explain 7.1 – 7.11	-projection	Identify	Guide student	Explain Indicator
	appropriate materials		-Text Books	appropriate	to:	Organisms
	for collectingwater		- Internet	materials for	-identify	C
	samples		-Lecture notes	collecting	appropriat	
	7.2 Prepare sampling		-Tutorials Water	water	e materials	
	bottles for water		sampleChemicals	samples	for	
	collection		-		collecting	
	7.3 Explain how to collect			Prepare	water	
	water samples			sampling	samples	
				bottlesfor		
	7.4 Explain how to			water	-prepare	
	dispatch sample bottles to			collection	sampling	
	the laboratory for analysis				bottles for	
	7.5 Explain how to			Collect water	water	
	package and labelsample			samples	collection	
	bottles for transportation					
	7.6 Explain Indicator			Dispatch sample	-collect	
	Organisms			bottles to he	water	
	7.7 Explain how to culture			laboratory for	samples	
	water samples for Indicator			analysis		
	organism				-dispatch	
	7.8 Explain how to identify			Package and	sample	
	other organism e.g. protozoa			label sample	bottles to	
	etc. In water samples from			bottles for	the	
	under the microscope			transportation	laboratory	
	7.9 Explain how to identify			Culture water	for analysis	
	hard water by its			samples for		
	characteristics			Indicator	-package and	

7.10 Explain how to	organism la	belsample
remove water hardness	bo	ottles for
	Identify other tr	ansportation
7.11 Explain now to treat water	organism C	ulture water
for odour	e.g. protozoa sa	amples for
	etc. In water In	idicator
	samples from 01	rganism
	under the	
	microscope -i	dentify
	ot	iher
	Identify hard OI	rganism
	water by its e.	g.
	characteristics pi	rotozoa
	Remove water et	c. In
	hardnessTreat	ater
	water for Odour sa	imples
	fr	om
	u	nder the
	m	hicroscop
	e	
	-i	dentify
	ha	ard
	W	ater by
	its	\$
	ch	naracter
	is	tics
	-r	emove
	W	ater

					hardness -treat water for		
					Odour		
ASSESS	MENT: The continuous assessme	ent; tests, quizzes, field wor	ks etc. will be awarded 4	0% of the total score	e. The end of the S	emester Examination will	
make up	make up for the remaining 60% of the total score.						

PROGRAMME: Higher National Diploma in Environmental Science and Management Technology							
COURSE: Environmental and Health RiskCODE: 314Credit Unit: 3.0CONTACT HOURS: 3 HOURS/WEEK							
<b>GOAL:</b> This course is designed to provide students	with knowledge of bas	ic risk concepts that apply to	health and environment				
YEAR: ONE (1), SEMESTER: ONE (1)PRE-REQUISITE: nonePRACTICAL: 1 HOUR/WEEK							
GENERAL OBJECTIVES							
On completion of this course, the student should be at	ole to:						
1.0 Know various terms associated with risk assessme	ent						
2.0 Know Hazard Identification (Step 1) of the Risk A	Assessment Process.						
3.0 Understand the principles and Calculation of Expo	osure 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 Contaminan	ts 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 analys	is						

PROGRAMME: Higher National Diploma in Environmental Science and Management Technology						
Course	Environmental And Health I	Risk Assessment Co	ourse Code: 314	Credit Unit: 3.0	<b>Contact Hours:</b> 3	
<b>GOAL</b> :	This course is designed to p	provide students with know	vledge of basic risk cond	cepts that apply to health a	and environment	
Course	Specification:	Th	eoretical Content:	Duratical Contants 1 h		
2hr				Practical Content: 11	If	
GENEI	RAL OBJECTIVE 1.0: Knov	w various terms associated	l with risk assessment			
Course	Specification:	THE	ORETICAL	PRACTICAL CONTE	NT	
CONTI	ENT	1				
Week	Specific Learning	<b>Teachers'</b> Activities	Learning Resources	Specific Learning	Teachers'	Evaluation
	Outcome			Outcome	Activities	
1-2	1.1 State the	Explain the differences	WhiteboardText	Identify risks	Guide students to	Explain the
	difference	betweenenvironment	books Journals	associated with	identify Risk	interaction
	between	risk assessment, health	Internet	different development	assessment in	betweenthe
	environment risk	risk assessment, risk		activities.	activitiessuch as	environment and
	assessment, health	management, risk			mining.	development
	risk assessment,	communication, and				activities-
	risk management,	comparative risk				
	risk	assessment.				
	communication,	assessment, voluntary				
	and comparative	and involuntary risk,				
	risk assessment.	risks posed by				
	1.2 List the four steps to	chemicals and those				
	riskassessment.	posed by				
1.3 Explain the four microorganisms						
	steps ofrisk	-				
	assessment.					
	1.4 Explain the					

	concept ofrisk				
	assessment.				
	1.5 Describe why				
	environmental and				
	healthrequirements				
	must be considered				
	in risk assessment.				
	1.6 Explain why we use				
	safety factors in risk				
	assessment.				
	1.7 Explain with				
	examples the				
	difference between				
	avoluntary and				
	involuntary risk.				
	1.8 List the				
	differences				
	between risks				
	posed by				
	chemicals and				
	those posed by				
	microorganisms				
GENE	RAL OBJECTIVE 2.0: Kno	ow Hazard Identification (	Step 1) of the Risk Asse	ssment Process.	 
3-4	2.1 Explain the	List the benefits of	WhiteboardText		Explain why a
	benefits of eliminating	eliminating hazards	books Journals		process hazard
	hazards.	and why a process	Internet		safety
	2.2 Explain why a	hazard safety			management
	processhazard safety	management program			program is

	managementprogram is important to a facility. 2.3 Describe the 14 elementsof process safety management 2.4 Explain the use of performance measurements	is importantto a facility. Describe the 14 elements of process safety management Explain the use of performance measurements				important to a facility
GENEF	<b>KAL OBJECTIVE 3.0:</b> Unde	erstand the principles and (	Calculation of Exposure	including the two main p	rinciple activities	<b>D</b> 1 '
	3.1 Describe common	Explain exposure	Whiteboard Text			Explain
	exposure pathways.	pathways.	booksInternet			Exposure
	3.2 Explain the					pathways
	need to					
	consider					
	Bioaccumulati					
	on inexposure					
	3.3 Calculate					
	exposure					
	pathways					
General	l Objective 4.0: Know dose-r	esponse assessment				
	4.1 Explain the	Explain the				Explain Dose
	importanceof	importance of				Response
	selection of the dose-	selection of the				Assessment
	response curve in risk	dose-response curve				
	management	in risk management				
	4.2 Describe what is	and what is meant by				

	meantby "the most conservative dose- response curve. 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 4.4 Identify the four steps ina formal health-risk assessment. 4.5 Explain why some chemicals are more likely to	"the most conservative dose- response curve"? Explain what a threshold dose- response curve is and give students examples of the types of toxicants that have a threshold dose-response curve. Explain the four steps in a formal health-risk assessment and why			
	health-risk assessment. 4.5 Explain why some chemicals are more likely to bioaccumulate than others	Explain the four steps in a formal health-risk assessment and why some chemicals are more likely to			
	4.6 Identify the types of dose-response curves thatbest reflect pathogen exposure.	bioaccumulate than others.			
Genera	l Objective 5.0: Understand t	he basic principles of toxi	cology		
	<ul><li>5.1 Define toxicity.</li><li>5.2 Give reasons for the use of small</li></ul>	Explain why small animals are used in laboratory tests	WhiteboardText books Internet		Describe how the safety of chemical substances is

	animals in	involving toxic		defined with
	laboratory tests	materials.		respect to
5.3	involving toxic materials. Describe how the safety of chemical	Give reasons why or why not chemical substances should be exposure		exposure
	substances is defined with respect to exposure.	Differentiate between exposure concentration and exposure dose including how theyare		
5.4 5.5 5.6	Differentiate between exposure concentrationand exposure dose including how they arerelated to one another. Define LD50 and howit is used. List the advantages of	related to one another Explain how LD50 is used. List the advantages of short-term toxicity testing. State reasons why some compounds are highly toxic when injected, but innocuous wheningested		
5.7	short-term toxicity testing. State reasons why some compounds are highly toxic when injected,			

	but innocuous								
Genera	General Objective 6.0: Understand the basic principles of epidemiology								
	<ul> <li>6.1 Define the following related terms of epidemiology: <ul> <li>relative risk</li> <li>absolute risk</li> <li>confounding factors</li> <li>protective factors;</li> </ul> </li> <li>6.2 Define the following term pairs: risk and proactive factors; retrospective and prospective studies</li> </ul>	Explain the principles of Epidemiology as it relates to: -relative risk, absolute risk, confounding factors protective factors; retrospective and prospective studies Describe epidemiological studies and how it is	WhiteboardText books Internet	Determine if an epidemiological study prove can belinked to diseases.	Guide students to determine if an epidemiological studyprove can be linked to diseases	Explain the principles of Epidemiology			
	<ul> <li>6.3 Describe</li> <li>epidemiological</li> <li>studies and how it is</li> <li>linked to diseases</li> <li>6.4 Explain the</li> <li>expression"rate of</li> <li>occurrence</li> <li>6.5 Describe the</li> </ul>	Explain the expression "rate of occurrence. Describe the limitations in using epidemiological studies to assess the							

		-		-	-	
	limitationsin using epidemiological studies to assess the toxicityor carcinogenicity of a chemical. 6.6 Recognize the negative effect of	toxicity or carcinogenicity of a chemical.				
	substance that is					
	carcinogen.					
Genera	al Objective 7.0: Understand	the Transport and Fate of (	Contaminants on Ecosys	tems		
	7.1 State What are the different kinds of stressors towhich an ecosystem might be exposed to.	Explain 7.1 fully.	White boardText books Internet			State What are the different kinds of stressors to which an ecosystem mightbe exposed to
Genera	al Objective 8.0: Know how H	Risks are estimated				
	<ul> <li>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.</li> <li>8.2 Determine the chemicalspecific risk</li> </ul>	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. Explain how to	WhiteboardText books Internet	Determine the risk (carcinogenic) of working in an environment for 70 years that results in achronic oral intake of 0.50 mg/(kg-day) ofbenzene.	Guide the studentsto conduct: -determine the risk (carcinogenic) of working in an environment	Calculate carcinogenicrisks

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

takento assess the	copper site if A former		assess the copper	former chemical
copper site if A	municipal landfill		site.	production facility
former municipal	exists from which			that spilled DDT,
landfill exists	copper is leaching into			which has been
from which	a large pond down			transported into a
copper is leaching	gradient of thesite and			nearby stream by
intoa large pond	the steps required to			surface water
down gradient of	assess the DDT site of			runoff,
the site.	a former chemical			
10.2 List the steps	production facility that			
required to assess	spilled DDT, which			
the DDT site of a	has been transported			
former chemical	into a nearby stream by			
production facility	surface water runoff.			
that spilled DDT,	Also calculate the steps			
which has been	to assess the PCB site			
transported into a	of a formerwaste-oil			
nearby stream by	recycling facility that			
surface water	disposed of PCBs in a			
runoff,	lagoon from which			
10.3 List the steps to	extensive soil			
assess the PCB	contamination had			
siteof a former	resulted			
waste- oil				
recycling facility				
that disposed of				
PCBs in a lagoon				

from which extensive soil contamination had resulted General Objective 11.0: Understa	nd the advantages of cost be	enefit analysis		
11.1 Define cost benefit analysis is.11.2 List the 11 steps of C-B analysis.11.3 Create a table to compare the different types of costs.11.4List the methods to analysis a C-B studyand identify the bestoverall method.11.5Describe this best overall method from the previous objective.	Explain cost benefit analysis Create a table for comparing different types of cost benefits	Whiteboard Calculators		List the methods toanalysis a C-B study and identify the best overall method

<b>PROGRAMME:</b> HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY								
COURSE: FUNDAMENTALS OF GEO-	CODE: ESM 315	Credit Unit: 2.0	CONTACT HOURS: 2					
INFORMATICS			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.		r						
YEAR: ONE (1), SEMESTER: ONE (1)	PRE-	<b>PRACTICAL:</b> 0 HOURS/WEEK						
	<b>REQUISITE:</b>							
GENERAL OBJECTIVES								
On completion of this course, the Student should be abl	e to:							
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	6.0 Know triangulation							
7.0 Know tacheometry								

PROG	PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
Course	: fundamentals of geo-information	atics C	ourse Code: 315	Credit Unit: 3.0	Contact Hours:	3	
GOAL	: The student on completion	of this course should have	e a sound understanding	of principles of surveying	ng and be able to un	dertake field	
	surveying required for environmental and safety management projects						
Course Specification: Theoretical Content: 2					hrs		
hrs							
GENE	RAL OBJECTIVE 1.0: Knov	w the Fundamental Conce	epts of Surveying				
Course	Specification:	THE	ORETICAL	PRACTICAL CONT	ENT		
CONT	ENT	1			I		
Week	Specific Learning	<b>Teachers' Activities</b>	Learning Resources	Specific Learning	Teachers'	Evaluation	
	Outcome			Outcome	Activities		
1-2	1.1 Define Surveying	Develop	Instructional			State the uses of	
	1.2 Distinguish	instructional	Manual.			plane surveying.	
	betweenthe	manual for	Recommended				
	following major		textbooks, e- books,				
	divisions of	Course.	lecture notes,				
	surveying:	Evalsia the	Whiteboard,				
	(1) geodetic surveying	Explain the	PowerPoint				
	(ii) plane surveying	rundamental	Projector, Screen,				
	1.3 State the uses of	concepts of	Magnetic Board, flip				
	plane surveying (e.g.	surveying.	charts, etc.				
	maps and plans,						
	geographical,	Explain the relevance					
	geological	OI					
	engineering, military	surveying to mining					
	purpose etc,).	industry and the					
	1.4 Explain the	various professions					

threestages of	where surveying is		
surveying	significant		
process.			
<ul> <li>Reconnaissan</li> </ul>			
ce			
<ul> <li>Observationa</li> </ul>			
nd			
Measureme			
nts			
• Presentation			
1.5 Explain the			
basic principles			
of surveying			
measurements			
(linear and			
angular)			
1.6 State the branches of			
surveying in mineral			
exploration and			
exploitation			

Genera	I Objective 2.0: Understand S	Surveying				
3-4	2.1 Review	• Revise trigonometric	Instructional	■ _	■ _	Solve problems
	trigonometricratios of	ratiosand solve	manual			involving triangles
	common angles	problemsinvolving	Recommended			<i>.</i>
		triangles	textbooks			(sinerule,
	2.1 Solve problems		eBooks, lecture note,			
	involving triangles (sine		whiteboardPower			cosinerule,
	rule, cosine rule, area		Point Projector,			area
	oftriangle, Napier's		screenmagnet board			oftriangle,
	tangentrule).		flip charts etc			Napier's tangent
						rule).
Genera	l Objective 3.0: Know Surve	y Drawing Techniques				
5-6	3.1 Explain the use of	Explain the use of	PowerPoint	Identify all the	Guide students to:	Explain the useof
	scales and handling of	basic survey drawing	Projector, Screen		-Identify all	scales and
	other drawing	techniques	Magnetic Board,flip	drawing	.1 1 .	handling of other
	instruments		charts, etc	instruments	thedrawing	drawing
					instruments	instruments
				(compasses,		
				dividana	(compasses,	
				dividers	dividan	
				protractors, set	dividers	
				squares, pencil, etc.)	protractors,	
					1	
					set	
				Demonstrate the	aguaraa	
				procedure for ink-	squales,	
				1	pencil,etc.)	

				drawing and lettering techniques	Guide students to demonstrate the procedure for ink- drawing and lettering techniques			
GENEI	GENERAL OBJECTIVE 4.0: Understand leveling							
7-9	4.1 Define leveling	Explain the terms	PowerPoint	Measure horizontal	Guide students	Describe the		
	<ul> <li>4.2 Explain the followingterms related to leveling: datum; level surface, lineof collimation, mean sea level, bench mark</li> <li>4.3 Describe the basicprinciple of leveling</li> </ul>	related to leveling:datum; level surface, line of collimation, mean sea level, bench mark and the following levelingprocedure • compound leveling	Projector, Screen, Magnetic Board, flip charts, etc Practical Manual. Theodolite, ranging rods,	and vertical angels using theodolite.	tomeasure horizontal and vertical angels using theodolite	effect of each curvature and Atmospheric refraction on Leveling.		
	4.4 Explain the followingleveling procedure	<ul><li>flying level</li><li>profileleveling.</li></ul>	ranging staff, survey record book					
	<ul> <li>compound leveling</li> <li>flying level</li> </ul>	Explain the effectof each curvatureand atmospheric						

	<ul> <li>profile leveling</li> <li>reciprocalleveling</li> </ul>	refraction on leveling.				
	4.5 Explain the	Enumerate errorsthat may occur inleveling.				
	reduction of leveling					
	results by					
	• rise and fall					
	method, and					
	• height of					
	collimation					
	method					
	4.6 Describe the effect					
	ofeach curvature and					
	atmospheric refraction					
	onleveling.					
	4.7 State typical errors					
	leveling					
GENEI	RAL OBJECTIVE 5.0: Kno	w traversing				
10-11	5.1 Define Traversing	Explain the	Whiteboard	Perform calculations of	Guide students to	Explain the
	5 2 Describe (he	conceptof	PowerPoint Projector,	bearings, distancesand	perform	concept of
	5.2 Describe the	traversing	Screen,Magnetic	co-ordinates from	calculations of	traversing
	principleof traversing		Board, flip charts, etc	traverse surveys	bearings, distances	

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

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

prin	ciple of thestadia-	determination of	Engineer's level Field	tachometricconstants	-determine	
syst	tem (fixed-hair and	tachometric	book drawingpaper,	from field	tachometric	
sub	tense tacheometers)	constants.	pencil,rules, eraser	measurement.	constants from	
syst sub 7.3 dete tach 7.4 tens opti 7.5 tach for 7.5 vert by r 7.6 E hor usi and 7.7 E c u	tem (fixed-hair and tense tacheometers) Describe the ermination of nometricconstant Describe thesub se system Outline the tical wedgesystem. Explain chometricmethods plotting contours Observe small tical anglesprecisely repetition Determine rizontal distance ingvertical stage d tachometry Explain the special characteristics and use of self-reducing	tachometric constants. Describe sub tense System Asses with good examples activities in 1.1 to1.5 and ask the students to solve problems on them.	book drawingpaper, pencil,rules, eraser Practical Manual. Theodolite tacheomers Staff RangingPoles	Plot contours from tachometric measurements Carry out compass traversing of a closed figure	constants from field measurement. -plot contours from tachometric measurements carry out compass traversing of a closed figure	
ta d	achometers Measure listances usinga					

	theodolites as					
	tacheometer					
	7.8 Determine spot					
	heights and survey detail					
	by tacheometry					
ASSES for the r	<b>SMENT:</b> The continuous assested as a set of the total score as a set of total sco	ssment; tests and quizze	s will be awarded 40% of	the total score. The end c	of the Semester Exami	nation will make up

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- PRACTICAL: 0 HOURS/WEEK								
REQUISITE:								
none								
GENERAL OBJECTIVES								
On completion of this course, the student should b	e able to:							
1.0 Understand the scope and concept of enviro	onmental economics							
2.0 Understand the impact of excessive exploit	ation of environmental	resources						
3.0 Understand the implication of economic pro-	ojects on the environme	ent.						
4.0 Understand the cost-benefits of conservation	n.							
5.0 Understand the implication of economic glo	obalization and market	system on the conservation	of nature.					
6.0 Understand the ecotourism potentials of the	Nigerian environment	•						

PROGE	RAMME: HIGHER NATIONAL	L DIPLOMA IN ENVIR	ONMENTAL SCIENCE	AND MANAGEM	ENT TECHNOI	LOGY		
Course:	Introduction to	(	Course Code: 316	Credit Unit: 2.0		<b>Contact Hours:</b> 2		
GOAL:	This course is designed to expos	se students to the economi	c ways of harnessing envir	ronmental resources	in a suitable way.			
Course	Specification:	TH	EORETICAL	PRACTICAL CO	NTENT: 0			
CONTENT								
Genera	<b>I Objective 1.0:</b> Understand the	scope and concept of envi	ronmental economics					
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation		
1-2	<ul> <li>1.1 Define environmental economics.</li> <li>1.2 Describe the relationship between environment and economics.</li> <li>1.3 Explain the major economic indicators in environmental economics.</li> <li>1.4 Explain the concept of environmental sustainability.</li> <li>1.5 List factors militating against environmental sustainability e.g. overutilization, over exploitation of natural resources e.t.c.</li> </ul>	Explain environmental economics and relationship between environment and economics. Explain the major economic indicatorsin environmental economics and the concept of environmental sustainability.	Multimedia. Projector, ScreenMagnetic Board,	-	-	State factors militating against environmental sustainability		

General	General Objective 2.0: Understand the impact of excessive exploitation of environmental resources					
4-5	<ul> <li>2.1 Define environmental resources.</li> <li>2.1 Explain the concept of use, overutilization and overexploitation of natural resources.</li> <li>2.3 Explain the impacts of excessive exploitation of natural resources on the environment.</li> </ul>	Explain the factors militating against Environmental sustainability e.g. overutilization, over exploitation of natural resources	Multimedia, Projector, Screen Magnetic Board.	-	-	List the impactsof excessive exploitation of
General	Objective 3.0: Understand the in	nplication of economic pro	jects on the environment.			
6-7	<ul> <li>3.1 List the characteristics of economic projects.</li> <li>3.2 List examples of economic and environmental projects in Nigeria.</li> <li>3.3 List the implications of economic projects on the</li> </ul>	Explain the characteristics of economic projects. Explain the examples of economic and environmental projects in Nigeria. Explain the implications of economic projects on	Multimedia, Projector, ScreenMagnetic Board.			List the characteristics of economic projects and their implications forthe environment.
General	<b>Objective 4 0</b> : Understand the c	the environment.	n			
General	Objective <b>4.</b> 0. Oliderstalld the c	Ust-benefits of conservation				

	4.1 Define environmental	Explain items 4.1 –4.3	Multimedia,			Outline cost- benefit of
8-10	conservation.		Projector, Screen			environmental projects.
0-10	4.2 Explain the concept of cost-benefit analysis.		Magnetic Board.			
	<ul> <li>4.3 Explain cost-benefit of projects under:-</li> <li>External and internal costs</li> </ul>					
	<ul> <li>The cost of environmental regulation</li> </ul>					
	• The benefit of environmental regulation					
General	Objective 5.0: Understand the in	nplication of economic glob	alization and market syst	tem on the conservat	ion of nature	
11	<ul> <li>5.1 Define economic globalization and market system.</li> <li>5.2 Describe the impacts of economic globalizationand market system on nature conservation.</li> </ul>	Explain the impactsof economic globalization and market system on nature conservation	Multimedia, Projector, ScreenMagnetic Board.			Explain the impacts of economic globalization and market system on nature conservation.
General	<b>Objective 6.0:</b> Understand the ed	cotourism potentials of the N	ligerian environment.	1	1	1

12-13	<ul> <li>6.1 Define ecotourism</li> <li>6.2 State some of the major ecotourism sites</li> <li>such as parks, lakes,</li> <li>waterfalls etc across the different geo-political</li> <li>zones of Nigeria.</li> </ul>	Explain ecotourismAnd give some of the major ecotourism sites such as parks, lakes, waterfalls etcacross the differentgeo-political zones of Nigeria.	Multimedia, Projector, ScreenMagnetic Board.	-	-	Describe the economic potentials of ecotourism site in any geo- political zone ofNigeria
ASSESS make up	<b>MENT:</b> The continuous assessme for the remaining 60% of the total	ent; tests, quizzes, field wor l score.	ks etc. will be awarded 4	0% of the total score	e. The end of the S	emester Examination will
## YEAR ONE, SEMESTER TWO COURSES

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
COURSE: Environmental Auditing and	<b>CODE:</b> 321	Credit Unit: 3	CONTACT HOURS: 3				
Management Systems			HOURS/WEEK				
<b>GOAL:</b> This course is designed to provide students with the skills and knowledge required to develop EnvironmentalManagement System and							
Auditing							
<b>YEAR:</b> ONE (1), <b>SEMESTER:</b> two (2)	PRE-	PRACTICAL: 1HOU	JRS/WEEK				
	REQUISITE:						
	none						
GENERAL OBJECTIVES							
On completion of this course, the Student should	be able to:						
1.0 Understand the introduction to environmenta	l systems and organiza	tion					
2.0 Understand Environmental Management Plan	nning, Leadership and	Support system					
3.0 Understand Emergency Preparedness and Re	sponse System						
4.0 Know the Environmental Management Syste	m Audit						
5.0 Understand EMS Auditing Tools and Technic	ques						
6.0 Know the elements of Environmental Audit	6.0 Know the elements of Environmental Audit						
7.0 Understand the need for resource efficiency							
8.0 Understand the benefits of Auditing							

PROGR	PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
<b>Course:</b>	Environmental Auditing and Man	nagement Systems C	Course Code: ESM 321	Credit Unit: 3		<b>Contact Hours:</b> 3		
<b>GOAL:</b>	This course is designed to provid	e students with the skills a	nd knowledge required to	develop Environmen	ntalManagement Sy	stem and Auditing		
Course	Specification:	THE	ORETICAL	PRACTICAL CO	NTENT			
CONTE	INT							
General	<b>Objective 1.0:</b> Understand the In	ntroduction to Environmen	tal Systems and Organization	tion	T			
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning	Teachers'	Evaluation		
				Outcome	Activities			
1-2	1.1 Explain	Explain the term	-projector	Identify the	Guide the	Explain the scope of		
	Environmental	environmental	-textbook	different typesof	studentto	Environmental		
	Management System	management system	-internet	ISO family	identify different	ManagementSystem		
	(EMS)	Explain the full	-lecture note		types of ISO			
	1.2 Explain the scope of	meaning of International	-tutorial					
	Environmental	Organization for						
	Management System	Standardization (ISO)						
	1.3 Define the organization	families and their						
	and itscontext	objectives and functions.						
	1.4 Explain what the	Explain the relationship						
	International	of ISOand Sustainable						
	Organization for	Development Goal						
	Standardization (ISO)is.	(SDG).						
	1.5 Explain why the ISO is							
	developing the ISO14000							
	standards series.							
	1.6 Describe the process							
	leading up to the							

	development of the				
	standard.				
	1.7 Explain what the				
	ISO/TC207 is and its				
	purpose.				
	1.8 List the primary				
	potential benefits of an				
	EMS				
	1.9 Explain using examples,				
	benefits of an EMS				
	1.10 Explain ISO				
	14001 and the ISO				
	14000 family				
	(Families)				
	1.11 Compare and				
	contrast the ISO				
	14001 and ISO 14004				
General	Objective 2.0: Understand Enviro	onmental Management Pla	nning, Leadership and Su	pport system	

4-5	2.1 Explain the role of	Explain leadership	-projection	Identify possible	Guide the	Explain environmental
JJ	Leadership and		-textbooks	leadershin	student to	compliance and
	commitment	State the various	- internet	qualities that can		obligations
	2.2 State the	environmental	- lecture notes	make an industry	identify possible	obligations
	2.2 State the	policies	tutorial	make an muusu y	leadership	
	2.2 Explain anomization	policies	tutoriai	glow	qualities that can	
	2.5 Explain organization	Evaloin			make an industry	
	roles, responsibilities and				grow	
	authorities	environmental			0	
	2.4 List the actions to be	policies				
	taken to address risks and					
	opportunities					
	2.5 Explain environmental	• Explain				
	aspects	environmental				
	Explain environmental	compliance and				
	compliance and obligations	obligations				
	2.7 Explain environmental					
	objectives and planning					
	2.8 Explain the following:					
	<ul> <li>Environmental</li> </ul>					
	resources					
	• competence					
	• awareness					
	• communication					
	Documented					
	information					
	mormation					
General	<b>Objective 3.0:</b> Understand Emer	gency Preparedness and Re	esponse System			

	3.1 Explain emergency	Explain Emergency	-projection	Identify steps for	Guide the	Explain Emergency
6-7	management of industrial	planning Ideals and	-textbooks	developing the	studentsin	planning Idealsand
0-7	system	implementation	- internet	emergency	identifying	implementation
	3.2 Explain Emergency		- lecture notes	response plan	various	1
	Planning Ideals and	Explain preparedness	tutorial		emergency	
	Implementation	phaseand response			response plans.	
	3.3 Compare and contrast					
	Communication and incident					
	assessment					
	3.4 Distinguish between					
	operational planning and					
	control measures					
	3.5 Compare and contrast					
	Preparedness phase and					
	response measures					
	3.6 List International					
	emergency management					
	society					
	Explain IncidentStabilization					

General	<b>Objective 4.0:</b> Know the Enviro	nmental Management System	n Audit			
General 8-10	Objective 4.0: Know the Enviro 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 environmentalaudit) 4.4 Explain the significance of environmental audit 4.5 Explain management review 4.6 List Audit tools and Technology used in Environmental Audit	nmental Management Systen Explain the different types and forms of environmental audit List the audit toolsand technology	n Audit -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
	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					

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

		Explain the benefitsto the EMS Auditorof using the			
		EMS audit tool.			
General	Objective 6.0: know the element	of environmental audit	·	·	·
12-13	<ul> <li>6.1 Describe the basic aim of environmental auditing</li> <li>6.2 Explain the foundational element of environmental Audit</li> <li>6.3 explain the types of environmental audit</li> <li>6.3 describe the main component of environmental audit</li> <li>6.4 Explain the steps involve in an environmental audit</li> <li>6.5 Explain the principle of</li> </ul>	Explain 6.1 -6.6with detailed note	Marker, marker board, projector. Charts.		Describe the basic aim of environmental auditing explain the types of environmental audit
	environmental audit				
General	<b>Objective 7.0:</b> Understand the net	eed for resource efficiency		•	

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

<b>PROGRAMME:</b> HIGHER NATIONAL DIPLON	IA IN ENVIRONMEN	NTAL SCIENCE AND MAN	NAGEMENT TECHNOLOGY					
COURSE: ERGONOMICS	<b>CODE:</b> 322	Credit Unit: 2.0	CONTACT HOURS: 2 HOURS/WEEK					
<b>GOAL:</b> This course is designed to enable the student know the purpose of Ergonomics in the work place								
YEAR: ONE (1), SEMESTER: TWO (2)	ESTER: TWO (2) PRE- REQUISITE: None PRACTICAL: 0 HOURS/WEEK							
GENERAL OBJECTIVES								
On completion of this course, the Student should	be able to:							
1.0 Know the Meaning and Significance of Ergon	omics in Industrial Saf	ety						
2.0 Understand Human Biological Systems Esser	ntial to Ergonomics							
3.0 Understand Ergonomics in Physical Effort Ta	ısks							
4.0 Know the Effects of Environment on Perform	ance in Physical Work	C.						
5.0 Understand Ergonomics in Psychomotor Tasl	KS							
6.0 Understand Ergonomics in Visual Inspection Tasks								
7.0 Know Workplace Design in Ergonomics								

PROGE	PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
<b>Course:</b>	ERGONOMICS		Course Code: ESM 322	Credit Unit: 2.0		<b>Contact Hours:</b> 2		
<b>GOAL:</b>	GOAL: This course is designed to acquaint the student with the							
Course Specification: THEORETICAL PRA			PRACTICAL CO	NTENT				
CONTE	ENT							
General	<b>Objective 1.0:</b> know the meaning	ng and significance of erg	onomics in industrial safety	/				
Week	Specific Learning Outcome	<b>Teachers'</b> Activities	Learning Resources	Specific Learning	Teachers'	Evaluation		
				Outcome	Activities			
1-2	1.1 Define ergonomics	Defines Ergonomics	-projection	• -	■ -	List factorsessential in		
	1.2 Explain the		-textbooks			ergonomics		
	significance of	List factors essentialin	- internet					
	ergonomics	ergonomics	- lecture notes					
	1.2 State factors relevant in		tutorial					
	ergonomics: nature of job,							
	biological capability, body							
	dimensions, acceptable							
	working hours							
	etc.							
General	<b>Objective 2.0:</b> Understand Hum	an Biological Systems Es	sential to Ergonomics		<u> </u>			

4-5	2.1 Name parts of the	Describe the	-projection	Identify two	Guide students to	Describe
	human skeleton and	components of the	-textbooks	Ergonomic	identify two	thecomponents
	associated muscles for	human skeleton and	- internet	solutionsto reduce	Ergonomic	ofthe humanskeleton
	movement	associated muscles	- lecture notes	the risk factors for	solutionsto	and
	2.2 Explain heartbeat,	for movement.	tutorial	musculoskeletal	roduce the risk	associated muscles
	breathing process and			injuries	feature for	for
	oxygen	Explain process			factors for	movement
	consumption/energy	essential in			musculoskeletal	
	production at rest and at	ergonomics both at			injuries	
	work.	rest and at work.				
	2.3 List the main parts of					
	the central nervous system	Describe the				
	(CNS) and the peripheral	nervous system,				
	nervous system (sensory	reflex and				
	and motor nerve)	voluntary actions				
	2.4 State the pathway of					
	nervous impulse in reflex					
	action and a voluntary	Show ergonomics				
	action.	checklist for task				
	2.5 Explain the risk factors					
	for musculoskeletal injuries					
	2.6 Discuss two					
	Ergonomic solutions to					
	reduce the risk factors for					
	musculoskeletal injuries					
General	<b>Objective 3.0:</b> Understand Ergor	nomics in Physical Effort 7	Tasks			

	3.1 Explain the three main	Describes physical	-projection	■ _	■ _	Explain physical effort
67	types of physical effort tasks	effort tasks and	-textbooks			tasks and parameters for
0-7	<ul> <li>– full body dynamic work,</li> </ul>	parameters for	- internet			measurement of physical
	localized muscular work,	measurement of	- lecture notes			work
	static muscular work.	physical work.	- tutorial			WOIR .
	3.2 Explain parameters for		ergonomicschecklist for			
	measurement of physical	Describe and	task			
	work – oxygen consumption,	demonstrate the				
	heart beat rate, blood	proper way to lift a				
	pressure, body temperature,	load.				
	sweat rate.					
	3.3 Explain the factors	Explain factors that				
	influencing results in 3.2	influence parameters				
	such as sex, age,	for measurement of				
	environment, etc.	physical work.				
	3.4 Explain work and rest					
	cycles, recovery time	Assign problems on				
	formula and its importance	work rest cycles and				
	in rest pausesduring	recovery time formula				
	physical effort tasks.	to students tosolve.				
	3.5 Explain biomechanical					
	factors in work and some	Explains				
	causes of disability of	biomechanical factors				
	biomechanical origin	and causes of				
		disability of				
		biomechanical origin				

		Show ergonomics checklist for task				
General	<b>Objective 4.0:</b> Know the Effects	of Environment on Perform	nance in Physical Work	1	I	
8-10	<ul> <li>4.1 Explain the effect of heat on performance at work.</li> <li>4.2 State factors which influence gain or loss heat <ul> <li>ambient temperature,</li> <li>relative humidity, air</li> <li>velocity, radiant heat.</li> </ul> </li> <li>4.3 Explain anti action of heat load – length of time a man carryout a specific task in a particular thermal environment.</li> <li>4.4 Explain heat stress index and the basis.</li> <li>4.5 Explain reduction of heat stress in a work environment.</li> </ul>	<ul> <li>Explains how heat can affect work performance</li> <li>Describes factors that influence gain or lossof heat.</li> <li>Gives the formula for heat stress index and ask students to determine the heat stress index of the environment.</li> <li>Explain the control of heat stress in the work environment</li> </ul>	-projectio n -textbooks - internet - lecture notes tutorial			Describes factors that influence gainor loss of heat.
General	Objective 5.0: Understand Ergon	nomics in Psychomotor Task	<u> </u>			
11	5.1 Define psychomotor tasks and list distinguishing features and examples of psychomotor tasks e.g.	Explains Psychomotor tasks and enumerates distinguishing	-projection -textbooks - internet - lecture notes	• -	• -	Explains Psychomotor tasks and enumerates distinguishingfeatures.

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

	<ul> <li>tasks – niuty glare, ageetc.</li> <li>6.4 Explain the psychological factors of training alertness, perceptual organization, learning and motivation in effectiveness in visual inspection tasks.</li> <li>6.5 Explain conditions for good visual inspection task design – lack of ambiguity, work done small loots, adequate time etc.</li> </ul>	effectiveness of visual inspection tasks. List condition for good visual inspection task designand show ergonomicschecklist for task				
General	<b>Objective 7.0:</b> Know Workplace	Design in Ergonomics				
14	<ul> <li>7.1 Explain a good</li> <li>workplace design in</li> <li>relation to operator</li> <li>efficiency and safety.</li> <li>7.2 Define Anthropometry</li> <li>7.3 State the main</li> <li>anthropometric dimensions</li> <li>necessary forthe design of</li> <li>workplacesin regards to</li> <li>sitting and standing</li> <li>postures.</li> <li>7.4 Explain the meaningand</li> <li>significance of working</li> <li>surface and statedimensions</li> <li>of working</li> </ul>	Explains a good workplace design Explains Anthropometry and anthropometric dimensions for workplace design. Explains the meaningand significance of -work envelope - workplace height - footrest and foot pedals	-projection -textbooks - internet - lecture notes - tutorial -ergonomicschecklist fortask	• -	• -	Explain the meaning and significance of working surface and state dimensions of working surface for males and females.

surface for males and females. 7.5 Explain the meaning and significance of working envelope and state dimensions for right hand	Describe the types of chairs in particular jobs and acceptable chair dimensions.		
side of the maximumworking envelope for males and females. 7.6 Explain the meaning and	Show ergonomics checklist for task		
significance of workplace			
height and describe the			
design dimensions of a sit-			
stand, standing, and sitting			
workplaces.			
7.7 Explain the significance			
of and state good design			
parameters offootrests and			
foot pedals.			
7.8 Explain selection offixed			
or swivel chairs inparticular			
jobs and statethe generally			
acceptablechair dimensions			
in relations to industrial			
population.			

## 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-**PRACTICAL: 2** HOURS/WEEK **REQUISITE: GENERAL OBJECTIVES** On completion of this course, the Student should be able to: 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. Know the use and maintenance of colony counter. 11.0

12.0 Know the use and maintenance of autoclave, centrifuge and incubator								
PROG	RAMME: HIGHER NATIO	NAL DIPLOMA IN EN	VIRONMENTAL ANI	D SAFETY MANAGEN	MENT TECHNOLOG	Y		
Course	: Instrumentation and Laborat	ory Analysis Co	ourse Code: ESM 325	Credit Unit: 3	<b>Contact Hours:</b> 3			
GOAL	GOAL: This course is designed to provide the student							
Course	Specification:	Th	neoretical	Practical Content: 2	hrs			
Conten	t:1hrs				111.5			
GENE	RAL OBJECTIVE 1.0: Unde	erstand the Principles and	Instrumentation of color	rimetry and spectrophoto	metry			
Course	Specification:	THE	ORETICAL	PRACTICAL CONTI	ENT			
CONT	ENT							
Week	Specific Learning	Teachers' Activities	Learning Resources	Specific Learning	Teachers'	Evaluation		
	Outcome			Outcome	Activities			
1-2	1.1 State the wave length	Explain the	Relevant	Carry out	Guide students to:	What are the		
	within the	differences between	transparencies;	measurement	-carry out	similarities in the		
	electromagnetic	wavelength of light	Overhead	using	measurement	working principle		
	spectrum.	within the visible	projector	colorimeters.	using	of the colorimeter		
	1.2 Distinguish between	region and invisible			colorimeters.	and		
	wavelength of light	region and the	Colorimeter;	Carry out routine		spectrophotometer		
	withinthe visible region	similarities in the	Spectrophotomet	maintenance on	-carry out			
	and invisible region.	working principle of	er;	the colorimeter	routine			
	1.3 Explain the	the colorimeter and	Filters.	e.g. care offilters	maintenance			
	similarities in the	spectrophotometer.		and cuvettes.	on the			
	workingprinciple of the		Spectrophotometer		colorimeter			
	colorimeter and	Exemplify the	samples solvents		e.g. care of			
	spectrophotometer.	various parts of a	Screw driver;Fine	Determine	filtersand			
	1.4 Identify the	colorimeter	brush; Bellow brush;	concentration of	cuvettes.			
	variousparts of a	and the functions of	Lens tissue.	samples applying				

 colorimeter	the parts in 1.4	Reer	-determine	
1 5 Explain the	above	- Lambert"s Law	concentration of	
functions of the parts in	above.	and using	complex	
1 4 above	- Evaluin the	and using	samples	
	• Explain the	spectrophotometer.	applying beer -	
1.6 State basic	similarities and	~ .	Lambert's Law	
similaritiesand	differences betweena	Carry out minor	and using	
differences between a	colorimeter and	maintenance work on	spectrophotomet	
colorimeter and	spectrophotometer	thespectrophotometer	er.	
spectrophotometer.	Explain the	e.g. dusting,		
1.7 Explain the	functions of	replacement of lamps	-Ccarry out	
limitationsof colorimeter	diffraction grating in	etc.	minor	
in microbiological	spectrophotometry		maintenance	
studies.	the term interference		workon the	
Explain the term	filtor		spectrophotomet	
spectrophotometry.	Inter.		er	
1.9 List the	Eurlain the function		e.g. dusting,	
varioussources of	Explain the function		replacement of	
light for	of optical filter in		lamps etc.	
spectrophotometr	spectrophotometry.		F	
icdetermination.	State the basic laws			
1.10 Describe	of			
diffractiongrating	spectrophotometry			
1 11 Explain the	viz: Bonger			
functions of diffraction	Lambert''s law,			
arating in	Beer's law.			
graning in spectrophotometry				
1 12 Exploin the	Explain the			
	working principles			
terminterference				

filter.	of the			
1.13 State the function	spectrophotometer.			
ofoptical filter in				
spectrophotometry.	List the functions			
1.14 State the basic	of the parts in the			
laws of	optical system of a			
spectrophotometry viz:	spectrophotometer.			
Bonger Lambert"s law,				
Beer"s law.	List the different			
1.15 Explain the	types of detections			
workingprinciples of	used in			
the spectrophotometer.	spectrophotometry.			
1.16 List the functions				
of the parts in the				
optical system of a				
spectrophotometer.				
1.17 List the different				
types of detections used				
inspectrophotometry.				
1.18 List the functions				
of parts in the optical				
systemof a				
spectrophotometer.				
1.8 List the different				
types of detection used				
inspectrophotometry.				
<b>GENERAL OBJECTIVE 2.0:</b> Kr	low the operation and care of	of flame photometers an	d spectrometers	

3-4	2.1 Explain the	Explain the various	Relevant	Determine	Guide students to:	State the
	principle of operation	parts of a	transparencies;	sodium,	-determine	similarities and
	of the flame	photometer.	Overhead	potassium and	sodium,	differences
	photometer.	and the functions of	projector	calcium using	potassiumand	between the
	2.2 Explain the	the various parts of		flame photometer	calcium using	spectrophotometer
	variousparts of a	atomizer, e.g. carbon	flame photometer	omission	flame	and flame
	photometer.	rod.	Atomizer cleaning	spectrum.	photometer	photometer.
	2.3 State the functions	State the similarities	device. Lamp nose		omission	
	of the various parts of	and differences	plier;Star	Clean atomizer	spectrum.	
	atomizer, e.g. carbon	betweenthe	screwdriver	usingcleaning		
	rod.	spectrophotometer	Calibrator.	probe.	-clean	
	2.4 State the similarities	and flame			atomizer	
	and differences between	photometer.	Service manual;		using	
	the spectrophotometer		Atomizer cleaning	Record spectra of	cleaning	
	andflame photometer.	List the errors inherent	device;Lens tissue	knowncompound	probe.	
	2.5 List the errors	in practicalflame		using Raman		
	inherentin practical	photometry and how		Spectrophotometer.	-record spectra	
	flame photometry and	they can be corrected			of known	
	how they can be	particularly as applied		Carry out	compound using	
	corrected particularly as	to biology.		routine	Raman	
	applied to biology.			maintenance	Spectrophotomet	
	2.6 Explain how to			on	er	
	correct he errors in 2.5			Spectrophoto		
	above.			meter.	-carry out	
	2.7 Describe parts of				routine	
	theSpectrometers.			Carry out typical	maintenance on	
	2.8 Explain the			maintenance routines	Spectrophotomet	
	functionsof the parts			for the flame	er	

	in 2.7 above.			photometer e.g. clearing deposits from theatomizer.	-carry out typical maintenance routines for the flame	
					photometer e.g. clearing	
					deposits from the atomizer.	
GENE	RAL OBJECTIVE 3.0: Know	w the operation and care o	f Atomic Absorption Sp	ectrophotometers (AAS)		1
5-6	<ul> <li>3.1 Explain how to Identify the parts of anAAS e.g. extension sources.</li> <li>3.2 Describe the working principle of each of the component parts of the AAS (especially the hollowcathode lamp).</li> <li>3.3 Describe the steps foroperating the AAS.</li> </ul>	Use diagrams and sketches AAS. Describe the working principle of each of the component parts of the AAS (especially the hollow cathode lamp). Explain the stepsfor operating theAAS	Relevant transparencies; Overhead projector AAS	Draw a schematic labeled diagram of the AAS. Measure the absorbanceof a sample of known concentration using the AAS. Carry out routine maintenance on an AAS	Guide students tomeasure the absorbance of a sample of known concentration using the AAS. Guide students to carry out routine maintenance on an AAS	State the working principle of each of the component parts of the AAS
GENE	KAL OBJECTIVE 4.0: Knov	w the operation and care o	t the X-ray spectroscope			

7-9	4.1 Explain how to	Use diagrams and	X-ray	Measure the	Guide students to:	State the operation
	Identify the parts of the	sketches to	fluorescence	absorption of a given	-measure the	and working
	X-ray spectroscope.	explainparts of the	spectrometer;	sample using the X-	absorption of a	principles of the
	4.2 Describe the	X-ray	Filters	ray instrument and	given sample	units such as
	partslisted in 4.1	spectroscope.	Lens tissue	alsoby varying the	usingthe X-ray	collimation,
	above.			filters.	instrument and	filters, analyzing
	4.3 Draw a block	the parts listed in			also by varying	crystals and
	diagramof an X-ray	4.1 above.		Measure the	thefilters.	detectors.
	spectroscope.	4.3 Draw a		absorption of a given		
	4.4 Describe the	blockdiagram of		sample using the X-	measure the	
	operation and working	an X-ray		ray instrument and	absorption of a	
	principles of the units	spectroscope.		alsoby varying the	given sample	
	such as collimation,	Describe the		filters.	using the X-ray	
	filters, analyzing crystals	operation and			instrument and	
	and detectors.	working principlesof			also by varying	
	4.5 Draw non-	the units such as		Carry out routine care	thefilters.	
	dispersiveX-ray	collimation		of the instrument e.g.		
	absorption meter.			cleaning of filters,	-carry out	
	4.6 List the parts of an			verification of optical	routine care of	
	X-ray fluorescence			instruments.	the instrument	
	spectrometer.				e.g. cleaning of	
	4.7 Describe parts of an				filters,	
	X-ray fluorescence				verification of	
	spectrometer				optical	
GENE				 	instruments.	
GENE	RAL OBJECTIVE 5.0 Know	the operation and care of	of electrolytic conductivit	y bridge; coulometric titrat	tion; PH meter; auto the	itration;
polarog	raph					

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

proportional coun	iters, photographic	roportional counters,	Semiconductor	source (emitter)	radioactive	envision,	
scintillation count	ters, envision, ionization	cintillation counters,	detector	using a gas	source(emitter)	ionization	
semi-conductor	chambers and	emi-conductor		counter.	using a gas	chambers and	
detectors,Geiger-	Muller proportional	etectors,Geiger-Muller			counter.	proportional	
counter.	counters, scintillation	ounter.		Measure counter		counters,	
	counters, semi-			per secof a beta	-measure	scintillation	
Explain the oper	rationof conductor detectors,	Explain the operation of		emitter using	counterper sec	counters, semi-	
each detector an	d counter Geiger- Muller	each detector and counte		scintillating	of a beta	conductor	
in 6.1 above.	counter	in 6.1 above.		counter.	emitter using	detectors, Geiger-	
					scintillating	Muller counter.	
				Measure counts	counter.		
				per secfor an			
				emitter using	-measure		
				proportional	countsper sec		
				counters.	for an emitter		
					using		
				Carry out routine	proportional		
				care of detectors	counters.		
				and counters in			
				6.1 above.	-carry out routine		
					care of detectors		
					and counters in 6.1		
					above.		
General Objective 7.0: Understand the operation and care of gas chromatographic equipment fluorimeter, polarimeter and refractometer							
7.1 Explain gas	Use diagrams and	.1 Explain gas	Gas chromatograph	Carry out	Guide students to	Identify the	
chromatograph	sketches to	hromatograph	Fluorimeter	measurements	:	parts of:	
у	explainparts of			using instruments	-carry out	(i) Gas	

	<ul><li>7.2 Identify the parts of:</li><li>(i) Gas chromatograph</li><li>(ii) Fluorimeter</li><li>Polarimeter iv)</li><li>Refractometer</li></ul>	Gas chromatograph Fluorimeter Polarimeter	Polarimeter Refractometer	in 7.2above. Carry out routine care and	measurements using instruments in 7.2 above. carry out routinecare and	chromatograph Fluorimeter(iii) Polarimeter (iv) Refractometer
	1 7.3 Explain the working principles of each instrument in 7.2 above	Refractometer		instruments in 7.2	maintenance of instruments in 7.2	
GENE	RAL OBJECTIVE 8.0: Know	w the concept of hydroge	en in concentration			
	8.1 Explain the term pH	Explain the term	pH meter; Buffer	Determine the pH	Guide students	State the
	8.2 Explain why the pH	pH,pH scale	tablets.	of solutions by	to measure pH	usefulness of
	scale ranges from 0 to	rangesfrom 0 to		using a pHmeter.	of different	pН
	14.	14.			solutions.	
	8.3 State Bronsted-					
	Lowrytheory of acid and	Explain Bronsted-		Carry out routine		Enumerate
	base.	Lowry theory of		maintenance of pH-	Guide students to	themain
	8.4 Calculate the pH of	acid and base and		meter	carry out routine	problems
	anacid and a base	calculate the pH of		e.g. cleaning and	maintenance of	involved in
	applying the theory in 8.3	an acid and a base		reactivation of the	pH- meter e.g.	pH
	above.	applying the		electrodes.	cleaning and	measureme
	8.5 Explain the	theory.			reactivation of the	nt
	functionsof buffer with				electrodes	
	example.	Explain the				
	8.6 Enumerate the main	functions of				
	problems involved in	bufferwith				
	pHmeasurement.	example.				
	8.7 Explain how the	$P^{H}$ .				
	problems in 8.6 above					

areovercome. 8.8 Describe The potentiomet ric method of determinati					
<b>CENERAL OBJECTIVE 9 0:</b> Know	w the various types of e	  ectrodes used in measurit	gions like fluoride nitra	te etc	
GENERAL OBJECTIVE 9.0: Know9.1 Identify ion - selectiveelectrodes9.2 State the uses of ion -selective electrodes9.3 Explain the basic principles of operations ofan ion-selective electrode.Explain the relationship between activity and concentrationof an ion.9.5 List the various typesof gas measuring electrode.9.6 Identify an oxygenelectrode.9.7 Identify the varioususes of an oxygen electrode	Explain the basicprinciples of operations of an ion-selective electrode, the relationship between activity and concentration of an ion and the various types of gasmeasuring electrodes: oxygen electrode, electrodes for pH measurement e.g. glass, combination.	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 principlesof operations of an ion- selective electrode

	9.8 List electrodes for	maintenance of						
	pHmeasurement e.g.	electrodes.						
	glass, combination							
	9.9 Describe the routine							
	maintenance of							
	electrodes							
	e.g. in store in							
	distilledwater, use							
	correct concentration							
	of							
	reactivator.							
Genera	General Objective 10.0: Know the principle of autoradiography							
			Γ	Γ				
	10.1 Explain	Use diagrams	Autoradiograph	Demonstrate the	Guide students to	List the		
	autoradiograph	and sketches to	yEquipment	techniques of	demonstrate the	various		
	У	explain		autoradiography	techniques of	techniques		
	10.2 Identify the	autoradiography			autoradiography	of		
	components used	, components				autoradiogra		
	inautoradiography	used in				phy		
	10.3 Describe	autoradiography						
	theapplications	, the						
	of	applications of						
	autoradiography	autoradiography						
	9.4 Demonstrate the	and the						
	techniques of	techniques of						
	autoradiography.	autoradiograpy.						
Genera	General Objective 11.0: Know the use and maintenance of colony counters							

	11.1 Identify types of	Use diagrams	. Colony	Count bacteria	Guide students to:	Describe the
	bacterial colony	and sketches to	counter	coloniesusing	-count	principle of
	counters.	explainthe		colony counter.	bacteria	operation of
	11.2 Identify the parts of	functions of		5	colonies	thecolony
	the counter in 13.1	different types		Carry out routine	using colony	counter
	above.	of colony		maintenance and	counter.	
	11.3 Explain the function	counters.		repair of colony		
	of each part in 13.2			counters	-carry out routine	
	above.				maintenance and	
	9.5 Describe the				repair of colony	
	principle of operation of				counters.	
	the colony counter.					
Genera	al Objective 12.0: Know the us	se and maintenance of a	utoclave, centrifuge and i	ncubator		
	12.1 State the	Use diagrams and	Autoclaves;	Sterilize centrifuge.	Guide students to:	State the
	functionsof:	sketches to	Centrifuge;		-	functions of:
	(a) Autoclave	explainthe	Incubator	Use	sterilize	(a) Autoclave
	(b) Centrifuge	functions of:		centrifuge	centrifu	(b) Centrifuge
	(c) Incubator.	(a) Autoclave		for	ge	Incubator.
	12.2 Identify the parts	(b) Centrifuge		separation.	-use centrifuge	
	of the instruments in	Incubator.			forseparation.	
	12.1 above.			Grow organism		
	12.3 Explain the functions			usingincubator	-grow	
	of the parts in 12.2				organism	
	above.			Carry out routine	using	
				maintenance of	incubator.	
				theinstruments in		
				12.1	carry out routine	
					maintenance of	

					theinstruments 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 PRE-**YEAR:** ONE (1), **SEMESTER:** ONE (1) **PRACTICAL: 2** HOURS/WEEK **REQUISITE:** none **GENERAL OBJECTIVES** On completion of this course, the Student should be able to: 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.

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

Non hozordous	nhysical		laboratory	
Non-nazaruous.	physical		laboratory	
1 4 Classify wastes	appearances to		analysis of	
1.1 Clussify wastes	classify waste as		samples	
according to their	given in 1.4		-	
physical appearance:				
• Paper				
Organics				
Glass	Use state of matterto			
V Glass	classify waste asgiven			
• Metals	in 1.5.			
Construction	Explain factors			
debris	influencing Waste			
1.5 Classify wastes	apparetion a g			
according to nature.	generation e.g.			
• Colid	• Population			
• Solid	density			
Liquid	Economic			
Gaseous	standing			
	Social standing			
1.6 Enumerate factors	• Social standing			
influencing Waste				
initiations waste				
generation:				
<ul> <li>Population density</li> </ul>				
<ul> <li>Economic standing</li> </ul>				
<ul> <li>Social standing</li> </ul>				
General Objective 2.0: Know the basic pr	inciples of wastes hierarch	ıy		

4-5	2.1 Define Waste hierarchy	Give the meaning of	Laptop White	Carry out field	Guide students to
		Waste hierarchy,	boardText Books	trips towaste	:
	<ul> <li>2.2 Explain the concept of Waste hierarchy</li> <li>Waste prevention (Rejection)</li> <li>Waste minimization</li> <li>Waste recycling</li> <li>Waste recovery</li> <li>Waste treatment</li> <li>Waste disposal</li> <li>2.3 State the purposes of Waste Hierarchy.</li> </ul>	purpose of waste hierarchy. Explain waste minimization: a) Waste stream analysis waste reduction/ minimization Assessment Explain Waste stream analysis.	Internet Projector Lecture NotesSamples	<ul> <li>management authorities.</li> <li>Observe waste collectionand disposal practices.</li> <li>Identify the waste hierarchy i.e.</li> <li>Waste prevention</li> </ul>	<ul> <li>-carry out field trips to waste management authorities.</li> <li>-observe waste collection and disposal practices.</li> </ul>
	<ul> <li>2.4 Enumerate Waste minimization guide i.e.:</li> <li>Waste stream analysis</li> <li>Waste reduction/ minimization assessment.</li> <li>2.5 Explain Waste stream analysis.</li> <li>2.6 Enumerate methods of waste disposal</li> </ul>	Explain waste disposal methods		(Rejection) Waste minimization Waste recycling Waste recovery Waste treatment Waste disposal.	-identify the waste hierarchy i.e. Waste prevention (Rejection) Waste minimization Wasterecycling

				Identify techniques of waste minimization. Identify waste disposalmethods. Undertake waste streamanalysis.	Wasterecovery Wastetreatment Wastedisposal. -identify techniquesof waste minimization. -identify waste disposal methods. -Undertake waste stream analysis.	
General	<b>Objective 3.0:</b> Know the implica	tions of poor waste handling	ng to man's health and his	environment		
6-7	<ul> <li>3.1 Name common pollutants in waste handling such as:</li> <li>dioxins</li> <li>furans</li> <li>Nitrogen</li> </ul>	Explain common pollutants in waste handling. • Explain the health	Laptop White boardText Books Internet Projector Lecture Notes	Identify health problems associated with waste handling such as: Reproductive	Guide students to: -identify health problems associated with waste handling	Explain the causative organisms of the health problems above, resultingfrom poor waste handling.
Oxide	implications of	effects	such as:			
--	---	---	--	--		
<ul> <li>Sulphur</li> </ul>	poor handling of	Congenital	Reproductive			
Oxide	waste, e.g.	malformations	effects			
Oxide • Lead • Cadmium • Mercury • Chromium, • Arsenic • Beryllium 3.2 Explain health problems associated with poor waste handling such as; • Reproducti ve effects • Congenital malformati ons • Cancer • Cardiovasc ular disorders • respiratory infe ction • Hepatitis B • Lassa fever	<ul> <li>waste, e.g.</li> <li>Reproductiv eeffects</li> <li>Congenital malformation s</li> <li>Cancer</li> <li>Cardiovascula rdisorders</li> <li>respiratory infection</li> <li>Hepatitis B</li> <li>Lassa fever</li> <li>Explain the causative organisms of the health problems above, resulting from poor waste handling</li> </ul>	malformations Cancer Cardiovascular disorders respiratory infection Hepatitis B Lassa fever. Identify the causative organisms of the health problems above, resulting from poor waste handling. Identify pollutants inwaste handling Identify the nature of pollutants inherent in waste	effects Congenital malformations Cancer Cardiovascular disorders respiratory infe ction Hepatitis B Lassa fever. -identify the causative organismsof the health problems above, resulting from poor waste handling. -identify pollutantsin waste handling identify the natureof			
		pollutants inherent in waste handling.	identify the natureof pollutants			

					inherent in				
					waste handling.				
General	eneral Objective 4.0: Know waste collection and disposal methods								
General 8-10	Objective 4.0: Know waste collection         4.1 Explain solid waste         collection and disposal         processes such as:         • Generation         • Segregation         • Primary collection         • Secondary         collection         • Treatment/Recover         y         • Disposal         4.2 Explain solid waste         disposal methods:         a) Open burning         b) Incineration         c) Composting         d) Barging into sea         e) Land Filling.	<ul> <li>ection and disposal methods</li> <li>Explain the processes of solid waste collection and disposal listedin 4.1</li> <li>Explain the various methods of disposal of solid waste listed in 4.2.</li> <li>Explain the liquid wastes e.g.         <ul> <li>d) Sewage</li> <li>e) Sullage</li> <li>f) Urine</li> </ul> </li> <li>Explain various means and/or facilities of disposal of excreta.</li> <li>Explain good practice of disposal of excreta</li> </ul>	Laptop White boardText Books Internet Projector Lecture Notes Samples	Identify         solid         waste         collection         methods.         Identify solid         wastedisposal         methods.         collection         methods.         Identify         liquid         waste         disposal         methods.	waste handling.Guide students to: -identify solid wastecollection methodsidentify solid wastedisposal methods. -identify liquid waste collection methods. -identify liquid waste disposal methods.	Explain good practice of disposal of excreta vis-a-vis sewage management			
	<ul><li>4.3 Name the liquid wastes e.g.</li><li>a) Sewage</li><li>b) Sullage</li></ul>	vis-a-vis sewage management. Explain composition of excreta such as;		means and facilities of solid treatment and disposal. Identify various	-identify various means and facilitiesof solid treatment and disposal.				

c) Urine	a) Nitrogen	n	means and		
	b) Phosphorus	f	facilities of	-identify	
4.4 Describe methods/	c) Potassiu	1	iquid waste	various means	
facilities of excreta	m	11 11	reatment and	and facilities of	
disposal:	d) Organia	u d	disposal	liquid wasta	
uisposai.	d) Organic	u	iisposai.	iiquiu wasie	
	Carbon			treatment and	
a) Conservancy	Patho gens	Ide	lentify various	disposal.	
b) Pit latrine	Explain sewage	me	eans and	identify various	
c) Sanplat latrine	disposal methodssuch	fac	cilities used in	means and	
d) VIP latrine	as:	se	ewage	facilities used in	
e) Pour flush latrine	a) Physical method	ma	anagement.	sewage	
	b) chemical			management	
4.5 Enumerate	method				
composition of excreta	Biologicalmethod				
such as;					
a) Nitrogen					
b) Phosphorus					
c) Potassium					
d) Organic carbon					
e) Pathogens					
, 2					
4.6 Explain sewage					
disposal methods:					
a) Physical					
b) Chemical					
c) Biological					
<b>General Objective 5.0:</b> Understand the co	procept of waste - to - wealth	to create job opening			
General Objective Stor Chaerstand the Co	meept of waste to weath	to create job opening			

	5.1 Define the term	Explain what	Laptop Text	Perform	Guide students	Explain whatwaste-to-
11	waste-to-wealth.	waste-to-wealth	BooksInternet	conversion of	to:	wealth means
		means with	Projector	wastematerials to	-perform	
	5.2 Explain wealth	examples.	Lecture NotesSamples	useful products.	conversion of	
	creation from solid				wastematerials	
	wastes e.g.	Explain how to collect,		Identify locally-	to useful	
	a) Manure production	sort out, process and		fabricated	products.	
	from:	turn waste into useful		machines and		
	i. House-hold	products, examplesin		processing	-identify	
	wastes	5.2.		equipment used	locally-	
	ii. Community waste			in converting	fabricated	
	compostinginto	Explain the processof		wastes-to-wealth	machinesand	
	organic fertilizer	wealth creation from		e.g.:	processing	
	b) Biogas Generation	waste waters e.g.		Hoppers	equipment used	
	from:	• Use of treated		Extruders	in converting	
	i. House-hold	effluent for		Aggregators	wastes- to-	
	sewage	agriculture		Rollers	wealth e.g.:	
	ii.Municipal Solid			~	Hoppers	
	wastes			Set up a	Extruders	
	b) Conversion of			demonstration	Aggregators	
	Extruders			household	Rollers	
	c) Aggregators			composting		
	Rollers			facilities	-set up a	
					demonstration	
					house-hold	
					composting	

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY										
COURSE: Remote Sensing Application       CODE: 327       Credit Unit: 2       CONTACT HOURS: 2         HOURS/WEEK										
<b>GOAL:</b> This course is designed to expose student	s to the process of dete	ecting and monitoring the ph	sysical characteristics of an area by							
measuring its reflected and enfitted radiation at a di	stance.									
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.

PROGR	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 characte	ristics of an area b	ymeasuring its			
reflected	and emitted radiation at a distance	е.		I					
Course	Specification:	THE	EORETICAL	PRACTICAL CO	NTENT				
CONTE			•						
General	<b>Objective 1.0:</b> Understand how	to use of Lasers in Survey			Taaahawa?	Evaluation			
vveek	Specific Learning Outcome	Teachers' Acuviues	Learning Resources	Outcome	Activities	Evaluation			
1-2	<ul> <li>1.1 Explain how to give an account of the historical background of position-fixing by satellite.</li> <li>1.2 Explain the Doppler shift of frequency and its use in position- fixing by means of satellite systems</li> <li>1.3 Describe the global positioning system</li> <li>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-</li> </ul>	Explain GPS Explain the historical background of position fixing by satellite Describe various equipment used Explain position fixing in relation to satellite signalsand Doppler measurement	GPS magnavox MX 2502 wild WM101	Use global positioningsystem (GPS)	Guide students to use of global positioning system(GPS)	Explain theposition- fixing technique			

		dimensional fix results				
	1					
	1.	5 Explain the position-				
		fixing technique, with				
		special reference to:				
	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				
General	Object	ive 2.0: Know the Geome	etric Characteristics of The	rmal, Radar, Landsat and	Spot Imageries	

4-5	2.1 Describe the sources	Explain	MSS, LandsatSPOT,	Determine	Guide	Explain the
	of distortions present	distortions in	CLAD	parallaxes on	students to	characteristics of
	in imageries	imageries	SLAK	thermal, SLAR	determine	signal returns
	2.2 Explain the causes of	• Explain the effects of	imageries and	Landsat and SPOT	parallaxes on	from
	each type of	start range and relief	CCT"s	imageries	thermal,	
	distortion	in SLAR/SPOT			SLAR Londoot and	
	of slant range and	Imageries			SPOT	
	ground range on	Explain spectral			Imageries	
	SLAR and SPOT	signature and parallax				
	imageries	on thermal, SLAR				
	2.4 Explain relief	Landsat and SPOT				
	displace in SLAR and	imageries				
	SPOT imageries					
General	<b>Objective 3.0:</b> Understand the T	<b>Sechniques of Interpretation</b>	n of Thermal, Radar, L/Sat	t & SPOT Imageries		
	3.1 State the bands and	Explain bandsand	WhiteboardGraphs	Determine the	Guide students to	List the componentof
6-7	ranges of pulse	ranges of pulse		differencesin	determine the	SOLAR
0 /	transmission of	transmission		radiant	differences in	and SPOT transmission
	SOLAR and SPOT	Discuss radient		temperatures	radiant	
	Landsat and	temperatures of		existing within a	temperatures	
	Thermalsystem.	comperatures of		scene.	existing within a	
	3.2 Describe the	earth leatures.			scene.	
	characteristics of	• State the advantages				
	like-polarized and	and disadvantages of				
	aross polarized of	imageries				
		miageries.				
	SOLAR imageries					

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

	4.1 Define image	Define image	Whiteboard	• -	■ _	List the different method
8-10	enhancement	enhancement				of image enhancement
	4.2 Mention the different methods of image enhancement	• Explain methodsof image enhancement such as density slicing, smoothing etc				
	4.3 Explain the methods of density slicing colour enhancement, contrast					
	stretching smoothing and					
	edge enhancement					
	4.4 Explain the necessity					
	of coaxilling data for image					
	Enhancement					
General	l Objective 5.0: Know the Calibr	ation Parameters for the App	plication of Remotely Se	ensed Data in Enviror	nmental	
	Resource Manag	ement	Γ	I	ſ	
1.1	5.1 Differentiate the bands	Explain the	Whiteboard	• -	• -	State the advantages
11	used in environmental	Electromagnetic				and limitation of
	5 2 Explain the aparent	Spectrum				thermal, radar,
	bands suitable	Explain energy bands				Lanusai anusron Imageries
	for different earth	suitable forearth				mageries
	resources	features				
	5.3 Explain the use of composite bands in	Explain the use of thermal scanners in				

the study of earth	sensing seepage and		
resources	land pollution		
5.4 Explain the bands	State advantages and		
used for air, water	limitations of each scanner		
and land pollution			
5.5 Explain the use of			
thermal scanners in			
sensing seepages of			
oil on underground			
water			
5.6 State the advantages			
and limitation of			
thermal, radar,			
Landsat and SPOT			
imageries			

Genera	eneral Objective 6.0: Understand the Basic Principles of Geographical Information System and its Application in						
	Environmental Mo	onitoring and protection					
12-13	<ul> <li>6.1 Define Geographical Information System (GIS).</li> <li>6.2 Define environmental monitoring</li> <li>6.3 Describe the basic principles of Geographical Information System</li> <li>6.4 Describe the application of information technology in environmental monitoring</li> <li>6.5 Describe the basic elements of environmental Monitoring</li> <li>Explain the use of GIS in environmentalmonitoring and protection</li> </ul>	<ul> <li>Define G.I.S.</li> <li>Explain the basic principles of GIS</li> <li>Describe application of information technology in environmental monitoring</li> <li>Explain use of GIS in environmental monitoring and protection</li> </ul>	Whiteboard			Explain theuse of GIS in environme ntal monitoringand protection	
General	<b>Objective 7.0:</b> Understand the A	pplication of Remote Sensin	ng Equipment to Environ	mental Monitoring a	ndIndustrial Safet	y.	
14	7.1 Describe the use of the	Describe the use of	SLAR, MSS,	Use SLAR,	Guide students	Describe the use of	
	tollowing: Side looking Aicharge lider	SLAR, MSS,	Radiometer, GPS, GIS	MSS, Padiomator CDS	touse SLAR,	remote	
	Side looking Airborne lidar	Radiometer, GPS, GIS	GPK	GIS GPR to solve	MSS, Padiometer	Sensing equipment	
	(SLAK), Mullispectral	GPK etc		environmental	CDS CIS CDD		
	Diachronic Filter Landsat	Solve environmental		problems in the	to solve		

Imagery, Sport Satellite,	problems such aswater	following areas	environmental	
Photographic Records from	Resources.	Population	problems in the	
space, GPS, GIS, GPR	Management, Oil	dynamic, Water	following areas	
(Ground Penetratry	spillage, air pollution	Resources	Population	
Radar)	etc	management,	dynamic, Water	
	• Prepare contingency plan	Desert	Resources	
7.2 Describe the	for the above	encouragement,	management,	
use the equipment	for the above	Oil spillage,	Desert	
enumerate in 7.1to		Biodiversty	encouragement,	
solve		monitoring, Air	Oil spillage,	
environmental		pollution	Biodiversty	
problems in the		monitoring,	monitoring, Air	
following areas		Industrial	pollution	
Population		pollution and	monitoring,	
dynamic, Water		monitoring	Industrial	
Resources		Disaster	pollutionand	
management,		information	monitoring	
Desert		management	Disaster	
encroachments, Oil		system	information	
spillage,Biodiversty			management	
monitoring, Air			system	
pollution				
monitoring,				
Industrial pollution				
and monitoring				
Disaster				
information managementsystem				

GENERAL OBJECTIVE 8.0: Understand Lidar application for classification grid merging and map scaling							
8.1 Explain Airborne LidarSystem8.2 Describe how to useLidar system forAirborne classification8.3 Describe how to useLidar for classifyingpoint clouds8.4 Explain Lidar time series8.5 Describe Lidarapplication for forestryDescribe gridsfrom Lidar forforestryapplication8.7 Describe Lidargrid inerges8.8 Explain Mapscale usingLidarapplication	Explain the system, use and classification of lidar system. Explain the Lidar application for forestry Explain Lidargrid emerges Map scale using Lidar application	Whiteboard	Demonstrate application of Airborne Lidar systemfor point cloud Use Airborne Lidarsystem for forestry application	Guide students on the application of Airborne Lidar system for point cloud Guide students on the use of Airborne Lidar system for forestry	Describe Lidar system forairborne classification		
make up for the remaining 60% of the tota	l score.						

## YEAR TWO, SEMESTER ONE COURSE

PROGRAMME: Higher National Diploma in Environmental Science and Management Technology							
<b>COURSE:</b> Environmental Legislation,	<b>CODE: ESM</b> 412	Credit Unit: 2	<b>CONTACT HOURS:</b> 2 HOURS/WEEK				
Enforcement and Compliance							
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 Enviro	onment						
YEAR: ONE (2), SEMESTER: ONE (1)	PRE-	<b>PRACTICAL:</b> 0 HOURS	S/WEEK				
	<b>REQUISITE:</b>						
GENERAL OBJECTIVE:		I					
On completion of this course, the students should	be able to:						
1.0 Understand the national acts, regul	lations and laws						
2.0 Know laws relating to planning sc	hemes						
3.0 Understand laws relating to forest	ry and mining						
4.0 Understand the laws relating to wa	ter and land pollution	control in Nigeria					
5.0 Understand existing environmenta	l laws in Nigeria for c	ontrolling air pollution					
6.0 Know some international conventi	6.0 Know some international conventions and other countries environmental laws and how they are administered.						
7.0 Know environmental regulatory be	odies and their function	ns					

PROGRAMME: Higher National Diploma in Environmental Science and Management Technology						
Course	Environmental Legislation, Enfo	preement and	Course Code: ESM 412	Credit Unit: 2		Contact Hours: 2
Complia	ance					
GOAL:	This course is designed to enable	le students understand	Government requirements	for manufacture and sa	ales of goods and servi	ce tosafeguard health
and safe	ty and conserve the Environment					
Course	Specification:		THEORETICAL	PRACTICAL CON	TENT	
CONTE	ENT					
Genera	<b>Objective 1.0:</b> Understand the I	National Acts, Regulati	ons And Laws			
Week	Specific Learning Outcome	<b>Teachers' Activities</b>	Learning Resources	Specific Learning	Teachers'	Evaluation
				Outcome	Activities	
1-2	1.1 Explain the common	Explain federal,	Board. Audio- Visual	■ -	■ _	Explain the national
	law relating to	state, and local	Systems.			policy on the
	Negligence	government				environment 1989
	1.2 Explain 1999	environmental acts				
	Constitution of Nigeria:	regulations, limits,				
	Concurrent Legislative	standards guides				
	list part IIof the 2 <sup>nd</sup>					
	Schedule, item 17	Explain				
	1.3 Explain the national	petroleumlaws				
	policy on the	and regulations				
	environment 1989	and food safety				
	Explain federal	regulations				
	government, federal	Explain the				
	state, and local	following Public				

government	health laws:		
environmental acts	Food and drug acts		
regulations, limits.	1974.Standard		
standards guides	organization of		
1.5 Explain petroleum	Nigeria act 1971,		
laws and regulations			
1.6 Explain the food	Animal disease		
safety regulations	control act 1988,		
1.7 Explain the following	The marketing of		
Public health laws: Food	breast milk		
and drug acts 1974,	substitute act 1990,		
Standard organization of	NAFDAC act, 1993.		
Nigeria act 1971, Animal			
disease controlact 1988,	Explain the factories		
The marketing of breast	act 1987,		
milk substituteact 1990,	compendium of		
NAFDAC act, 1993.	Nigeria labour laws		
1.8 Explain the act 1987	1997, compendium		
1.9 Explain compendium of	of Nigeria social		
Nigeria labour laws1997	and labour laws		
1.10 Explain	2001 and		
compendium of	nuclear safety and		
Nigeria social and	radiation protection		
labour laws 2001	act 1995.		
1.11 Explain nuclear			
safety and radiation	Explain workplaceon		
protection act 1995	HIV/AIDS, Sea		
1.12 Explain workplace	fisheries act 1990		

	factories on HIV/AIDS	national crop varieties				
	1.13 Explain Sea	and livestock breeds				
	fisheries act 1990	act1987.				
	Explain nationalcrop					
	varieties and livestock					
	breeds act1987					
Genera	Objective 2.0: Know Laws Rel	ating to Planning Scheme	es			
4-5	2.1 Distinguish between	Distinguish	Board. Audio-	■ _	-	List composition
	Planning Authority and	between planning	Visual Systems.			responsibilities of
	Planning Scheme	authority				planning authorities
	2.2 List composition	and planning	Survey Equipment.			
	responsibilities of such	scheme.				
	authorities					
	2.3 State the power of	List composition and				
	Planning Authorities	responsibilitiesof				
	2.4 Explain provisions on	such authorities.				
	land acquisition, land	Explain provisions				
	compensation and	on land acquisition,				
	betterment	Compensation and				
	2.5 Describe the Procedure	betterment.				
	in declaring anarea a					
	planning area	Describe procedure				
	Explain the scope, contents and	in declaring an areaa				
	effects of schemes.	planning area.				
		• State laws				
		concerning				

		"protected" and Reserved Forestsand Prohibitions.			
General	Objective 3.0: Understand laws	s relating to forestry and r	nining		
6-7	<ul> <li>3.1 State laws concerning "Protected" and "Reserved" forests</li> <li>3.2 List practices prohibited in forest areas, and penalties attached</li> <li>3.3 Explain the provisionon parks, game reserves and wildlife sanctuaries</li> <li>3.4 Explain restriction on methods of hunting and disturbance of animals</li> <li>3.5 Define mining licenses, mining lease andway-leases</li> <li>3.6 State laws governing prospecting and working at mines</li> </ul>	<ul> <li>Explain the provision on parks, games reserves and wildlife sanctuaries.</li> <li>Explain methods restricting hunting and disturbance of animals.</li> <li>State laws governing prospecting and Working at mines.</li> <li>Explain safety regulations in underground mine working</li> </ul>	Board. Audio- Visual Systems.		Explain restriction on methods of hunting and disturbance of animals

	Explain safetyregulations in underground mine Working.				
Genera	l Objective 4.0: Understand the	laws relating to water and	land pollution control in	n Nigeria	
8-10	<ul> <li>4.1 Explain the laws <ul> <li>enabling the River Basin</li> <li>Development Authoritiesto</li> <li>control pollution in the</li> <li>4.2 rivers and lakes in</li> <li>eachauthority's area</li> <li>Explain the laws</li> <li>relating to "Oil in</li> <li>Navigable Waters"</li> <li>4.3 Identify existing laws</li> <li>designed to tackle problem</li> <li>of oil pollution atsea within</li> <li>50 miles from land and</li> <li>outside the territorial waters</li> <li>of Nigeria</li> <li>4.4 Explain the various</li> <li>Petroleum Acts and</li> <li>regulations for preventionof</li> <li>pollution of water- courses</li> <li>during oil operations</li> <li>4.5 Explain the role of</li> <li>Petroleum Inspectorate</li> <li>with regard to</li> <li>environmental protectionin</li> </ul></li></ul>	Explain the laws enabling the River Basin Development Authorities to control pollution in the rivers and lakes in each authority"sarea, laws relating to "Oil in Navigable Waters" 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	Board.Maps		Identify existing laws designed to tackle problem of oil pollution at seawithin 50 miles from land andoutside the territorial waters of Nigeria

	the Nigerian Oil Industry 4.6 Explain the development of water pollution laws in Nigeria Explain the sections of the Public Health Act Concerned with control of water and land pollution	role of Petroleum Inspectorate with regard to environmental protection in the Nigerian Oil Industry. Explain Public Health Act Concerned with control of water and land pollution				
Genera	l Objective 5.0: Understand exis	ting environmental laws in	n Nigeria for controlling	air pollution		
11	<ul> <li>5.1 Explain the Gas Reinjection Act as it relatesto control of air pollution</li> <li>5.2 Explain the Petroleum Refining Regulations as they relate to control of air pollution</li> <li>5.3 Explain the Noxious Act as it relates to air pollution control</li> <li>5.4 Explain sections of the</li> </ul>	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 Explain the philosophy of setting emission standards, the advantages and	Board and Legal Material International Journals on Environment		-	Explain the Petroleum Refining Regulations asthey relate to control of air pollution

	<ul> <li>Public Health Act concerned with preventionand control of atmospheric pollution</li> <li>5.5 Explain the philosophy of setting emission standards in environmental pollutioncontrol</li> <li>Describe the advantages and disadvantages of setting emission standards.</li> </ul>	disadvantages ofsetting emissionstandards in environmental pollution control				
General	<b>Objective 6.0:</b> Know some inte	ernational conventions and	other countries environ	mental laws and how	they are administered	
12-13	<ul> <li>6.1 Explain the ILO codeof practices, guides and manuals</li> <li>6.2 Explain the ILO conventions and recommendations since 1981 concerning occupational safety and health and the working environment</li> <li>6.3 Explain the air quality guidelines for the European</li> </ul>	Explain the ILO code of practices, guides and manuals, ILO conventions and recommendations since 1981 concerning occupational safety and health and the working environment Explain the air quality guidelines for the European	Board and Legal Material International Journals on Environment	•		Explain the ILO conventions and recommendatio ns since 1981 concerning occupational safety and health and the working environment

region, 1987	region, 1987		
6.4 Explain the standardson	Explain the standards		
limits for substances and	on limitsfor		
characteristic affecting	substances and		
acceptability ofwater for	characteristic		
domestic uses	affecting		
	acceptability of water		
6.5 Explain the importance	for domesticuses and		
of the US National	the importance of the		
Environmental Quality Act	US National		
of 1969 to Environmental	Environmental		
Protection.	Quality Act of 1969to		
	Environmental		
Explain the importance of	Protection.		
the US National			
Environmental Quality Act	Explain the functions		
of 1970 to Environmental	of the Environmental		
Protection	Protection Agency		
	[EPA] in USA and the		
6.7 Identify the functionsof	functions of the US		
the Environmental	Council on		
Protection Agency [EPA]in	Environmental		
USA.	Quality.		
	<b>D</b> 1 · <b>D</b> · · · <b>#</b>		
6.8 Identify the functions of	Explain Britain <sup>s</sup>		
the US Council on	Control of Pollution		
Environmental Quality.	Act 1974, the role of		

		D'4' ' 1 A 11 1'				
		Britain``s Alkali				
	6.9 Explain Britain"s	Inspectorate, the				
	Control of Pollution Act	functions of Health				
	1974	and Safety and				
		executives in relation				
	6.10 Explain the role of	to pollutioncontrol in				
	Britain"s Alkali	Britain				
	Inspectorate					
	L	• Explain the activities				
	6.11 State the functions of	of Britain"s				
	Health and Safety	Department of				
	Executives in relation to	Environment with the				
	pollution control in Britain	Department of				
	F	Environmental				
	6.12 Compare the activities of	Planning				
	Britain''s Department of	6				
	Environment with the					
	Department of					
	Environmental Planning					
	and Protection of Nigeria's					
	Federal Ministry of					
	Environment					
	Liiviioinnent					
Genera	l Objective 7.0 Know environm	ental regulatory bodies a	and their functions	1		
14	7.1 Outline the	Explain the	Board and Legal	• -	■ _	List the function of
	administrative legal	functions of	Material			National
	framework in Nigeria.	regulatory bodies,	InternationalJournals			Environmental
	7.2 List the function of	such as:	on Environment			Standards and

 the following			Regulations
regulatory bodies:	Ministry of		Enforcement Agency
	Environment		(NESREA).
Ministry of Environment			<
	- Ministry of		
- Ministry of Petroleum	Petroleum		
Resources	Resources		
-Ministry of Mines Steel	-Ministry of Mines		
and Development	Steel and		
	Development		
-Ministry of Labour and			
Productivity	-Ministry of Labour		
	and Productivity		
-National Environmental			
Standards and Regulations	-National		
Enforcement Agency	Environmental		
(NESREA).	Standards and		
	Regulations		
National Oil Spill Detection	Enforcement		
and Response Agency	Agency		
and Responser igeney.	(NESREA).		
	<ul> <li>National Oil Spill</li> </ul>		
	Detection and		
	Response Agency		

**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					
<b>GOAL:</b> 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-	PRACTICAL: 1 HOUR/WEEK						
	<b>REQUISITE:</b>							
	none							
GENERAL OBJECTIVES								
On completion of this course, the Student should	be able to:							
1.0 Understand the Concept of Environmental As	sessment							
2.0 Understand Environmental Working Docume	nts							
3.0 Understand Public Participation								
4.0 Understand Environmental Impacts and Resou	irce Factors							
5.0 Understand Screening process for EIA								
6.0 Understand Scoping process for EIA								
7.0 Understand Assessment Preparation and Revie	ew							
8.0 Understand the concepts of reporting and revi	ewing for EIA							
9.0 Understand the concepts of decision making a	nd mitigation measure	s used for environmental im	ipacts					
10.0 Understand the necessity of monitoring the	EIA process and projec	et management						
11.0 Understand concepts from EIA to predict fu	ture direction.							

PROG	PROGRAMME: Higher National Diploma in Environmental Science and Management Technology						
Course	: Advanced Environmental Assessment	ţ	Course Code: ESM 413	Credit Unit: 3		<b>Contact Hours:</b> 3	
GOAL	: The course is designed to teach stude	ents the key elements of	f an environmental	impact assessment (EIA), tech	hniques, anddevelopm	ent processes	
Course	Specification:	I	THEORETICAL	PRACTICAL CONTENT			
CONT	ENT						
Genera	l Objective 1.0: Know the	1				1	
Week	Specific Learning Outcome	<b>Teachers' Activities</b>	Learning	Specific Learning	Teachers'	Evaluation	
			Resources	Outcome	Activities		
1-2	<ul> <li>1.1 Define the term Environmental Assessment(EA), Environmental Impact Assessment (EIA) and</li> <li>1.2 Describe EA as contained in the national environmental Policy Act</li> <li>1.3 Describe the evolution EIA</li> <li>1.4 Describe the guiding principles for an EIA</li> <li>1.5 Explain law, policy, and institutional arrangement for EIA</li> <li>1.6 Explain public involvement and consultation in EIA</li> </ul>	Explain Environmental Assessment (EA), Environmental ImpactAssessment (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	• _	• -	Explain public involvement and consultation in EIA	

		public involvement and consultation in EIA				
GENE	RAL OBJECTIVE: 2.0: Understand	Environmental Workin	ng Documents			
4-5	<ul> <li>2.1 Explain various types of environmental workingdocuments such as EIA, Environmental Auditing.</li> <li>2.2 Explain the legal conditions and regulationson preparing EIA.</li> <li>EA. etc.</li> <li>2.3 Explain how to prepare samples of EIA. EA.</li> <li>document formats.</li> <li>2.4 Describe Environmental Contract Documents such as legaland technical aspects</li> <li>2.5 Discuss how to Prepare samples of environmental contractdocuments.</li> <li>2.6 Explain the general processing requirements:-</li> <li>a) Notice of Intent</li> </ul>	<ul> <li>Explain types of environmental working documents such as legal technicalaspects and legal conditions for preparing</li> <li>E.I.A., E.A.</li> <li>Explain how environmental contract documentsare prepared.</li> <li>Explain the general process requirements</li> </ul>	Whiteboard Legal Documents	Prepare samples of EIA. EA. document formats. Prepare samples of environmental contract documents.	Guide students to: -Prepare samples ofEIA. EA. document formats. -Prepare samples of environmental contract documents	List the types of environmental working documents
	b) Environmental					

	Assessment c) Draft E.I.S. Finding of No. Significant impact					
GENE	RAL OBJECTIVE 3.0: Understand I	Public Participation				
	3.1 Explain the following:	Explain:	Charts Public	■ _	■ _	Explain effective
6-7	<ul> <li>Effective public participation</li> <li>Public information and involvement</li> <li>Participation as a groupmember</li> <li>Benefits from an effective public participation programme.</li> <li>3.2 Explain hindrances to 3.1 above.</li> <li>3.3 Organise 3.1 above Evaluate 3.1 above.</li> </ul>	<ul> <li>Effective public participation</li> <li>Public informationand involvement</li> <li>Participation as agroup member</li> <li>Benefits from an effective public participation programme.</li> </ul>	meetings and visual aids.			public participation

GENE	ERAL OBJECTIVE 4.0: Understand	<b>Environmental Impacts</b>	and Resource F	actors		
	4.1 Classify the differenttypes of	• Identify various	Charts Public	• -	■ _	Explain the
8-10	impacts, viz:	impacts and their	meetings and			varioustypes of
	- direct impacts	classes.	visual aids.			impacts
	- indirect impacts	Give examples and measure				
	- cumulative impacts	various impacts				
	4.2 Explain the varioustypes of impacts	• Explain categories ofresource factors suchas water,				
	4.3 Measure various typesof impact	atmosphereland human aspects etc.				
	4.4 List examples of impacts					
	4.5 Explain categories of resource factors namely					
	- atmosphere					
	- water					
	- land					
	- biological environment					
	- sound					
	- human aspect					

	- economic aspects					
Genera	al Objective 5.0: GENERAL OBJEC	<b>FIVE 5.0:</b> Understand Sc	creening process f	for EIA		
11	5.1 Explain the term screening List element of screening List what information is required in a screeningdocument	Explain the term -screening element of screening information required in a	Charts Public meetings and visual aids.	• -	• -	Explain information required in a screening document
	<ul><li>5.5 Explain what areas are examined in a screening</li><li>5.5 Develop questions to help one analyze the areasof examination</li></ul>	- areas that are examined in a screening				
	5.6 Evaluate a project as ascreener and produce a screening document	Explain how to construct questions tohelp one analyze				

		the areas of				
		examination				
		Explain how to				
		valuate a project as a	a			
		screener and produc	e a			
		screening document				
GENE	RAL OBJECTIVE 6.0: Understand	l Scoping process for I	EIA			
12-	6.1 Explain the term	Explain the term	Charts Public	• -	• -	Explain what
13	scoping	scoping, element	meetings and			information is
	() List also and a f	of scoping,	visual aids.			required in a
	6.2 List element of	informationis	vioual aldor			scoping document
	scoping	required in a				scoping document
		scoping document				
	6.3 List what information is					
	required in a scoping document	• Explain the areas				
		thatare examined				
		in a scoping				
	6.5 Explain what areas are	in a scoping				
	examined in a scoping Develop					
	questions to help one analyze the					
	areasof examination					
	6.6 Evaluate a project as a					
	scoping exercise and produce a					
	list of elements that are					
	contained in the document as a					
	report					
	Tepott					

GENI	ENERAL OBJECTIVE 7.0: Understand Assessment Preparation and Review								
14	<ul> <li>7.1 Define the scope of the environmental assessment project.</li> <li>7.2 Explain the need forthe following: Interdisciplinary team <ul> <li>Baseline studies</li> <li>Scoping, i.e.</li> </ul> </li> <li>7.3 Describe assessment methodologies. <ul> <li>Explain how to prepare an environmental assessment(EA) document from results of the impact analysis.</li> <li>7.5 Explain document review e.g. Internal andinter agency reviews.</li> </ul> </li> <li>Explain how to Prepare a document review of an environmental Assessment Project.</li> </ul>	Specify the scope of the environmental assessment project andassessment methodology. Explain the need forinter- disciplinary team, scooping andbaseline studies. • Prepare environmental assessment (EA) document from resultsof the impact analysis and review an environmental assessment project	Charts Public meetings and visual aids.	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 document review of an environmental Assessment Project	Prepare an environmental assessment (EA) document from results of the impact analysis.			
	GENERAL OBJECTIVE 8.0: Unde	erstand the concepts of r	reporting and re-	viewing for EIA					

	8.1 Describe the element of an	Explain the	Charts Public	-	-	State steps in the	
	EIA report	elementof an	meetings and			reviewing process	
	8.2 Explain how to identify an	EIA and	visual aids.				
	ineffective EIA report	EIA report					
	8.3 Explain how to identify						
	steps in thereviewing	Explain the steps in					
	process	the reviewing					
	8.4 Explain the range of review	process And the					
	methods	range of review					
	8.5 Explain the table of review	methods Explain					
	criteria ratings	the table of review					
		criteria ratings					
GEN	GENERAL OBJECTIVE 9.0: Understand the concepts of decision making and mitigation measures used for environmental impacts						
		1	1			1	
	9.1 Describe the mitigation	Explain the	Charts Public	-	-	Explain	
	measures for EI	mitigationmeasures	meetings and			commonEIA	
	0.2 Describe the components of	for EI and the	visual aids.			implementation	
	an impactmanagement plan	components of an					
	an impactmanagement plan	impact					
	9.3 Describe EIA aims and	management plan					
	concepts	Explain FIA aims					
	9.4 Explain common EIA	and concepts and					
	implementation	implementation					
	0.5 Explain EIA	within					
	implementation within	decision making					
	desision malting	organization					
	decision making	organization					
1	organization.		1				

GEN	9.6 Explain public reviewor challenge. ERAL OBJECTIVE 10.0: Understan	nd the necessity of moni	toring the EIA p	process and project manageme	nt		
	<ul> <li>10.1. Describe the purpose for monitoring</li> <li>10.2 Describe the process of monitoring program.</li> <li>10.3 Explain how to identify the tasks of agood project manager.</li> <li>10.4 Explain how to identify considerations in the selection of team members.</li> <li>10.5 Explain importance of scheduling and budget preparation.</li> </ul>	Explain purpose, process of monitoring program. List tasks of a good project manager and considerations in theselection of team members. List the importance ofscheduling and budgetpreparation.	Charts Public meetings and visual aids.	_	-	Explain importance of scheduling and budget preparation.	
GENERAL OBJECTIVE 11.0: Understand concepts from EIA to predict future direction							
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	<ul><li>11.1 Explain</li><li>Sustainability</li><li>11.2 Explain immediate and short</li><li>term challenges of an EIA</li></ul>	Explain immediate and short term challenges of an EIA	Charts Public meetings and visual aids.	-	-	Define sustainability	
ASSE make	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	<b>CONTACT HOURS:</b> 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     VEAD: ONE (2)     SEMESTED: ONE (1)     DDE     DDACTICAL: 1     HOUD/WEEK							
TEAK. ONE (2), SEIVIESTEK. ONE (1)	REOUISITE:	FRACTICAL: I HOUK/WEEK					
	none						
GENERAL OBJECTIVES							
On completion of this course, the Student should	be able to:						
1.0 Understand the fundamentals of wor	kplace sanitation and v	vaste disposal					
2.0 Understand the need for proper layout	ut of industries and pro	vision of essential facilities					
3.0 Know the various methods of control	lling industrial waste						
4.0 Understand sanitation procedures in	an industrial environm	ent					
5.0 Understand the role of various Agen	cies in control of indus	trial waste					
6.0 Know the different methods of solid	waste management						

PROG	PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY								
Course	e: Sanitation and WasteManager	nent	Course Code: ESM 414	Credit Unit: 2.0	Credit Unit: 2.0 Cont 2-0-1				
GOAL	: This course is designed to pro	ovide students with the	e knowledge and skills re	quired to carry out industrial	sanitation and waste				
Course Specification: THEORETICAL			PRACTICAL CONTENT						
CONTENT									
Genera	al Objective 1.0: Understand th	e fundamentals of wo	rkplace sanitation and wa	ste disposal					
Week	Specific Learning Outcome	Teachers' Activitie	s Learning Resources	Specific Learning	Teachers'	Evaluation			
				Outcome	Activities				
1-2	<ul> <li>1.1 Define industrial wastes</li> <li>1.2 Classify industrial waste</li> <li>1.3 Explain how to identify sources of industrial waste</li> <li>1.4 Explain characteristicsof industrial waste</li> <li>1.5 Explain the public health implication of public wastes</li> <li>Explain wholesome and unwholesome ofwater.</li> </ul>	Explain industrial wastes, classification andsources of industrial waste Explain the public health implication o public wastes and th wholesome and unwholesome water	-projector n -textbook -internet -lecture note -tutorial f e	Identify different types of industrial wastes.	Guide the studentsto identify industrial wastes	Explain characteristics of industrial waste			
Genera	al Objective 2.0: GENERAL O	BJECTIVES: 2.0 UI	nderstand the Common D	iseases of Food Animals, the	ir Prevention and Control	•			

4-5	<ul> <li>2.1 Describe an ideal layout of an industry</li> <li>2.2 Explain the essential facilities needed in an Industry</li> <li>2.3 Explain the risks associated with poor sanitary conditions in an industry</li> <li>2.4 Describe appropriate measures to address the problems created in 2.3 above</li> </ul>	<ul> <li>Explain an ideal layout of an industry and the essential facilities needed in an industry</li> <li>Explain the risks involved in a unsanitized industry</li> </ul>	-projection -textbooks Internet lecture notes		-	Explain the essential facilities needed in an industry
GENE	RAL OBJECTIVES: 3.0 Under	rstand the Principles Of	Managing Sewage Des	ign		
	<ul> <li>3.1 Explain industrial Health control measures under the following</li> <li>Engineering <ul> <li>Substitution</li> <li>modification of equipment</li> </ul> </li> <li>Administrative e.g <ul> <li>. shifting</li> <li>Motivation (incentives annual leave etc).</li> </ul> </li> </ul>	Explain industrial Health control in Engineering substitution ii. modification of equipment b. Administrative e.g. i. shifting ii. Motivation (incentives, annual leave etc.	-projection -textbooks - internet - lecture notes - tutorial	-	-	Explain the specific methods of disposal of industrial waste according to its characteristics

Gener	<ul> <li>Inspection etc</li> <li>Personal protection e.g</li> <li>use of gloves, aprons boots, goggles</li> <li>3.2 Explain the specific methods of disposal of industrial waste according to its characteristics (gaseous, liquid and solid)</li> <li>3.3 Describe problems of industrial waste</li> <li>al Objective 4.0: Understand Sa</li> </ul>	iii. Inspection etc. c. Personal protection e.g. use of gloves, aprons, boots, goggles	ndustrial Environment			
8-10	<ul> <li>4.1 Describe various ways of ensuring environmental sanitation in an industry.</li> <li>4.2 Explain procedures involved in plant inspection with a view to detecting and abating to nuisances</li> <li>4.3 Explain how to carry out plant inspection and health education Programmes inindustry.</li> <li>Write technical reporton industrial visit</li> </ul>	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 writinga	-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			
GENE	RAL OBJECTIVE 5.0: Under	stand the Role of Variou	as Agencies in Control of	of Industrial Waste	
11	<ul> <li>5.1 Describe the role of Governmental and Non- Governmental Agencies in:</li> <li>legislation</li> <li>direct involvement ofindustry</li> <li>industrial HealthEducation</li> <li>5.2 Describe the contributions of other professionals in the control of industrial waste</li> </ul>	Explain the role of Governmentaland Non- Governmental Agencies in: legislation direct involvement of industry - industrialHealth Education	-projection -textbooks - internet - lecture notes tutorial		Explain the contributions ofother professionals inthe control of industrial wasteand management.

## 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 environmentalprojects PRE-REQUISITE: none PRACTICAL: 0 HOURS/WEEK GENERAL OBJECTIVES VEX VEX VEX VEX

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

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.

PROG	ROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
Course: Environmental Project Management		<b>Course Code:</b> ESM 416	Credit Unit: 2		<b>Contact Hours:</b> 2		
GOAL	GOAL: This course is designed to introduce students to project mana			nd tools and its applica	tion to environmental	projects	
Course	Specification:		THEORETICAL	PRACTICAL CON	TENT		
CONT	ENT						
Genera	al Objective 1.0: Understand the	e key concepts and elemen	t of project management				
Week	Specific Learning Outcome	Teachers' Activities	Learning	Specific Learning	Teachers'	Evaluation	
			Resources	Outcome	Activities		
1-2	<ul> <li>1.1 Describe a project in termsof a definition; and the key components.</li> <li>1.2 Describe the different factorsthat can have impact on a project.</li> <li>1.3 Describe the guidelines used in setting the stage for successful project.</li> <li>1.4 Describe the four steps in analyzing a project from the past.</li> </ul>	Explain projects and its key components, the role of Governmental and Non- GovernmentalAgencies in: - legislation direct involvement of industry industrialHealth Education	<ul> <li>Chalkboard</li> <li>Multi-media</li> <li>Magnetic</li> <li>Board</li> <li>Markers</li> </ul>		• -	Explain the different factors that can have impact on project	

	1.5 Describe the characteristic	3				
	of a successful project					
Genera	al Objective 2.0: understand ho	w to develop a project plan us	sing the twelve steps of	f project planning.	1	I
4-5	<ul><li>2.1 Describe the steps used indefining a project.</li><li>2.2 Describe the overall</li></ul>	• Explain in detailitems 2.1 – 2.2	Chalkboard Multi- mediaChart	• -	-	Explain the steps used in defining aproject
	structureused in presenting the project plan.					
Genera	al Objective 3.0: Know how to	set up project plan		Γ	T	
	3.1 Describe the	• Explain in detail the	Chalkboard	•	•	List the various types of
6-7	a task.	and their	Multi-media			task
	3.2 Illustrate the four	interrelationships and	MagneticBoard			
	typesoi tasks.	interdependencies				
	process of					
	scheduling.					
Genera	al Objective 4.0 : Know how to	constitute and Manage Proje	ect team	•	·	

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

11	<ul> <li>5.1 Describe the key management activities involved in tracking and monitoring a project.</li> <li>5.1 Describe the key aspects ofproject administration</li> </ul>	Explain how to track and monitor aproject. Discuss the key aspects of projectadministration	Multi-media Magnetic Board Markers	•	• -	Explain how to track and monitor a project
Genera	I Objective 6.0: Understand proj	ect cost analysis.				
12-13	<ul> <li>6.1 Describe the characteristics of project costs.</li> <li>6.2 Describe the six steps in calculating planned project costs and the trade-offs of accuracy versus effort in those calculations.</li> <li>6.3 Describe the guidelines to beused for building a project budget.</li> <li>6.4 Compare and contrast the concept of budget versus</li> </ul>	• Explain the six steps in calculatingplanned project costs and the trade-offs of accuracy versus effort in those calculations.	Multi-media Magnetic Board Markers	•	• -	Describe the six steps in calculatingplanned project costs and the trade-offs of accuracy versus effort in those calculations.

	actual costs.					
	6.5 Describe the					
	concepts of earned					
	value and activity-					
	based costing					
Genera	Objective 7.0 Understand the k	knowledge necessary to mana	ge the differences inh	erent in large and sma	ll projects andprogram	ns.
14	<b>7.1</b> Describe the size of a project in terms of: measuring project size; relating project sizewith potential risk; and sizing a project	•Discuss in details how to manage both small and large projects taking cognizanceof the potential risks.	Multi-media Magnetic Board Markers		•	Explain the characteristics of large and small projects
	<b>7.2</b> Describe the characteristics of large and small projects.					
	<b>7.3</b> Describe the four levels of projects that address the size and complexity of different projects and approaches for managing the different levels.					
Genera	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	•Explain Project	Multi-media			Explain Project
	to beused in defining and addressingproject issues	Management issues	Magnetic			Management issues

Genera	and opportunities. 8.2 Describe the possible symptoms and underlying issuesthat may occur when a project runs into problems, as well as possible solutions. <b>I Objective 9.0</b> Understand the v	variety of project managemen	Board Markers t tools and methods				
	<ul> <li>9.1 Describe the role that communications play in projectmanagement.</li> <li>9.2 Describe the types and uses of communications necessary togood project management.</li> <li>9,3 Describe project management software in terms of: what it is; why it is used andthe five key activities that relateto its use.</li> </ul>	•Explain various project management toolsand methods with specific examples.	Multi-media Magnetic Board Markers			Explain various project management toolsand methods	
Genera	General Objective 10.0 Understand the processes and techniques involved in the evolution, revolution, and termination of a project						
	10.1Describe the process ofproject change and death in	•Explain the processes and techniques in the	Multi-mediaChart		•	Explain the processes and techniques in the evolution, revolution	

		1				
	terms of: characteristics	evolution, revolution and				and termination of a
	of change; approaches	termination of a project				Project
	for					5
	implementing change: and					
	approaches for killing a					
	approaches for kning a					
	project.					
	10.2 Describe the process of					
	project reviews in terms of:					
	defining a project's success:					
	and conducting a project					
	review.					
	10.3 Describe the value of					
	project managementto					
	organizations and					
	individuals					
ACCECCI	MENT: The continuous assessment: tes	to anizzoa field morks at a will be	awarded 40% of the tota	l soore. The and of the Sam	actor Examination will m	also up for the remaining 60%
HOOLOOI	vient: the continuous assessment; tes	sis, quizzes, field works etc. will be	awarded 40% of the tota	i score. The end of the Sen	iester Examination Will II	lake up for the remaining 60%
of the tota	al score.					

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				
<b>COAL</b> . This course is designed to enable the stude	nt know the impact of	man's activities on the envir	onment				
GOAL. This course is designed to chable the stude	int know the impact of	man's activities on the chivit	onnent.				
YEAR: TWO (2), SEMESTER: ONE (1)	PRE-REQUISITE:	<b>PRACTICAL:</b> 0 HOURS/WE	EEK				
	none						
GENERAL OBJECTIVES							
On completion of this course, the Student should l	be able to:						
1.0 Understand the role of man as a geomorpholog	ical agent						
2.0: Understand man's impact on climate and the a	tmosphere						
3.0: Understand the powers of man in further environmental changes.							

PROGRA	PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY						
COURSE	E: Advanced Man and Environm	nent	Course Code: ESM 417	Credit Unit: 2.0		Contact Hours: 2-0-0	
GOAL:	This course is designed to acqu	aint the student with t T	his course is designed to	enable the student kno	w the impact of man's	activities on the	
environme	ent.						
Course S	pecification:		THEORETICAL	PRACTICAL CON	TENT		
CONTEN	NT						
General (	Objective 1.0: Understand the F	Role of Man as a Geomo	rphological Agent				
Week S	Specific Learning Outcome	<b>Teachers' Activities</b>	Learning Resources	Specific Learning	Teachers'	Evaluation	
				Outcome	Activities		
1-2	<ul> <li>1.1 Describe landforms produced by excavations</li> <li>1.2 Describe landforms produced by waste dumping</li> <li>1.3 Explain the role of man in accelerated sedimentation</li> <li>1.4 Describe the impactof man in ground subsidence</li> <li>1.5 Explain the role of man in accelerated weathering of landforms</li> </ul>	Explain landforms produced b yexcavations, 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 andcoastal erosion	

	<ul> <li>1.6 Explain the role of man in accelerated massmovement of landforms</li> <li>1.7 Describe the various aspects of man's</li> </ul>				
	deliberate modifications of channels				
	1.8 Explain the role of man in accelerated coastalerosion				
	1.9 Explain man's				
	Seismicity andvolcanoes				
General	I Objective 2.0: Understand man	's impact on climate and	the atmosphere		
4.5	2.1 Explain the corbon	Evaluin the mehlom	nrojection	-	Describe mon's
4-3	2.1 Explain the carbon	Explain the problem	-projection	-	Describe man's
			-textbooks		impacton the
	2.2 Explain the problemot	carbon dioxide and	- Internet		atmosphere
	other gases	other gases and	- lecture notes		
	2.3 Explain the problemof	aerosols	tutorial		List the influence of
	aerosols	Explain the problem			aerosol on the
	2.4 Explain the problemof	of thermal pollution			environment
	thermal pollution of air	of air atmospheric			
	2.5 Describe the role of	pollution in climate			
	atmospheric pollutionin	modification.			
	climate	Explain the effects of			

	<ul> <li>modification.</li> <li>2.6 Describe the effects of high-flying aircraftson the upperatmosphere</li> <li>2.7 Explain vapour trails in relation to climate modification</li> <li>2.8 Explain the ""Green House"" effect</li> <li>2.9 Explain the possible effects of water diversion</li> <li>schemes onmicro-climates</li> <li>2.10 Describe the role of man in creating urban climates</li> <li>2.11 Describe the role of smoke haze on photochemical smog formation</li> <li>2.12 Explain the effects of artificial rain-making on climate modification</li> </ul>	<ul> <li>high-flying aircrafts on the upper atmosphere</li> <li>Explain vapour trails in relation to climate modification</li> <li>Explain the ""Green House"" effect Explain the possible effects of waterdiversion schemes onmicro- climates</li> </ul>				
GENER	RAL OBJECTIVE: 3.0: Unders	tand the Powers of Man in	n 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

3.2 Distinguish between	environmental	- lecture notes		influences reversible
reversible and	impacts	tutorial		and irreversible
irreversible				changes
environmental changes.	List the differences			U
3.3 List examples of	between reversible			
reversible environmental	and irreversible			
changes	environmental			
3.4 List examples of	changes.			
irreversible	List examples of			
environmental changes	reversible			
3.5 Describe thesusceptibility	environmental			
of the environmentto	changes			
changes	List examples of			
3.6 Describe the roleof	irreversible			
nature in resisting	environmental			
-	changes			

## 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				
<b>GOAL:</b> 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	<b>PRACTICAL:</b> 0 HOUR	S/WEEK				
GENERAL OBJECTIVES							
On completion of this course, the Student should b	be able to:						
1.0 Understand the Basic Concepts of Toxicolo	ogy						
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							

PROGR	ROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
Course:	Environmental toxicology	(	Course Code:ESM 418	Credit Unit: 3.0		<b>Contact Hours:</b> 3		
GOAL: This course is designed to enable the student know the Ecosystem and biosphere levelCourse Specification:T			fect of toxic chemicals on EORETICAL	biological organism a	nt population comm	nunity,		
General	<b>Objective 1.0:</b> Know the							
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation		
1-2	<ul> <li>1.1 Define the following: <ul> <li>Toxicant</li> <li>Toxic</li> <li>Toxicity</li> <li>Pollutant</li> <li>Dose</li> <li>LC50 and</li> <li>LD50</li> </ul> </li> <li>1.2 Classify toxicants. <ul> <li>1.3 List some environmental toxicants, their sources and effects on the environment and health.</li> <li>1.4 Describe the different types of toxicity; development and reproductive toxicity; mutagenicity.</li> </ul> </li> </ul>	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 centrifugeand 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, waterand soil samples and identify toxicants in them. -determine toxicityusing extraction -analyze air, waterand soil samples and identify toxicants in	Describe the different types of toxicity namely:- chronic toxicity;development and reproductive toxicity; mutagenicity. Differentiate between chronic , developmentand reproductive toxicity		

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

4-5	2.1 Explain the different	Explain stages of	-projection	■ _	-	Explain the different
	stages in the history of	toxicology in:	-textbooks			stagesin the history of
	toxicology namely;	Antiquity; Middle	- lecture notes			toxicology/
	Antiquity; Middle Ages;	Ages; Age of	tutorial			
	Age of Enlightenment;	Enlightenment;				
	Modern Toxicology.	Modern Toxicology.				
	2.2 Describe the different					
	branches of toxicology	List the different				
	namely Environmental	branches of toxicology				
	Toxicology, Forensic	such as:Environmental				
	toxicology, Clinical	Toxicology, Forensic				
	toxicology, economic	economic toxicology				
	toxicology.	toxicology, Clinical				
		toxicology,				
General	<b>Objective 3.0:</b> Understand Toxic	cology			I	
	3.1 Explain the meaning	Explain toxicology.As	Centrifuge, hot plate	Conduct	Guide students	Explain the
6-7	and importance of	additives and	shakers, magnetic	Practical	to:	meaning and
0-7	toxicology.	contaminants.	stirrer, white tiles	analysisof food	-conduct	importance of
	3.2 Describe the		melting point	toxicants	Practical	toxicology
	toxicology of food	Explain how to	apparatus.		analysis of food	
	additives and	determine the	Air sample anaerobic	Determine the	toxicants	List pollutant
	contaminants.	toxicity of food	jar Incubator,	toxicity offood		toxicity
	3.3 Determine the toxicity of	additives and	thermometer,	additives and	-determine the	
	food additives and	contaminants in	spectrophotometer,	contaminants	toxicity of food	What is soiltoxicity
	contaminants in food	food samples.	alcohol analyser,	in food	additives and	
	samples.		moisture analyser etc.	samples.	contaminants in	
	3.4 Describe the methodof	List atmospheric			food samples.	

 analysis of food toxicants.	pollutants e.g. carbon	Determine the		
3.5 List atmospheric	monoxide, asbestos.	toxicity of	determine the	
pollutants e.g. carbon	chlorofluorocarbon.	atmospheric	toxicity of	
monoxide, asbestos.	photochemical smog.	toxicants	atmospheric	
chlorofluorocarbon	oxides of nitrogen and	••••••••••	toxicants	
photochemical smog	Sulphur	Determine the	tometants	
oxides of nitrogen and		toxicity of	-determine the	
sulphur		aquatic	toxicity of	
3.6 Explain the sources and		toxicants	aquatic	
toxicity of the various			toxicants	
atmospheric pollutants listed		Determine the		
in 3.5 above.		toxicity of soil	determine the	
3.7 Describe the method of		pollutant.	toxicity of soil	
analysis of atmospheric	Explain the methods of	r · · · · ·	pollutant.	
toxicants.	analysisof aquatic		I	
3.8 Determine the toxicity of	toxicantsand soil			
atmospheric toxicants.	pollutants			
3.9 List aquatic	1			
pollutants.				
3.10 Explain the sourcesof				
toxicity of the pollutants,				
listed in 3.9 above.				
3.11 Describe the methods of				
analysis of aquatic toxicants.				
3.12 List types soil pollutants.				
3.13 Explain the sourcesof				
toxicity of soil pollutants				
listed in 3.12 above.				

				1		
	3.14 Describe the methods					
	of analysis of soil toxicants.					
General	Objective 4.0: Know Toxicity F	Tactors				
General 8-10	<ul> <li>of analysis of soil toxicants.</li> <li>Objective 4.0: Know Toxicity F</li> <li>4.1 Explain the influenceof route of administrationon toxicity.</li> <li>4.2 Explain how to Identify the animalsused in toxicity tests.</li> <li>4.3 Describe the effects of chemical interactions on toxicity.</li> <li>4.4 Describe the biological toxicity e.g. barriers, biotransformation, sensitivity of organs, etc.</li> <li>4.5 Explain the effects of dose and duration of exposure on toxicity.</li> <li>4.6 Describe the effects of toxicity:</li> <li>Species, strain and individual differences.</li> </ul>	PactorsExplain the influence of routeof administration on toxicity and the animalsused in toxicity tests.Explain the effectsof chemical interactions on toxicity and the biological toxicity e.g. barriers, biotransformation, sensitivity of organs, etc.Explain the effectsof dose and duration of exposure on toxicity.	Centrifuge, hot plate shakers, magnetic stirrer, white tiles melting point apparatus. Air sample anaerobic jar Incubator, thermometer. Animal sample	Identify the animals usedin toxicity tests. Administer toxins into a guinea pig through different routes and determine the influence ofroute of administration ontoxicity	Guide students to: -identify the animals used in toxicity tests. administer toxinsinto a guinea pig through different routes and determine the influence of routeof administration on toxicity	Explain the influence of route of administrationon toxicity.
	• Sex, Hormonal status and pregnancy.					

	<ul> <li>Age</li> <li>Nutritional Status</li> <li>Diseases.</li> <li>4.7 Describe the physicaland social factors that modify toxicity in organisms.</li> </ul>					
General	<b>Objective 5.0:</b> Know Hazardous	substances				
	5.1 Define hazardous	Explain hazardous	-projection	Identify	Guide students	Explain the
11	substances.	substances, types and	-textbooks	hazardous	to:	characteristicsof
	5.2 Explain the	their characteristics.	- internet	wastes	-identify	hazardous
	characteristics of		- lecture notes	generated by	hazardous	substances
	hazardous substances.	Explain hazardous wastes	tutorial Industrial visit	Business and	wastes	
	5.3 Discuss hazardous	generated byBusiness and		industries.	generated by	List the five types of
	Wastes generated by	industries and methods of		Community out a visit to	industrias	nazards
	5 4 Describe methods of	nazardous substances		industries to know	muusuies.	Define hazardeumbale
	hazardous substances control	generation to the point of		the different	carry out a visit	of warning
	from the point of generation	ultimate disposal		hazardous waste	toindustries to	or warning
	to the point of ultimate	utilitate disposal.		generated by them	know the	
	disposal.			generated by mom.	different	
	P • • • • • •				hazardous waste	
					generated by	
					them.	

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

<ul><li>6.10 Describe radioactive materials and their toxicity.</li><li>6.11 Describe poly-halogenated compounds and their toxicity</li></ul>	various plant andanimal toxins		

<b>PROGRAMME: HIGHER NATIONAL DIPLO</b> <b>COURSE:</b> construction, machine and tools safety	MA IN ENVIRONM	IENTAL SCIENCE AND N         Credit Unit: 2	IANAGEMENT TECHNOLOGY CONTACT HOURS: 2 HOURS/WEEK				
<b>GOAL:</b> This course is designed to acquaint stude:	nts 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	be able to:						
<ol> <li>Understand construction site activities</li> <li>Understand the Principles of Guarding</li> <li>Know safety in metal working machinery.</li> <li>Know Safety in Woodworking Machinery</li> <li>Know safety in the Use of Hand and Portab</li> </ol>	le Power Tools.						

PROGR	PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
<b>Course:</b>	: Construction Safety, Machineryan	nd Tools Safety C	Course Code: ESM 419	Credit Unit: 3		<b>Contact Hours:</b> 3		
GOAL:	: This course is designed to acquai	int students with the neces	sary knowledge required of	on how to handle diff	erent tools and ma	chines		
Course	Specification:	THE	EORETICAL	PRACTICAL CO	NTENT			
CONTE	ENT							
General	<b>l Objective 1.0:</b> Understand constr	ruction site activities	T	T				
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning	Teachers'	Evaluation		
				Outcome	Activities			
1-2	1.1 Mention types of	List types of	PPE, tool components,			Describe safetypractices		
	construction sites	construction sites	workshops and field.			outlining general safe		
	1.2 Describe the basic safe	and tools used in				practices in construction		
	applications of tools in	construction.				operations.		
	constructionsites (ropes,							
	hoist, chains, bolts,	Explain best safety						
	drilling, wielding,	practices and in						
	crane, conveyor, wire)	construction						
	and their deterioration.	operations.						
	1.3 Describe safety							
	practices outlining	Explain bracing and						
	general safe practices	scaffolding.						
	in construction							
	operations.	List the guidelinesfor						
	1.4 State the significance	excavation.						
	and activities							
	involvedin lateral							
	bracing and							

	scaffolding. 1.5 Explain the fundamental safety procedure for demolition operations 1.6 List the guidelinesinvolved in excavation				
General	Objective 2.0: Understand the Pr	rinciples of Guarding			
4-5	<ul> <li>2.1 Explain the meaning of the term "guarding" themajor areas of safety as considered with machines.</li> <li>2.2 Explain guarding during maintenance of machines and written policy for ZMS (Zero Mechanical State)</li> <li>2.3 Explain guarding of hazards.</li> <li>2.4 Explain point-of- operation protective devices.</li> <li>2.5 Explain the guarding of Power transmissions in machinery.</li> </ul>	<ul> <li>Explain the term guarding" the major areas of safety as considered with machines.</li> <li>Explain guarding of hazards, point-of- operation, protective devices and the guarding ofPower transmissions in machinery.</li> </ul>	• Machines Charts	-	Explain the guarding ofPower transmissions in machinery.
General	<b>Objective 3.0:</b> Know safety in m	etal working machinery			

	3.1 List various types of	List different types of	Charts, Machines,	Demonstrate	Guide students to	List different
67	metalworking machinery.	metalworking		with relevant	demonstrate with	types of
0-7	3.2 State the general safety	machines and		machines	relevant	metalworking machines
	rules in operating	associated hazards.		associated hazards	machines	andassociated
	metalworking machinery.				associated	hazards
	3.3 Explain the functional	Demonstrate with			hazards	
	components, the associated	relevant machines				
	hazards and thesafety	associated hazards				
	precautions to be observed					
	in the following	Visit workshop/industry				
	metalworking machinery:					
	• Turning machines,					
	Boring machines					
	Milling machines					
	Planning machines					
	Grinding machines					
General	Objective 4.0: Know Safety in V	Voodworking Machinery				
	4.1 Explain the general	List with examples of	Woodworking	Demonstrate	Guide students	List woodworking
8-10	Safety Principles in	woodworking machines	machines Personal	safety precaution	to demonstrate	machines and their
0-10	woodworking machineryas	and theirrespective	protective equipment,	and safe handling	safety precaution	respectivecomponents
	it concerns:	components.	toolsand components.	of special	and safe	1 1
	(a) Electrical components;		Charts Workshops	woodworking	handling of	
	(b) Guards;	Show relevant personal	enaits wontshops	tools and	special	
	(c) Work areas; (d) Material	protectiveequipment.		equipment	woodworking	
	handling; (e) Inspection; (f)				tools and	
	Health of Personnel; (g)	List safety and			equipment	
	Personal protective equipment	health hazards				

and	associated work		
(h) Standards and Codes.	activities.		
4.2 Explain the Safety			
Precaution in the application	Demonstrate safety		
of the following types of	precaution and safe		
Saws:	handling of special		
• Circular,	wood working toolsand		
• Over- head swing and	equipment.		
straight- line pull cut-			
off saws,	Visit workshops or		
• Under-slung cut-off	industry.		
saws,			
• Radial Saws,			
• Power-feed ripsaws,			
• Band saws &			
• Routers.			
4.3 Explain Safety			
Precautions in the			
applications of the various			
woodworking equipment e.g.:			
■ Jointer/Planers,			
<ul> <li>Shapers,</li> </ul>			
<ul> <li>Power-feed (thickness)</li> </ul>			
Planers,			
<ul> <li>Sanders,</li> </ul>			
Lathes &			
<ul> <li>Routers.</li> </ul>			

General	<b>Objective 5.0:</b> Know safety In the	e Use of Hand and Portable	Power Tools		
11	5.1 Explain safe practices,			B	
11	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.				
	5.2 Explain techniques of				
	inspection and control of				
	hand and portable power				
	tools and its significance.				
	5.3 State the hazards				
	associated with and the				
	safety precautions neededin				
	the application of the hand				
	tools:				
	State the hazards associated				
	with and the safety				
	precautions needed in the				
	application of the following				
	portable powerTools: (a)				
	Electric tools (b)				
	Air-powered tools etc.				
	5.5 State type of eye				
	protection equipment				

## YEAR TWO SEMESTER TWO

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

GENERAL OB	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					

PROG	<b>PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTA</b>				ND MANAGE	MENT TEO	CHNOLOG	Y
<b>COURSE:</b> Ecological Disaster, Prevention and Control		tion and Control	Course Code: ESM 421	Credit Unit: 3				<b>Contact Hours:</b> 3
GOAI	: This course is designed to give	e students knowledge nee	eded to identify va	rious environm	ental hazards a	nd how to co	ntrol them.	·
Cours	e Specification:		THEORETICAL	PRACTICAI	L CONTENT			
CONT	TENT							
Gener	al Objective 1.0: Understand the	e concept of environment	al hazards					
Week	Specific Learning Outcome	Teachers' Activities	Learning	Specific	Learning	<b>Teachers'</b>		Evaluation
			Resources	Outcome	-	Activities		
1-2	<ul> <li>1.1 Define an environmental hazard</li> <li>1.2 Define geographical hazard</li> <li>1.3 State the environmentalist definition of environmental deterioration</li> <li>1.4 Explain the concept of environmental quality</li> <li>1.5 Describe climatological factors asagents of environmental hazards.</li> </ul>	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
Gener	al Objective 2.0: Understand the	basic principles of dese	rtification					
4-5	2.1 Define desertification	Explain encroachment	Audio visual	Identify the causal agents of	Guide students to identify	Explain types		
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	2.2 Describe the processof	and the causal agents of	AidCharts	desert encroachment	the causalagents of desert	and patterns of		
	desert	desertencroachment.			encroachment	desertification		
	encroachment	List :						
	2.4 Identify the causal	-types				Explain the		
	agents of desert	- patterns and				climatological		
	encroachment Explain	effects of				hypothesis		
	types andpatterns of	desertification				of		
	desertification	and also the effects of				desertification		
	2.5 Explain the effects of	desert advancement						
	desert advancement	on the environment						
	on the environment							
	2.6 Explain the	• Explain the						
	climatological hypothesisof	climatological						
	desertification	hypothesis of						
	Describe ways of preventing	desertification and						
	desertification	state ways of						
		preventing						
		desertification						
Gener	ral Objective 3.0: Understand the	Process of Soil Erosion						
	3.1 Describe the soil	Explain the soil	Auto visual	• _	<b>•</b> -	List various		
< <b>7</b>	erosion process	erosion, the causes	Aid			erosion features		
6-/	3.2 List causes of erosion	and types of erosion,						
	3.3 Explain the effect of	such as: glacial scars						
	erosion on soil	and wave erosion						
	3.4 Describe glacial scars	List the effect of						
	and wave erosion	erosion on soil						

	<ul> <li>3.5 Describe erosion patterns in different soil types</li> <li>3.6 List various erosion features</li> <li>3.7 Explain irrigation as a soil erosion hazard</li> <li>Explain ways of preventing erosion</li> </ul>	<ul> <li>Explain the erosion patterns and features in differentsoil types</li> <li>Explain irrigation as a soil erosion hazard and ways ofprevent it.</li> </ul>				
Gener	al Objective 4.0: Understand the	Basic Principles of Floods				
	4.1 Define geophysical	Classify types of	Magnetic	Identify flood-susceptible	Guide students toidentify	Explain the
8-10	hazard	hazards:	Board,	areas	flood- susceptible areas	environmental
0 10	4.2 List geophysical	-geophysical hazard	Auto visual			hazards of floods,
	occurrences in nature that	and	Aid			hurricanes.
	disturb the environment	-environmental				typhoons and
	4.3 Explain the	hazards				monsoons
	environmental hazards of					monsoons
	floods,	List geophysical				
	hurricanes, typhoons, and	occurrences in				
	monsoons	nature that disturb				
	4.4 Explain the role of the	the environment				
	following in making					
	or breaking landscapes:	List the				
	- rivers and streams	environmental				
	- earthquakes and	hazards of floods,				
	landslides	hurricanes,				
	- hurricane, typhoons,	typhoons, and				
	monsoons	monsoons				

	and floods 4.5 Describe flood as a natural phenomenon 4.6 Identify flood- susceptible areas Explain ways ofpreventing floods.	Explain the role of the following in making or breaking landscapes: - rivers and streams earthquakes and landslides - hurricane, typhoons, monsoons and floods Describe flood as a natural phenomenon • Explain ways of preventing floods				
Gener	al Objective 5.0: Understand bas	ic principles of drought		I		
11	<ul> <li>5.1 Define drought as a natural phenomenon</li> <li>5.2 Describe the drought process</li> <li>5.3 Identify the causal agents of drought</li> <li>5.4 Describe the early warning systems of drought</li> </ul>	Explain drought asa natural phenomenon Explain the drought process, the causal agents of drought Explain the early warning systems of	Auto visual AidCharts	Identify the causal agentsof drought	Guide students to identify the causalagents of drought	Explain the climatological hypothesis of drought formation

5.5 Explain the	drought and the		
climatological hypothesisof	climatological		
drought formation	hypothesis of drought		
	formation.		

PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
COURSE: Environmental Performance	CODE: ESM 422	2 Credit Unit: 2 CONTACT HOURS: 2 HOURS/WEEK					
<b>GOAL:</b> The course is designed to provide stude	GOAL: The course is designed to provide students with clear and meaningful picture of any organization's environmental performanceby						
collecting absolute data information on performance	e.						
YEAR: ONE (1), SEMESTER: ONE (1)	PRE-	<b>PRACTICAL:</b> 0 HOURS	S/WEEK				
	<b>REQUISITE:</b>						
GENERAL OBJECTIVE:							
On completion of this course, the students should	be able to:						
1.0 Understand life cycle analysis/material utiliza	tion efficiency						
2.0 Understand the environmental benchmarking	compliance						
3.0 Understand business and the environment							
4.0 Understand principles of social responsibility/	community affair, safe	ety, health environment and s	security programme				

PROG	RAMME: HIGHER NATIONA	AL DIPLOMA IN ENVI	IRONMENTAL SCIEN	CE AND MANAGEN	IENT TECHNOLOO	GY
COUR	SE: Environmental Performance		Course Code: 422	Credit Unit: 2.0		<b>Contact Hours:</b> 2
<b>GOAL:</b> The course is designed to provide students with clear and meaningful picture of a data information on performance.				y organization's envir	onmental performance	eby collecting absolute
Course Specification: THEORETICAL			PRACTICAL CON	TENT		
CONT	ENT					
Genera	l Objective 1.0: Understand Lif	e Cycle Analysis/Materia	al Utilization Efficiency			1
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	<ul> <li>1.1 Define the term:</li> <li>(i)life cycle Analysis</li> <li>(ii)Material utilization</li> <li>Efficiency</li> <li>1.2 Explain the goal and purpose of LCA and material utilization</li> <li>efficiency</li> <li>1.3 Mention four main phases of LCA and Describe each of them</li> <li>1.4 Describe the use of data analysis on LCA and mode of collection</li> </ul>	Explain the term: (i) life cycle Analysis (ii) Material utilization Efficiency Explain the goal and purpose and phases of LCA andmaterial utilizationefficiency Explain the use ofdata analysis on LCA and mode ofcollection.	Magnetic Board, Auto visual Aid	■ _	■ _	Describe theuse of data analysis on LCA and mode of collection
Genera	<b>I Objective 2.0:</b> Understand the	Environmental Benchma	rking Compliance	1	1	1

4-5	2.1 Mention local	Explain local	Magnetic Board,	<b>-</b>	-	Explain various
	contribution to global	contribution to	Auto visual Aid			ways used to
	climate change	global climate				accomplish
	2.2 State the	change				environmental benchmarking
	communication strategy	Explain the				compliance
	used in environmental	communication				I I I I I I I I I I I I I I I I I I I
	benchmarking compliance	strategy used in				
	2.3 Explain the terms	environmental				
	(i)Nature	benchmarking				
		compliance				
	(11)Biodiversity	Explain the terms				
	(iii)Pollution	(i)Nature				
	2.4 Describe	(ii)Biodiversity				
	environmental waste					
	production and	(111)Pollution				
	management	Explain anvironmental wests				
	2.5 Describe the	environmental waste				
	importance of green urban	productionand				
	arrears and sustainable	management				
	land	Explain the				
	land	importance of green				
	2.6. Explain water	urban arrears and				
	consumption and waste	sustainable land				
	water treatment.	and water				
	2.7 Describe noise	consumption and				
		wastewater treatment.				

	pollution	Explain noisepollution				
Genera	I Objective 3.0: Understand Bus	iness and The Environment	· ·			
6-7	3.1 Describe the conceptof environment and business	Explain the concept of environment and business	Magnetic Board, Auto visual Aid	• _	• -	Describe the concept of environment
	3.2 Explain types of business environment	Explain types, components and				and business
	3.3 List different components of business environment	factor affecting an Organization of business environment				
	3.4 Explain environment factor affecting business of an Organisation	Explain how economic problemsaffect				
	3.5 State how economic problems affect business environment	business environment and how does ethnic behavior affect the				
	3.6 Explain how does	performance of				

	ethnic behavior affects the performance of employee or an Organisation 3.7 Describe what extent will political instability impact business environment 3.9 State five major variables found in an Organisation 3.10 Explain internal and external environment	<ul> <li>employee or an</li> <li>Organisation</li> <li>Explain extent to which political instability impact business environment, internally and externally.</li> </ul>				
Gener	al Objective 4.0: Understand Prin	nciples of Social Responsibility	ility/Community Affair	, Safety, Health Enviro	onment And Security	
Program	nme					Γ
	4.1 Define corporate	Explain corporate social	Magnetic Board,	• -	• -	Explain how
8-10	social responsibility	responsibility	Auto visual Aid			does CSR relateto
	(CSR)	(CSR) and				stress at work
	4.2. Explain corporate social responsibility.	corporate social responsibility. Explain the benefitsof				
	4.3 List the benefits of	CSR and how				
	CSR	CSR relate to stress				
	4.4 Explain how does	at work.				
	CSR relate to stress at work 4.5.Describe the policy on community affair safety,	Explain the policyon community affair safety, health,				

health ,environment and security(CASHES) 4.6.Describe the relationship between business operator and the community in terms of safety, health, environment and security 4.7.Enumerate (CASHES) regulation/ references and standards	environment and security (CASHES) Explain the relationship between business operator and the community in terms of safety, health, environment and • security.		
<ul> <li>4.8. Explain night work precautions in an environment</li> <li>Describe health, medical and welfare programme for hostingcommunity</li> </ul>			

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/W								
<b>GOAL:</b> This course designed to give students the	<b>GOAL:</b> This course designed to give students the knowledge and skills for sampling methods of contaminated sites							
YEAR: TWO (2), SEMESTER: TWO (2)	PRE-	<b>PRACTICAL: 2</b> HOUR	S/WEEK					
<b>REQUISITE:</b>								
	none							

## **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.

PROG	PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY							
COUF	<b>RSE:</b> Sampling Methods for Po	lluted Sites	C <b>ODE:</b> ESM 423	Credit Unit: 3		Contact Hours: 3		
GOAI	: This course is designed to g	vive students the kno	wledge and skills for	sampling methods of contaminated	sites			
Cours	e Specification:		THEORETICAL	PRACTICAL CONTENT				
CONT	TENT							
General Objective 1.0: Understand Environmental Methods and Techniques								
Week	Specific Learning Outcome	Teachers'	Learning	Specific Learning Outcome	Teachers'	Evaluation		
		Activities	Resources		Activities			
1-2	<ul> <li>1.1 List sampling techniques and analytical methods used to determine common pollutants.</li> <li>1.2 Explain the complexity of pollution issues and environmental chemistry with emphasis on chemicals" fugacity and environmental partitioning.</li> <li>1.3 Explain how to analyze environmental issues in order to select appropriate sampling and analytical methods to quantitatively and</li> </ul>	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		

	qualitatively 1.4 Assess the magnitude of environmental contamination/pollution 1.5 Describe how to apply statistical tools and modeling applications to process, analyze and interpret data obtained in environmental sampling and analyses. 1.6 Discuss the advantages	analyze environmental issuesin order to select appropriate samplingand analytical methods to quantitatively and qualitatively assessthe magnitude of environmental.			
	and analytical methods employed in environmental Analyses	advantages and limitations of the sampling procedures and analytical methods employed in environmental analyses			
Genera	a Objective 2.0: Know how t	o obtain soil samples	s for chemical analys	315	

4-5	2.1 Explain concerns	• Explain	Laptop	Perform soil vapour screening as	Guide students to perform	Explain soil
	associated with sample	concerns	White	an aid to sample selection and	soil vapourscreening as an	vapour screening
	collection procedure and	associated with	boardText	corelogging.	aid to sample selection	and core logging.
	labelling, sample tool	sample	Books		and core logging	
	decontamination	collection	Internet			
	procedures.	procedure and	Projector			
		labelling,	Lecture Notes			
	2.2 Explain the following:	sample tool				
	Soil vapour screening and	decontamination				
	core logging.	procedures and				
		how to practice				
	2.2 Describe how to	soil vapour				
	2.5 Describe now to	screening as an				
	screening as an aid to	aid to sample				
	some selection and core	selection and				
	logging	core logging.				
Genera	al Objective 3.0: Know how to	o view construction o	f a monitoring well a	after drilling a borehole		
	3.1 Explain the method to	Explain how to	Lanton	Identify the method todevelop	Guide students to identify	Describe the
	develop and purge a	develop and	White	and purge a monitoring well	the method to developed	methods and
6-7	monitoring well	nurge a	boardText	and purge a monitoring wen.	purge a monitoring well	concerns in
	3.2 Describe the methods	monitoring well.	Books		purge a monitoring wen.	collecting water
	and concerns in	and methods and	Internet			samples for a
	collecting water	concerns in	Projector			variety of
	samples for a variety	collecting water	Lecture Notes			chemical
	of chemical	samples for a				contaminants,
	contaminants, and	variety of				and
	preservation	chemical				preservation

	techniques.	contaminants,				techniques.		
		and preservation						
		• techniques.						
Gener	General Objective 4.0: Know how to operate organic, vapour analyzers for use in performing a soil gas survey							
	4.1 Define soil survey.	Explain how to	Laptop	Conduct a soil survey and collect	Guide students to conduct	Explain the		
8-10		conduct a soil	White	vapor samples	a soil survey and collect	problems or		
0 10	4.2 Describe how to	survey and	boardText		vapor samples	conditions thatmay		
	conduct a soil survey and	collectvapor	Books			affect thesurvey		
	collect vapor samples.	samples.	Internet			results		
			Projector			1054115.		
	4.3 Enumerate the	• Discuss the	Lecture Notes					
	problems or conditions	problems or						
	that may affect the	conditions that						
	surveyresults.	mayaffect the						
		survey results.						
Genera	al Objective 5.0: GENERAL	<b>OBJECTIVE 5.0:</b>	<b>k n o w</b> utility locati	on demonstration for a subsurface of	lata collection			
	5.1 Explain how to	Explain different	Laptop	Identify different types of	Guide students toidentify	State how to use		
11	Identify different types	types of	White	geophysical tools	different types of	different types of		
	of geophysical tools.	geophysicaltools	boardText		geophysical tools	geophysical tools		
	5.2 Describe how to use	and how to use	Books					
	different types of	the different tools	Internet					
	geophysical tools	and the problems	Projector					
	5.3 Describe the	or conditions that	Lecture Notes					
	problemsor	may affect the	Geophysical tools					
	conditions that may	geophysical result.						
	affect the							

	g	eophysical results					
GENE	RAL (	<b>DBJECTIVE 6.0:</b> Unde	erstand how to use a l	backhoe for collectin	g soil sample		
12-13	6.1	Explain the use of headspace test to determine the presence of volatile organics. Describe the correct safety procedures when working alongside excavating equipment.	<ul> <li>Explain the use of headspace test to determine the presence of volatileorganics.</li> <li>Explain the correct safety procedures when working alongside excavating equipment.</li> </ul>	Laptop Text Books Internet Projector Lecture Notes Calculators 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 head spacetest.	List the correct safety procedures when working alongside excavating equipment
GENE	RAL (	<b>DBJECTIVE 7.0:</b> Unde	erstand how to perfor	m a hydraulic respon	se test in a monitoring well to deter	mine hydraulic conductivity	
14	7.1 7.2 7.3	Define hydraulic conductivity. Describe how to conduct a hydraulic response test. Describe the procedure used for applying either the Bouwer and Rice method or the Hvorslev method.	Explain hydraulic conductivity and how to conduct a hydraulic responsetest and the procedure used forapplying either the	Laptop White boardText Books Internet Projector Lecture Notes Calculators Geophysical tools	Perform a hydraulic responsetest in a monitoring well to determine hydraulic conductivity	Guide students to perform a hydraulic response test in a monitoring well to determine hydraulic conductivity	Describe how to conduct a hydraulic response test

	<ul> <li>7.4 Describe how to gather data using a data logger.</li> <li>7.5 Calculate hydraulic conductivity using field data.</li> </ul>	Bouwer and Rice method or the Hvorslev method. Explain how to gather data using adata logger and calculate hydraulic conductivity using field data.				
GENE	CRAL OBJECTIVE 8.0: Und	derstand how to condu	ict a water level surv	vey to determine the water table grad	lient and direction of ground	l water flow
	<ul> <li>8.1 Explain how to use an electric watertape to measure water levels in a monitoring well.</li> <li>8.2 Explain how to use a surveying level to determinerelative borehole elevations.</li> <li>8.3 Explain how to</li> </ul>	<ul> <li>Explain the use of electric water</li> <li>tape tomeasure</li> <li>water levelsin a</li> <li>monitoring well</li> <li>and surveying</li> <li>level to determine</li> <li>relativeborehole</li> <li>elevations.</li> <li>Explain how to</li> <li>calculate ground</li> <li>water elevations.</li> </ul>	Laptop White boardText Books Internet Projector Lecture Notes Calculators Electric watertape Survey	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.	Guide studentsto: -use an electric water tape to measure water levels in a monitoring well. -use a surveying level to determinerelative borehole elevations. -calculate groundwater elevations. -prepare a hydraulic	State the importance of water level in a monitoring well.

	Calculate	And prepare a	level		gradientmap.					
	groundwater	hydraulic		Determine the direction of ground	-determine the direction of					
	elevations.	gradient map to		water flow	ground water flow					
	8.4 Explain how to	the directionof								
	Prepare a	ground water								
	hydraulicgradient	flow.								
	map.									
	8.5 Explain how to									
	Determine the									
	direction of ground									
	water flow									
ASSES	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 u	make up for the remaining 60% of the total score.									

## PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY

<b>COURSE:</b>	Polluted	Site	Investigation	and	CODE: ESM 424	Credit Unit: 3	<b>CONTACT HOURS:</b> 3 HOURS/WEEK				
Remediation	1										
<b>GOAL:</b> This course is designed to acquaint students with the summary of the main processes in the management of polluted sites, site											
audit, site in	vestigation	, samp	ling, risk assess	ment,	remediation						
YEAR: TW	O (2), SEN	AEST	<b>ER: TWO</b> (2)		PRE-	PRACTICAL: 2 HOURS	S/WEEK				
					<b>REQUISITE:</b>						
CENEDAL											

## **GENERAL OBJECTIVES**

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

- 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.

PROGR	PROGRAMME: HIGHER NATIONAL DIPLOMA IN ENVIRONMENTAL SCIENCE AND MANAGEMENT TECHNOLOGY									
COUR	SE: Polluted Site Investigation and	Remediation (	CODE: ESI	M 424	Credit Unit: 3.0		<b>Contact Hours:</b> 3			
GOA	L: This course is designed to acqu	aint students with the s	ummary of	the main	processes in the management of	of polluted sites, site				
audit, s	ite investigation, sampling, risk asse	essment, remediation								
Course	e Specification:		PRACTICAL CONTENT							
CONT	ENT									
Genera	al Objective 1.0: Understand Envir	conmental Site Assessme	ent and Au	dit						
Week	Specific Learning Outcome	<b>Teachers' Activities</b>	Learning	5	<b>Specific Learning Outcome</b>	Teachers'	Evaluation			
			Resource	S		Activities				
1-2	1.1 Define environmentalsite	Explain	Text	Books	Locate potential	Guide student tolocate	Differentiate			
	assessment, environmental	environmental site	Internet	Projector	environmental concerns,	potential environmental	between an			
	site investigation and	assessment,	Calculato	rs	associated with a host of	concerns, associated with	environmental			
	environmental audit.	environmental site			industrial or commercial	ahost of industrialor	site assessment,			
	1.2 Differentiate the above(1.1)	investigation and			properties	commercial properties	environmental			
	with examples.	environmental audit.					site investigation			
							and an			
	1.3 Explain the regulatory	Explain the regulatory					environmental			
	context for environmental	context for					audit including			
	site assessment and	environmental site					examples of their			
	environmental audit.	assessment and					respective			
	1.4 Describe how to locate	environmental audit					contextual uses.			
	potential environmental	and how to locate								
	concerns associated with a	potential								
	nost of industrialor	environmental					Explain now to			
	commercial properties.	concerns associated					evaluate the			
	1.5 Explain the different types of	with a nost of					allerent types of			
	environmentalaudits based	industrial or								

on the process to perform an	commercial		environmental
audit.	properties.		activities.
1.6 Explain how to Identify the			
element within the			
contaminated sites			
regulations that applyto site			
investigation procedures			

Genera	General Objective 2.0: Know Environmental Site Investigation Techniques and Methods									
4-5	2.1 List environmental site	Explain	Text Books	Perform site investigation	Guide students to perform	List				
	investigation techniques and	environmental site	Internet Projector	based on evaluation of field	site investigation basedon	environmental				
	methods.	investigation	Audio visuals	data.	evaluation of field data.	site investigation				
		techniques and				techniques and				
	2.2 Describe the concepts of non-	methods.				methods				
	invasive assessmenttechniques to					Explain the				
	site assessment.	Explain the concepts				statistical				
		of non-invasive				relevant to				
	2.3 Illustrate the application	assessment				sample location				
	of invasivetechniques used	techniques to site				and analysis of				
	in sitecharacterization.	assessment and the				analytical data in				
	2.4 Explain the statistical	application of				the planning of				
	relevant to sample locationand	invasive techniques				sampling				
	analysis of analytical data in the	used in site				programs.				
	planning of sampling programs.	characterization.				1 0				
	2.5 Describe how to designsite	<b>F</b> 1 1 1								
	investigation based on	Explain the								
	evaluation of field data.	statistical relevant to								
		sample location and								
		analysis of analytical								
		data in the planning								
		of sampling programs								
		and how to								
		• design site								
		investigation based								

		on evaluation of				
		field data				
Genera	al Objective 3.0: Understand the ele	ement within the contam	inated site regulation	ns the apply to remediation		
	3.1 Describe remedial	Explain the use of	Text Books	Identify remedial screening	Guide students toidentify	Explain feasibility
67	screening chart	remedial charts,	Internet Projector	chart	remedialscreening chart	analyses, cost
0-7		feasibility analyses,	Lecture Notes			analysis and pilot
	3.2 Explain feasibility	cost analysis, pilot	Audiovisuals			study
	analyses, cost analysisand	studies, and using	charts			study
	pilot study.	different remedial				
		strategies in				
	3.3 Explain the use of	tandem.				
	remedial charts,					
	feasibility analyses, cost	Explain the				
	analysis, pilot studies,	evaluation process				
	and using different	for site remediation				
	remedial strategies in	common to soil and				
	tandem.	ground water				
	3.4 Describe the evaluation	remediation.				
	process for site remediation					

	<ul><li>common tosoil and ground water remediation.</li><li>3.5 Explain the concepts of designing a site remediation plan and a monitoring system.</li></ul>	• Explain the conceptsof designing a site remediation plan anda monitoring system.									
Gener	General Objective 4.0: Know remediation plan site restoration										
8-10	<ul> <li>4.1 List in-situ and ex-situ remediation strategy.</li> <li>4.2 Explain excavation and replacement as a remedial strategy.</li> <li>4.3 Explain soil vapour extraction and air sparging techniques.</li> <li>4.4 Describe what contaminants are suitable for applyingsoil vapour extraction (SVE) andAir sparging (AS).</li> </ul>	Explain in-situ and ex-situ remediation strategy with excavation and replacement as a remedial strategy. Explain soil vapour extraction and air sparging techniques and contaminant soil vapour extraction (SVE) • and Air sparging (AS	Text Books Internet Projector Lecture Notes Calculators Geophysical tools			Explain soil Vapour extraction andair sparging techniques					
Genera	al Objective 5.0: Know when risk a	ssessment should be con	sidered for manager	nent of contaminated site							
11	<ul><li>5.1 Describe a contaminated site</li><li>5.2 Describe the elementsthat</li></ul>	Discuss a contaminated sites and the elements that comprise a risk	Text Books Internet Projector Lecture Notes	Apply risk assessment methodology in analyzing case study data	Guide Student to apply risk assessment methodology	Explain the elements that comprise a risk assessment and					

			1			-
	<ul> <li>comprise a risk assessment and the necessary data to support risk assessment.</li> <li>5.3 Explain risk assessment methodology in analyzing</li> </ul>	assessment and the necessary data to support risk assessment.	Calculators Geophysical tools		in analyzing case study data	the necessary data to support risk assessment
	case study data					
Conors	<b>A Objective 6.0</b> • Know basic in-situ	l u and ex_situ remediation	n strategies			
12-13	<ul> <li>6.1 Explain the basic steps to accomplish remediation. Describe how remediation process will be effective at the site.</li> <li>6.3 Explain the physical, biological and chemical processes involved in site remediation.</li> <li>6.4 Compare in-situ versus ex-situ, on-site versus off-site treatment and land disposal.</li> </ul>	<ul> <li>Explain the basic</li> <li>steps to accomplish</li> <li>remediation and how</li> <li>remediation process</li> <li>will be effective at</li> <li>the site.</li> <li>Explain the</li> <li>physical,biological</li> <li>and chemical</li> <li>processes involved</li> <li>in site remediation</li> <li>and compare in-situ</li> <li>versus ex-situ, on-</li> <li>site versus off-site</li> <li>treatment and land</li> <li>disposal.</li> </ul>	Laptop Text Books Internet Projector Lecture Notes Geophysical tools			Explain the physical, biological and chemical processes involved in site remediation
Genera	al Objective 7.0: Know remediation	n design and implementa	tion		•	
14	7.1 Describe treatability studies, field, bench andpilot tests.	Explain treatability studies, field, and bench and pilot tests.	Laptop Text Books	•	• -	Describe how to develop soil and

	<ul><li>7.2 Explain how to developsoil and groundwater management plans.</li><li>7.3 Explain remedial technologies for controlling exposure</li></ul>	• Describe how to develop soil and groundwater management plans and remedial technologies for	Internet Projector Lecture Notes Calculators			groundwater management plans.
CENE	pathways.	pathways.	alogical treatment to	abaologies for remediation of a		
GENE	<b>KAL OBJECTIVE 8.0:</b> Understan	id ex-situ thermai and bi	ological treatment te	chnologies for remediation of (	organic contaminants	
	<ul> <li>8.1 Explain ex-situ thermaland biological treatment technologies for remediation of</li> <li>8.3 organic contaminants</li> <li>8.4 Explain the characteristics of organic contaminants.</li> <li>8.5 Explain thermal treatment: incineration and thermal desorption.</li> <li>8.6 Explain land farming: treatability studies, design considerations, and performance monitoring</li> </ul>	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. Explain treatability studies, design considerations, and performance	Text Books Internet Projector			Explain ex-situ thermal and biological treatment technologies for remediation of organic contaminants Explain land farming: treatability studies, design considerations,and

			monitoring of land farming			performance monitoring
GENI	ERAL C	<b>DBJECTIVE 9.0:</b> Know Ai	r-flushing technologies f	for remediation of or	ganic contaminants	
	9.1 9.2 sizing	Explain the physical/chemical principles: air flow in unsaturated and saturated porous media, mass transfer, partitioning between phases and in- situ biodegradation. Explain SVE and AS system design considerations: pilot- scale tests, pipe/well sizing andspacing and blower	Explain physical/chemical principles of airflow in unsaturated and saturated porous media, mass transfer, partitioning between phases and in-situ biodegradation. List SVE and AS system design considerations: pilot- scale tests, pipe/well sizing and spacing and blower sizing.	Text Books Internet Projector Lecture Notes Calculators		Explain the physical/chemical principles of air flow in unsaturated and saturated porous media

GENERAL (	<b>GENERAL OBJECTIVE 10.0:</b> Understand free product-recovery and groundwater treatment					
10.1	<ul> <li>Explain free product- recovery and groundwater treatment</li> <li>Explain the physical/chemical/bi ological processes involved in free product</li> </ul>	Explain free product- recovery and groundwater treatment and the physical/chemical/ biological processes involvedin free product recovery	Text Books Internet Projector Lecture Notes Calculators	• -	• -	Explain free product-recovery and groundwater treatment Evaluate in-situ groundwater treatment
10.3	Explain free product- recovery methods.	Explain free product-				methods. Evaluate pumpand
10.4	Explain in-situ groundwater treatment methods. Explain pump and	recovery methods and in- situ groundwater treatment methods.				test methods
test m	ethods.	Explain pump and test methods.				

PRACTICAL GUIDE FOR HND I AND II				
COURSE: House Keeping Emergency Preparedness/Contingency Response				
CODE: ESM 311				
SPECIFIC LEARNING OUTCOME	TEACHERS ACTIVITIES			
Identify work areas/ work space and the areasneeding	Guide students to:			
housekeeping	-identify workareas/ work space and the areas needing housekeeping			
Identify types of dirt, litter, garbage etc				
	-identify types of dirt, litter, garbage etc			
Identify tools/equipment's in				
housekeeping	-identify tools/ equipment's inhousekeeping			
Identify potential hazards in workplace	-identify potential hazards in			
	Workplace			
	Guide students to:			
Identify escape route and places of assembly point.	: identify escape route and assemblypoints.			
Demonstrate the use to redies during emergenery				
situations	demonstrate the use to radios during emergency situations			
situations.	- demonstrate the use to radios during emergency situations.			
Identify firefighting equipment's	- identify firefighting equipment's			
ruentify menghenig equipment 5.	Rechard mengining equipment of			
Simulate a safetyevacuation drill	-simulate a safetyevacuation d			
Carryout a contingencyplan for a workplace	Guide students to develop and			
	Organize a contingency planfor a work place			
Identify safety andhealthcare systems	Guide students to:			
	-prepare a safety and health care plan			

Identify the general environmental and safety guide	- identify the general environmental andsafety guide line
line for industries interms of:	for industries in terms of: Environmental,
• Environmental	
<ul> <li>Occupational Health and Safety</li> </ul>	Occupational Health and Safety Community healthand
Community healthand safety	safety,
Construction and Decommissioning	
	Construction and Decommissioning
Identify an unsafe condition in work place.	Guide students tocarry out a safetyaudit for a case
	study.
Identify an unsafe act	
	Guide students to prepare an accident report fora case
Identify the main factors to be investigated in an unsafe	study.
COURSE TITLE: Environmental Biotechnology	CODE : ESM 312
conduct a practical on biodegradation xenobiotic	
compounds (hydrocarbons, detergent, dyes and pesticide)	Guide student to conduct a practical on biodegrardation
	xenobiotic compounds (hydrocarbons, detergent, dyes and
	pesticide)
	Guide student to Carry out practical on phyto- remediation
Communication in the remodiction	Carry out practical on air, water and soil toxicity
Carry out practical on phyto- remediation	testing
carry out practical on anaerobic aerobic digestion	Guide student to carry out practical on anaerobic aerobic
	digestion
carry out treatment on waste water.	

	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 sources of water supply to community.	Guide the studentsin identifying various sources ofwater supply to community.
Disinfect well	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.	Guide student tovisit industrial wastewater treatment plant.
Design chemical feed systems that will allow the estimation of chemical sludge production.	Guide students todesign chemical feed systems that will allow the estimation of chemical sludge production.
	Guide students to plot adsorption isotherms and breakthrough curves (adsorptionand ion exchange

Plat advartian isothermound broakthrough curves	
(adsorption and ion exchange	
Visit municipal wastewater treatmentplant.	Guide student tovisit municipal wastewater treatment
	plant.
Measure municipal wastewater strength basedon the	Guide students to measure municipalwastewater strength
neusate manerpar wastewater strength basedon the	based on the physical and chamical
physical and chemical characteristics of the wastewater.	based on the physical and chemical
	characteristics of the wastewater.
Visit drinking watertreatment plant.	Guide student tovisit drinking water treatment plant.
	Guide students to measure the key bacteriological water
Measure key bacteriological waterquality parameters	quality parameters
Identify appropriate materials for collectingwater	Guide student to:
somplos	identify appropriate materials for collecting water
samples	-identify appropriate materials for concerning water
	samples
Prepare sampling bottles for water collection	
	-prepare samplingbottles for water collection
Collect water samples	
	-collect watersamples
Dispatch sample bottles to the laboratory for analysis	1
Disputen sumple bottles tottle luboratory for analysis	-dispatch samplebottles to the laboratory for analysis
	-dispatch samplebotiles to the laboratory for analysis
Package and label samplebottles for transportation	
Culture water samples for Indicator organism	-package and labelsample bottles for transportation
	Culture water samples for Indicator organism
Identify other organism	
e.g. protozoa etc. In watersamples from under the	-identify other organism e.g. protozoa etc. Inwater
microscope	samples from under the microscope

	-identify hard water by its characteristics
Identify hard water by itscharacteristics	-remove waterhardness
Remove water hardnessTreat water for Odour	-treat water forOdour
<b>COURSE: Environmental and Health</b>	
RiskAssessment	<b>CODE: 314</b>
Identify risks associated withdifferent development	Guide students to identify Risk assessment in activities
activities.	such as mining.
Determine if an epidemiological studies prove can be	Guide students to determine if an epidemiological studies
linked to diseases	prove can be linked to diseases
Determine the risk (carcinogenic) of working in an	Guide the studentsto conduct:
environment for 70 years that results in achronic oral intake of 0.50 mg/(kg-day) ofbenzene.	-determine the risk (carcinogenic) of working in an environment for 70 years that results in achronic oral intake of
Determine the chemical specific riskfor an intake of	0.50 mg/(kg-day) ofbenzene.
0.00025 mg/(kg-day)of benzene via ingestion with Water.	-determine the chemical specific riskfor 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-INFORMATI CODE: ESM 315	CS
Identify all the drawing instruments(compasses,	Guide students to:
dissidence	-Identify all thedrawing instruments (compasses,
protractors, set squares, pencil, etc.)	dividers protractors, set
	Guide students to demonstrate the procedure for ink-
	drawing and lettering techniques

Demonstrate the presedure for intr drawing and lattering	
Demonstrate the procedure for link- drawing and lettering	
techniques	
Measure horizontal and vertical angels using theodolite.	Guide students tomeasure
	horizontal and vertical angels using theodolite
Perform calculations of bearings, distances and co-	Guide students to perform calculations of bearings,
ordinates fromtraverse surveys	distances and co-ordinates from traverse surveys
Conduct a tachometricexercise.	Guide students to:
	-conduct a tachometricexercise.
Determine tachometric constants from field	-determine tachometric constants from field measurement.
measurement.	
	-plot contours from tachometric measurements carry out
Plot contours fromtachometric measurements Carry out	compasstraversing of a closed
compass traversing of a closedfigure	Figure
COURSE: Environmental Auditing And Managemen	t Systems CODE: ESM 321
Identify the different types of ISO family	Guide the studentto identify different types of ISO
Identify possible leadership qualities thatcan make an	Guide the student to identify possibleleadership
industry grow	qualities that can make an industry grow
Identify steps for developing the emergencyresponse plan	Guide the studentsin identifying various emergency
	response plans.
Carry out a specificenvironmental audit	Guide the studentsto carry out an environmental audit
COURSE: ERGONOMICS	CODE: ESM 322
Identify two Ergonomic solutionsto reduce the risk	Guide students to identify two Ergonomic solutionsto
factors for musculoskeletal injuries	reduce the risk factors for musculoskeletal injuries
COURSE: ENVIRONMENTAL TOXICOLOGY	CODE: ESM 323
Soil test kits pHmeter, Turbid meter centrifugeand	Analyze air, water and soil samples and identify

magnetic stirrer shakers. Membrane filtration	toxicants in them.
apparatus.	
	Determine toxicity using extraction
EP Kit	
	Analyze air, water and soil samples and identify
	Determine toxicity using extraction procedure
Conduct Practical analysis of food toxicants	Guide students to:
	-conduct Practicalanalysis of food toxicants
Determine the toxicity offood additives and	
contaminants in food samples.	-determine the toxicity of foodadditives and contaminants
	infood samples.
Determine the toxicity of atmospheric toxicants	
	determine thetoxicity of atmospheric toxicants
Determine the toxicity of aquatic toxicants.	
	-determine the toxicity of aquatictoxicants.
Determine the toxicity of soil pollutant.	determine the toxicity of soil collutent
Identify the animals used in terrisity tests	Cuide students to:
identify the animals used in toxicity tests.	Guide students to:
A dminister toxing into a guinea nig through different	-identify the animals used intoxicity tests.
Administer toxins into a guinea pig through different	administratovinsinte a svince nie through different
routes and determine the influence of of	administer toxinsinto a guinea pig through different
administration ontoxicity	routes and determine the influence of routeof
	administration on toxicity
Identify hazardous wastes generated by Business and	Guide students to:
industries.	-identify hazardous wastesgenerated by Business and
	industries.

Carry out a visit to industries to know the different	
hazardous wastegenerated by them.	carry out a visit toindustries to know the different
	hazardous waste generated by them.
Determine the toxicity of some selected pesticides	Guide students to:
	-determine the toxicity of some selected pesticides
Determine pesticideresidues in the environment.	
	-determine pesticide residues in the environment.
Determine the toxicity of various plant and animal	
toxins	determine the toxicity of variousplant and animal toxins
COURSE: construction, machine and tools safety	CODE: ESM 324
Demonstrate with relevantmachines	Guide students to demonstrate with relevant machines
associated hazards	associated hazards
Demonstrate safety precaution and safe handling of	Guide students to demonstrate safety precaution and safe
special woodworking tools and equipment	handling of special woodworking tools and equipment
COURSE: instrumentation and laboratory	CODE: ESM 325
analysis	
Carry out measurementusing colorimeters.	Guide students to:
	-carry out measurement using colorimeters.
Carry out routine maintenance on the colorimeter	
e.g. care offilters and cuvettes.	-carry out routinemaintenance on the colorimeter
	e.g. care of filtersand cuvettes.
Determine concentration of samples applying Beer	-determine concentration of samples applying Beer -
- Lambert"s Law and using spectrophotometer.	Lambert"s Law and using spectrophotometer.
Carry out minor maintenance work on the	-Carry out minormaintenance workon the
spectrophotometer e.g. dusting, replacement of lamps	spectrophotometer
etc.	e.g. dusting, replacement of lamps etc.
Determine sodium notessium and calcium using	Guida students to:
---	--
Determine sourum, potassium and calcium using	
flame photometeromission spectrum.	-determine sodium, potassiumand calcium usingflame
	photometer omission spectrum.
Clean atomizer using cleaning probe	
cieur atomizer asingereaning probe.	alaan atomizarusing alaaning proba
	-clean atomizerusing cleaning probe.
Record spectra of knowncompound using Raman	-record spectra of known compound using Raman
Spectrophotometer.	Spectrophotometer
Come out nouting maintenance on	community out nouting maintenance on Spectrophotometer
Carry out routine maintenance on	-carry out routine maintenance on spectrophotometer
Spectrophotometer.	
	-carry out typicalmaintenance routines for the flame
Carry out typical maintenance routines for the flame	photometer
nhotometer e a clearing deposits from theatomizer	e a clearing deposits from the atomizer
Measure the absorbance of a sample of known	Guide students tomeasure the absorbance of a sample
concentration using the AAS.	of knownconcentration using the AAS.
Carry out routine maintenance on an $\Delta \Delta S$	Guide students to carry out routine maintenance on an
Carry out routine maintenance on an AAS	
Measure the absorption of a given sample using the X-	Guide students to:
ray instrument and alsoby varying the filters.	-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-	
inclusive the absolution of a given sample using the A-	many the character of a given completion the V
ray instrument and alsoby varying the filters.	measure the absorption of a given sample using the X-
	ray instrument and also by varying thefilters.
Carry out routine care of the instrument e.g. cleaning	-carry out routine care of the instrument e.g. cleaning of
of filters, varification of onticalinetrymonts	filters verification of optical
or muchs, vermeation of opticalitist unlettis.	Inters, vermeation of optical

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

Measure accurately oxygen concentration using the	Guide students to:
gas measuringelectrodes.	-measure accurately oxygenconcentration using the gas
	measuring electrodes.
Carry out maintenance of electrode including	-carry out maintenance of electrode includingrecharging.
recharging.	
Demonstrate thetechniques of autoradiography	Guide students todemonstrate the techniques of
	autoradiography
Count bacteria coloniesusing colony counter.	Guide students to :
	-count bacteria colonies using colony counter.
Carry out routine maintenance and repair of colony	
counters	-carry out routinemaintenance and repair of colony
	counters.
Sterilize centrifuge.	Guide students to:
	-sterilize centrifuge
Use centrifuge forseparation.	-use centrifuge forseparation.
Ggrow organism usingincubator	-grow organismusing incubator.
Carry out routine maintenance of theinstruments in	carry out routine maintenance of theinstruments in 12.1
COURSE: Waste Utilization	CODE: 326
Identify different types of waste generated in the	Guide the studentsto identify the different types of waste
environment.	generated in the environment
	Guide students to display samples of wastes
	Guide students to conduct laboratoryanalysis of samples
Carry out field trips towaste management authorities.	Guide students to :

	-carry out fieldtrips to waste management authorities.	
Observe waste collectionand disposal practices.		
	-observe waste collection and disposal practices.	
Identify the wastehierarchy i.e.		
Waste prevention(Rejection)	-identify the waste	
Waste minimization	hierarchy i.e.	
Waste recycling	Waste prevention(Rejection)	
Waste recovery	Waste minimization	
Waste treatment	Wasterecycling	
Waste disposal.	Wasterecovery	
	Wastetreatment	
Identify techniques of waste minimization.	Wastedisposal.	
Identify waste disposalmethods.	-identify techniquesof waste minimization.	
Undertake waste streamanalysis.	-identify waste disposal methods.	
	-Undertake wastestream analysis.	
Identify health problems associated with waste handling	Guide students to:	
such as:	-identify health problems associated with waste handling	
Reproductive effects	such as:	
Congenital malformations	Reproductive effects	
Cancer	Congenital	
Cardiovascular	malformations	
disorders	Cancer	
respiratory infection	Cardiovasculardisorders	
Hepatitis B	respiratory infection	
Lassa fever.	Hepatitis B	

	Lassa fever.
Identify the causative organisms of the health problems	
above, resultingfrom poor waste handling.	-identify the causative organisms of the health problems
	above, resulting from poor waste handling.
Identify pollutants inwaste handling	
	-identify pollutantsin waste handling
Identify the nature of pollutants inherent in waste	
handling.	identify the nature of pollutants inherent in waste handling.
Identify solid wastecollection methods.	Guide students to:
	-identify solid wastecollection methods.
Identify solid wastedisposal methods.	
collection methods.	-identify solid wastedisposal methods.
	-identify liquid waste collectionmethods.
Identify liquid wastedisposal methods.	-identify liquidwaste disposalmethods.
Identify various means and facilities of solid treatment	-identify various means and facilities of solid treatment
and disposal.	and disposal.
Identify various means and facilities of liquid waste	-identify various means and facilities of liquid waste
treatment and disposal.	treatment and disposal.
	identify variousmeans and facilities used insewage
Identify various means and facilities used in sewage	management
management.	
Perform conversion of wastematerials to useful	Guide students to:
products.	-perform conversion of wastematerials to useful products.
Identify locally-fabricated machines and processing	-identify locally- fabricated machinesand processing
equipment used in convertingwastes-to-wealth e.g.:	equipment used in converting wastes- to-wealth e.g.:

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

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

Perform soil vapour screening as an aid to sample	Guide students to perform soil vapourscreening as an
selection and corelogging.	aid to sample selection and core logging
Identify the method todevelop and purge a monitoring	Guide students to identify the method to develop and
well.	purge a monitoring well.
Conduct a soil survey and collect vapor samples	Guide students to conduct a soil survey and collectvapor samples
Identify different types of geophysical tools	Guide students toidentify different types of geophysical tools
Demonstrate the use of headspace test to determine	Guide students to determine the presence of volatile
the presence of volatile organics	organics using head spacetest.
Perform a hydraulic responsetest in a monitoring well	Guide students to perform a hydraulic response test in a
to determine hydraulic conductivity	monitoring well to determine hydraulic conductivity
Use an electric water tape tomeasure water levels in a	Guide studentsto:
monitoring well.	-use an electric water tape to measure water levels in a monitoring well.
Use a surveying level to determine relative borehole elevations.	-use a surveying level to determinerelative borehole
Coloulate group divisional sustained	elevations.
Calculate ground waterelevations.	colculate groundwater elevations
Prenare a hydraulic gradientman	-calculate groundwater elevations.
riepare a nyuraune grautentinap.	-determine the direction of ground water flow
Determine the direction of ground water flow	
COURSE: Polluted Site Investigation and	CODE: ESM 424
Remediation	
Locate potential environmental concerns, associated	Guide student tolocate potential environmental
with a host of industrial or commercial properties	concerns, associated with ahost of industrialor

	commercial properties
Perform site investigation based on evaluation of	Guide students to perform site investigation basedon
fielddata.	evaluation of field data.
Identify remedial screeningchart	Guide students toidentify remedialscreening chart
Apply risk assessment	Guide Student
methodology in analyzing case	to apply risk
study data	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	
Α	WATER and WASTE-WATER LABORATORY	
	Toxic gas monitor with accessories for CO, NO, NO2, H2S	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 $150 \times 1^{\circ}$ 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 weather equipment)	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, NO2, H2S	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 thefollowing tests:-	2no
	• Alkalinity, 0.5 – 8ppm	
	• Chloride, 2 – 100 ppm	
	Hardness, 2 – 100 ppmSulphite, 2 - 50 ppm	
18	Water Colorimetric field test kit covering the following test:-	1no.
	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.	
19	Water titrimetric field test kit covering the following test:-	1no.
	11-11-11-11-11-11-11-11-11-11-11-11-11-	
	• Alkalinity (total), $0 = 500 \text{ ppm}$	
	• Colour, $0 - 100$ units	
	• Cyanide, $0 - 1$ ppm	
	• Hardness (low range), $0 - 10$ ppm	
	<ul> <li>Hardness (High range), 0 – 500 ppm</li> <li>Disselved everyon 0.04 – 20 mm</li> </ul>	
	• Dissolved oxygen, $0.04 - 20$ ppm Sulphate 1, 750 ppm Turbidity 5, 100 HM (AAS)	
P	ENVIONMENTAL BIOLOCY LABOATORY	
D	ENVIONMENTAL BIOLOGY LABOATORY	04
	Description	Qly Boquirod
1	Binocular Microscope -	
1.	Dinocular Microscope -	13140.
2	Prepared sindes of Animal cells/fissues(various types)	50 No
3	Prepared slides of plants cells/tissues(various types)	
		50No

4	Plain slides (plastic)	100No
5	Petri-dishes( plstic/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)	A 1
24	Pipettes/bulb pipettes (of various capacities)	Assorted
24.	ripettes/build pipettes (of variouscapacities)	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
С	CHEMISTRY LABORATORY	
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	Hydrology Laboratory	
	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:	30NO
	- general purpose grade 2 impact	
		15no.
2	Eye protection goggles:	15no.each

	<ul> <li>grade 2 impact</li> <li>chemical, type C</li> <li>dust, type D</li> <li>gas, type G</li> <li>molten metal, type M</li> </ul>	
3	Face shields:	5 each
	-grade 2 impact, C resistance	
	- grade 2 impact, C and M resistance	
	-grade 1 impact, C and M resistance -Ultraviolet	
4	Eye wash assembly	2
5	Fire extinguishers	3each
	- BCF dry powder	
6	First aid kit (up to 30 persons)	3
7	Resuscitator (Brook airway)	5
8	Lifting manikin model	1
9	Safety hand gloves:	Assorted
	<ul> <li>sterile types</li> <li>non-sterile types Heat/cold resistance type</li> </ul>	(1strream of 30students)
10	Hazard warning labels:	1no symboleach
	<ul> <li>Chemical (corrosive, flammable, irritant, toxic)</li> <li>general (laser beam, radiation, radioactive, toxic)</li> </ul>	
11	Protective coats:	(1steam of 30 students)

	- flame retardant chemical resistant	
12	Dust/mist/fumes masks	5 each
13	Respirators:	
	- dust/mist type	2pack
	- mercury vapour type	3
	- nuisance odor	
	- organic vapour	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:-	1
	<ul> <li>Pocket Stereoscope</li> <li>Mirror Stereoscope</li> <li>Dual mirror Stereoscope</li> </ul>	
2.	Densiometer	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:	30NO
	- general purpose grade 2 impact	15no.
2	Eve protection goggles:	15no.each
	<ul> <li>grade 2 impact</li> <li>chemical, type C</li> <li>dust, type D</li> <li>gas, type G</li> <li>molten metal, type M</li> </ul>	
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	Eve wash assembly	2
5	Fire extinguishers	- 3each

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

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.	

# B Surveying Equipment Store

### (C)Remote Sensing Equipment

S/No. Description Qty
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1.	Stereoscopes:-	1
	- Pocket Stereoscope	
	- Mirror Stereoscope	
	Dual mirror StereoscopeInterpretoscope	
2.	Densiometer`	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