NATIONAL BOARD FOR TECHNICAL EDUCATION

NATIONAL DIPLOMA
IN
MARINE METEOROLOGY AND COASTAL MANAGEMENT (MCM)

CURRICULUM AND COURSE SPECIFICATIONS

DEVELOPED IN COLLABORATION WITH

MARITIME ACADEMY OF NIGERIA, ORON

MAY, 2017

Produced by the National Board for Technical Education (NBTE)
Plot B, Bida Road, P.M.B. 2239, Kaduna Nigeria.

FOREWORD

The National Diploma (ND) in Marine Meteorology and Coastal Management is designed to replace the various syllabuses used by training institutions which produce manpower in the different sub-sectors of Maritime profession nationwide.

The acute shortage of professionally trained manpower in the Maritime industry in Nigeria as well as the need to produce Maritime Sciences practitioners with the ethics of the profession through the acquisition of desirable knowledge and skills informed the production of this national curriculum.

It is my belief that this curriculum and course specifications which is the minimum requirement for producing professionals with sound knowledge and skills in Maritime Sciences, if properly implemented with the required resources (qualified teaching staff in adequate number and mix, adequate consumables, training materials, teaching aids) and admission of qualified candidates into the programme, will lead to the production of the required competent and skilled manpower in the sector.

I wish to express my deep appreciation to the Maritime Academy of Nigeria, Oron for collaborating with the Board by funding the entire exercise for the development of this curriculum. I wish to also express my appreciation to our stakeholders for their invaluable contributions to the development of this curriculum.

I hope that this curriculum would be properly implemented so as to lead to the goal of producing the required Maritime industry work force of our dreams.

Dr. M.A. Kazaure, *mni*
Executive Secretary,
NBTE, Kaduna.

GENERAL INFORMATION

1.0 GOAL AND OBJECTIVES

NATIONAL DIPLOMA (ND)

The certificate to be awarded and the programme title shall read:

NATIONAL DIPLOMAINMARINE METEOROLOGY AND COASTAL MANAGEMENT (MCM)

PROGRAMME GOAL:

The National Diploma (ND) in Marine Meteorology and Coastal Management is aimed at producing diplomates with knowledge and skills in weather, climate, and coastal management profession as related to marine operation, ocean exploration including oil and gas, fishing activities, dredging industries, port operation etc.

Programme Objectives:

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

- Apply basic weather instrumentation to monitor marine and coastal observationsof merchant ships and related oil installations;
- Interpret short and medium range weather changes in respect to marine and coastal hazards;
- Assist in data gathering in ocean and coastal exploration of marine resources for national development;
- Apply basic skill with regards to coastal management and weather observation in marine technology

2.0 ENTRY REQUIREMENTS

The academic requirements for admission into the ND Marine Meteorology and Coastal Management programme are:
Five (5) G.C.E. (O level), WASSCE, NECO or NABTEB subjects passed at not more than two sittings. The subjects must be passed at least at Credit level and should include English Language, Mathematics, two(2) basic sciences (Chemistry, Physics, Biology/Agricultural Science and one social science (Geography and Economics).

3.0 CURRICULUM

The curriculum consists of four main components. These are:

i. General Studies Courses
ii. Foundation Courses
iii. Professional Courses
iv. Supervised Industrial Work Experience Scheme (SIWES)

The General Studies component shall include courses in Science and Technology related programmes, English Language, Computer/Information Communication Technology, Entrepreneurship Education and Citizenship Education. The General Studies component shall account for between 10-15% of total contact hours for the programme.

Foundation courses include courses in English Language, Physical Geography, Physics, Mathematics, Statistics and Basic Computer Applications. The number of hours will account for about 10-15% of the total contact hours.

Professionalcourses are the core Marine Meteorology and Coastal Management Courses which give the students the theoretical and practical skills needed to practise in the Marine industry. These may account for between 70-80% of the contact hours.

4.0 CURRICULUM STRUCTURE OF THE ND PROGRAMME IN MARINE METEOROLOGY AND COASTAL MANAGEMENT

The structure of the ND programme consists of four semesters of classroom, laboratory and fieldwork activities in the institution. Each semester shall be of 17 weeks duration made up as follows: 15 contact weeks of teaching (lecture and practical exercises), and 2 weeks for tests, quizzes, examinations, and registration.

5.0 ACCREDITATION

The National Diploma (ND) in Marine Meteorology and Coastal Management shall be accredited by the National Board for Technical Education (NBTE) before the diplomates can be awarded the diploma certificate.

The details of the process of accrediting a programme for the award of the ND are available from the office of the Executive Secretary, National Board for Technical Education, Plot 'B', Bida Road, P.M.B. 2239, Kaduna, Nigeria or the Board's website at www.nbte.ng.org.

6.0 CONDITIONS FOR THE AWARD OF THE NATIONAL DIPLOMA

(A) Grading system:

For test, examination, practical, and fieldwork for all courses, the grading are as follows:

Marked Range (%)	Letter Grade	Weighting
75-100	A	4.00
70-74	AB	3.50
65-69	B	3.25
60-64	BC	3.00
55-59	C	2.75
50-54	CD	2.50
45-49	D	2.25
40-44	E	2.00
Below 40	F	0.00

Institutions offering accredited programmes shall award the National Diploma (ND) to candidates who have successfully completed the programme after passing the prescribed course work and examinations.

(B) Classification of National Diploma (ND)

The National Diploma shall be classified on a 4-point Cumulative Grade Point Average (CGPA) as follows:

Distinction - GPA of 3.50 and above
Upper Credit – GPA of 3.00 – 3.49
Lower Credit – GPA of 2.50 – 2.99
Pass - GPA of 2.00 – 2.49

7.0 GUIDANCE NOTES FOR TEACHERS TEACHING THE PROGRAMME

7.1 The new curriculum is drawn in course units. This is in keeping with the provisions of the National Policy on Education which stress the introduction of the semester credit units that will enable a student who so wishes to transfer the units already completed in an institution to another of similar standard.

7.2 In designing the units, the principle of the modular system by-product has been adopted, thus making each of the professional modules, when completed, to provide the student with technical operative skills which can be used for job creation and employment purposes.

7.3 As the success of the credit unit system depends on the articulation of programmes between the institutions and industry, the Curriculum Content has been written in behavioural objectives so that the expected performance of the student who successfully completed the courses of the programme is clear. There is a slight departure in the presentation of the performance-based curriculum which requires the conditions under which the performances are expected to be carried out and the criteria for the acceptable levels of performance to be stated. It is a deliberate attempt to get 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 to follow that with the criteria for determining an acceptable level of performance. The Academic Board of the institution may vet departmental submission on the final curriculum. The aim is to continue to see to it that a solid internal evaluation system exists in each institution for ensuring minimum standards and quality of education in the programmes offered throughout the polytechnic and other specialized institution such as Maritime Academy of Nigeria, Oron.

7.4 The teaching of the theory and practical work should, as much as possible, be integrated. Practical exercises, especially those in professional courses and fieldwork should not be taught in isolation from the theory. For each course, there should be a balance of theory and practice.

8.0 CAREER OPPORTUNITIES

The ND Marine Meteorology and Coastal Management course prepares students for career in areas that include:

- Shipping;
- Meteorology application in oil and gas industries;
- Coastal Tourism and Recreation facilities;
- Oil Pollution and Control agencies;
- Federal Ministry of Environment
- National Oil Spill Detection and Regulatory Agency
- National Environmental Standard Regulatory and Enforcement Agency
- Nigerian Maritime Administration and Safety Agency
- Fishing industries;
- Port Authority;
- Search and Rescue Agency and Coast Guard;

9.0 QUALIFICATION OF THE IMPLEMENTERS OF THE CURRICULUM

Owing to the scarcity of specialists to implement the ND Marine Meteorology and Coastal Management curriculum, those in the maritime industry with qualifications in the relevant subjects should be considered. Additional qualifications in the profession and years of working experience in the maritime industry will be an added advantage.

CURRICULUM TABLE

1ST SEMESTER (ND I)

S/N	Course Code	Course Title	L	P	CU	CH
1	MCM 101	Basic Safety at Sea	0	0	0	0
2	MCM 111	General Meteorology I	2	1	3	3
3	MCM 112	Codes and Observation	1	1	2	2
4	MCM 114	Coastal Marine Resources and Management	3	0	3	3
5	PHY 101	Mechanics and Properties of Matters	1	1	2	2
6	MTH 112	Algebra and Elementary Trigonometry	2	0	2	2
7	COM 101	Introduction to Computing	1	1	2	2
8	STA 111	Statistics (Descriptive Statistics I)	1	0	1	1
9	GNS 101	Use of English I	1	0	1	1
10	GNS 111	Citizenship Education I	1	0	1	1
11	GNS 224	Physical Geography	1	0	1	1
			14	**4**	**18**	**18**

NB: The students must have evidence of basic safety courses especially personal survival at sea before end of first semester

2ND SEMESTER (ND I)

S/N	Course Code	Course Title	L	P	CU	CH
1	MCM 121	General Meteorology II	2	1	3	3
2	MCM 122	Plotting Practices	1	2	3	3
3	MCM 123	Introduction to Geographic Information System and Remote Sensing	1	2	3	3
4	MCM 124	Coastal Hazards and Management	2	0	2	2
5	MCM 125	Meteorological Instrumentation	1	2	3	3
6	PHY 111	Physics II (Heat and Electricity)	1	1	2	2
7	GNS 102	Communication in English I	1	0	1	1
8	GNS 121	Citizenship Education II	1	0	1	1
9	EED 126	Introduction to Entrepreneurship	1	1	2	1

			11	**9**	**20**	**20**

3RD SEMESTER (ND II)

S/N	COURSE CODE	COURSE TITLE	L	P	CU	CH
1	MCM 211	Synoptic Meteorology	2	2	4	4
2	MCM 212	Dynamic Meteorology	2	1	3	3
3	MCM 213	Oil Spill Management and Contingency Plan	2	3	5	5
4	MCM 214	Marine Meteorology I	2	1	3	3
5	MCM 216	Guided Field Trip	0	1	1	2
6	MCM 215	Integrated Coastal Management	2	0	2	2
7	GNS 201	Use of English II	2	0	2	2
8	GNS 228	Research Methods	2	0	2	2
9	EED 216	*Practice of Entrepreneurship	1	1	2	2
			15	**9**	**24**	**24**

NB: Guided field trip to marine and coastal facilities

4TH SEMESTER (ND II)

S/N	COURSE CODE	COURSE TITLE	L	P	CU	CH
1	MCM 221	Coastal Environmental Impact Assessment	2	3	5	5
2	MCM 222	Socio-Economic Aspects in Coastal Environmental Management	2	0	2	4
3	MCM 223	Geographic Information System and Remote Sensing II	1	2	3	3
4	MCM 224	Marine Meteorology II	2	1	3	3
5	MCM 225	Project	0	4	4	4
6	GNS 202	Communication in English II	2	0	2	2
			9	**10**	**19**	**19**

NB: Please see NBTE curriculum for GNS and Foundation Courses

Programme: ND	**Course Code:**		**Total Contact Hours: 45** **Credit Unit: 3**
Course Title: GENERAL METEOROLOGY I	MCM 111		**Theoretical: 2 hours**
Semester: 1st	**Pre-requisite:**		**Practical: 1 hour**

Goal: The course is designed to expose the students to weather codes and decoding messages

General Objectives:
On Completion of this course the students will be able to:

1] Appreciate the importance of the Science of meteorology to mankind
2] Understand the atmosphere and its composition
3] Understand temperature and its variation
4] Understand the pressure system of the earth's atmosphere
5] Understand clouds formation, types and classifications
6] Acquire basic knowledge on issues related to atmospheric optics

	Course Title:	Course Code:		Total Contact Hours: 45		
	GENERAL METEOROLOGY I	MCM 111		Theoretical: 2 hours		
	Semester: 1st			Practical: 1 hour		
	Theoretical Content			Practical Content		
	General Objective 1.0 Appreciate the importance of the Science of meteorology to mankind					
Week /s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1 – 2	1.1 Define meteorology & Meteorological observations 1.2 Outline areas of application of meteorological sciences 1.3 State the importance of meteorology to humanity 1.4 Explain the need for an international organisation for the science of meteorology.	Explain meteorology & Meteorological Outline areas of application of meteorological sciences State the importance of meteorology to humanity Explain the need for an international organisation for the science of meteorology.	Video tapes, Overhead projector	Take a visit to see a meteorological station.. .	Guide and supervise students on a visit to a meteorological station..	State the importance of meteorology to humanity?
	General Objective 2.0: Understand the atmosphere and its composition					
3 - 4	2.1 Define the atmosphere 2.2 Describe the composition of the	Explain the atmosphere and	Video tape Overhead	Take readings of atmospheric pressure	Demonstrate how to do it through	Describe the composition of the

	atmosphere 2.3 Explain the vertical divisions of the atmosphere 2.4 Explain the heat exchange processes of the atmosphere 2.5 Enumerate the effect of gravity on the atmosphere and air density.	the composition of the atmosphere Explain the vertical divisions of the atmosphere, the heat exchange processes of the atmosphere, Explain the effect of gravity on the atmosphere and air density.	projector	using digital and analogue barograph Depict how to measure temperature using thermometer and thermograph Demonstrate how to measure relative humidity using hydrometer	practical application.	atmosphere?
	General Objective 3.0 Understand temperature and its variation					
5 – 7	3.1 Define temperature and surface air temperature 3.2 State the instrument use for measuring temperature 3.3 Explain temperature scale and its conversion 3.4 Explain the diurnal variation of surface air temperature 3.5 Explain the physical processes use in thermometry. 3.6 Describe the working principle of thermograph 3.7 Explain the horizontal and vertical variations of air temperature	Explain temperature and surface air temperature, the instrument use for measuring temperature, temperature scale and its conversion Explain the diurnal variation of surface air temperature, the physical processes use in thermometry, be the working principle of thermograph and the horizontal and vertical variations	Video tape, Overhead projector	Demonstrate how to measure temperature using different types of thermometers	Guide and supervise students	Explain temperature variation with height?

		of air temperature.				
	General Objective 4.0 Understand the pressure system of the earth's atmosphere					
8 - 9	4.1 Define atmospheric pressure 4.2 Discuss the correction for standard condition 4.3 Explain the essence of horizontal and vertical variations in pressure 4.4 Discuss the ICAO standard atmosphere 4.5 State the use of barometer as an altimeter 4.6 Explain the significance of pressure gradient	Define atmospheric pressure Discuss the correction for standard condition Explain the essence of horizontal and vertical variations in pressure Discuss the ICAO standard atmosphere State the use of barometer as an altimeter Explain the significance of pressure gradient	Video tape Overhead projector	Use barometer to measure atmospheric pressure	Guide and assist students	Discuss the correction for standard condition
	General Objective 5 .0: Understand clouds formation, types and classifications					
10 – 12	5.1 Define moist air 5.2 Discuss the three states of matter 5.3 Explain isobaric and adiabatic processes. 5.4 Define latent heat 5.5 Discuss moisture indicators 5.6 Discuss the elementary theory of the wet-bulb thermometer 5.7 Explain the working principles of the phychrometer and the hygrometer 5.8 Explain the relationship between dry-bulb, wet-bulb and dew-point	Explain moist air Discuss the three states of matter Explain isobaric and adiabatic processes. Define latent heat Discuss moisture indicators Discuss the elementary theory of the wet-bulb	Video tapes, Overhead projector	Use wet and dry bulb thermometer to compute the relative humidity	Guide and assist students	Discuss the three states of matters

	temperatures for saturated and unsaturated air 5.9 Discuss the human body as a wet-bulb thermometer 5.10 Explain the diurnal variation of relative humidity.	thermometer Explain the working principles of the phychrometer and the hygrometer Explain the relationship between dry-bulb, wet-bulb and dew-point temperatures for saturated and				
	General Objective 6.0 Acquire basic knowledge on issues related to atmospheric optics					
13 – 14	6.1 Outline the general principle in clouds fog and precipitation formation 6.2 State the major classification of clouds 6.3 Explain the types of precipitation associated with clouds: Orographic, frontal, conventional, Turbulent, etc 6.4 Explain visibility, factors affecting visibility, the influence of water droplets and dust (aerosols) and the economic importance	Explain the general principle in clouds fog and precipitation formation State the major classification of clouds Explain the types of precipitation associated with clouds: Orographic, frontal, conventional, Turbulent, etc Explain visibility, factors affecting visibility, the influence of water droplets and dust (aerosols) and the	Video tape, Overhead projector	Use visual observation to determine type, amount and height of clouds	Guide and assist students	Differentiate between clouds and fog

		economic importance				

Programme: ND	**Course Code:**		**Total Contact Hours: 30** **Credit Unit: 2**
Course Title: CODES AND OBSERVATION	MCM 112		**Theoretical: 1 Hour**
Semester: 1st	**Pre-requisite:**		**Practical: 1 Hour**

Goal: This course is designed to enable students appreciate coastal and marine resource management

General Objectives:

On Completion of this course the students will be able to:

1] Appreciate the background to codes and coding
2] Understand decoding METARs and METAR Reports
3] Know group number
4] Appreciate station plot model
5] Understand weather Code and decoding message

	Course Title:		**Course Code:**			**Total Contact Hours: 30** **Credit Unit: 2**
	CODES AND OBSERVATION		MCM 112			**Theoretical: 1 hour**
	Semester: 1st					**Practical: 1 hour**
	Theoretical Content			**Practical Content**		
	General Objective 1: Appreciate the background to codes and coding					
Week /s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1-2	1.1 Define Codes and Coding 1.2 Explain surface METAR Report and Plotting Practices 1.3 Identify the primary variables in a standard METAR-format surface report 1.4 Explain how to plot surface reports using the Standard Station Model	Define Codes and Coding Explain surface METAR Report and Plotting Practices Identify the primary variables in a standard METAR-format surface report	Video tape , Overhead projector	1] Demonstrate how to present a METAR Report 2] Use standard station Model to explain weather variable	Guide and assists the student.	What is the rationale for using codes to meteorologist?

		Explain how to plot surface reports using the Standard Station Model				
	General Objective 2: Understand decoding METARs and METAR Reports					
3-4	2.1 Define METAR and METAR reports 2.2 Explain the International standard code format to report surface weather observation 2.3 Identify codes for surface winds 2.4 Identify codes for visibility and cloud base height change 2.5 Identify codes for occurrences of severe weather	Explain METAR and METAR reports, the International standard code format to report surface weather observation, codes for surface winds, codes for visibility and cloud base height change and codes for occurrences of severe weather	Video tapes , Overhead projector	1] Demonstrate how to measure basic weather variables using meteorological measuring instrument. 2] Take the measurements of other related surface observations	Guide and assists the students.	Show the code for winds, visibility and severe weather

	General Objective 3: Know group number					
5-6	3.1 Describe group numbers and their meaning 3.2 Describe Group 1-4 as 6hrs max/min temperature to convert to nearest degree Fahrenheit 3.3 Describe Group 5 as pressure density information 3.4 Describe Group 6, Precipitation	Describe group numbers and their meaning Describe Group 1-4 as 6hrs max/min temperature to convert to nearest	Video tapes , Overhead projector	1] Demonstrate how to use rain gauge to measure rainfall. 2] Demonstrate how to use thermometer to measure temperature	Guide and assists the students	What are group numbers in coding?

	measured in last 6 hrs. 3.5 Describe precipitation measured in 24 hours	degree Fahrenheit Explain Group 5 as pressure density information Describe Group 6, Precipitation measured in last 6 hrs. Describe precipitation measured in 24 hours		3] Show how to distinguish various clouds using visual observation		
7-8	3.6 Explain station identifier 3.7 Discuss the different meteorological variables for example wind speed and direction, visibility, weather phenomena, sky cover 3.8 Describe station type 3.9 Explain sea level pressure 3.10 Explain precipitation recorded at different time interval. 3.11Explain pressure change and so on.	Explain station identifier, the different meteorological variables for wind speed and direction, visibility, weather phenomena, sky cover. Explain station type, sea level pressure Explain precipitation recorded at different time interval and pressure change and so on.	Video tapes , Overhead projector			Show the code for pressure, temperature and clouds
	General Objective 4: Appreciate station plot model					

9-10	4.1 Define Station Plot Models 4.2 Explain the procedure for plotting a station models 4.3 Plot a station models for a station	Define Station Plot Models Explain the procedure for plotting a station models Plot a station models for a station	Video tapes , Overhead projector			Draw a station model and indicate the position of pressure, pressure tendency and clouds
	General Objective 5: Understand weather Code and decoding message					
11-12	5.1 Explain the ship Weather Code 5.2 Identifyq the code forms in 5.1 above and the required explanatory notes. 5.3 Explain the various sections of code forms 5.4 Discuss the scope of supplementary ships 5.5 Write reports in an abbreviation form	Explain the ship Weather Code forms in 5.1 Give explanatory notes. in the various sections of code forms Explain the scope of supplementary ships Explain how to write reports in an abbreviation form	Video tapes overhead projector	Visit Nigerian Port Authority Observe and appreciate the role of Port Meteorological Officer (PMO)	Guide and supervise the students	Administer Fieldwork

Programme: ND NATIONAL DIPLOMA MARINE METEOROLOGY AND COASTAL MANAGEMENT	**Course Code:**		**Total Contact Hours: 30** **Credit Unit: 2**
Course Title: COASTAL MARINE RESOURCES AND MANAGEMENT	MCM 114		**Theoretical: 2 hours/week**
Semester: 1st	**Pre-requisite:**		**Practical: 0 hour /week**

Goal: This course is designed to enable students understand the effective management of resources
General Objectives
At the end of this course the student should be able to:

1] Know the difference between living and non-living resources
2] Appreciate resource exploration, exploitation and strategies
3] Understand marine ecology and environmental policies for effective management of coastal resources
4] Appreciate sustainable use of resources
5] Understand Coastal and Marine resource management

	Course Title:		**Course Code:**		**Total Contact Hours: 30** **Credit Unit: 2**	
	Coastal Marine Resources and Management		MCM 114		**Theoretical: 2 hours/week**	
	Semester: 1st				**Practical: 0 hour /week**	
	Theoretical Content			**Practical Content**		
	General Objective 1: Know the ddifference between living and non-living resources					
Week /s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
	1.1 List the types and functions of	Explain				What is the

1-2	coastal and marine resources 1.2 Explain the Coastal zone as an integrated resource area 1.3 Differentiate between Marine resources: biotic, mineral and energy resources 1.4 Discuss Renewable vs. Non-Renewable Resources 1.5 Explain the Sea floor resource exploration and marine archaeology	functions of coastal and marine resources, the Coastal zone as an integrated resource area explain the difference between Marine resources: biotic, mineral and energy resources Discuss Renewable vs. Non-Renewable Resources Explain the Sea floor resource exploration and marine archaeology	Video tapes , Overhead projector	Identify marine geophysical methods	Guide and assists the students in Identifying marine geophysical methods	significance of coastal zone as an integrated resource area?
	General Objective 2: Appreciate resource exploration, exploitation and strategies					
3-4	2.1 Explain marine minerals 2.2 Enumerate the difference between mineralogical deposits and hydrocarbon deposits 2.3 Explain the polymetallic nodules 2.4 Explain extraction of natural minerals 2.5 Explain sea salt	Explain marine minerals, the difference between mineralogical deposits and hydrocarbon deposits Explain the polymetallic nodules	Video tapes, Overhead projector	Conduct practical to identify methyl/gas hydrates	Conduct a practical to identify methyl/gas hydrates Laboratory	What are the marine minerals?

		Explain extraction of natural minerals 2.5 Explain sea salt				
	General Objective 3: Describe marine ecology and environmental policies for effective management of coastal resources					
5-6	3.1 Define Living Marine Resources (LMR) 3.2 Explain Ecosystem based approach 3.3 Climate effects on living marine resources 3.4 Discuss biological monitoring of marine ecosystems	Define Living Marine Resources (LMR) Explain Ecosystem based approach Climate effects on living marine resources and biological monitoring of marine ecosystems	Video tapes, Overhead projector	1] Identify Marine Protected Areas (MPA) 2] Identify the Large Marine Ecosystems (LMEs)	Organise Fieldwork	Vividly discuss the process of monitoring marine ecosystem?
	General Objective 4: Appreciate sustainable use of resources					
7-8	4.1 Describe renewable energy from the ocean 4.2 Describe Ocean dumping 4.3 Explain Oil spills 4.4 Explain Coral reef bleaching	Describe renewable energy from the ocean Describe Ocean dumping Explain Oil spills Explain Coral	Video tapes , Overhead projector	1] Identify hydrocarbons, Gas, Wind, Wave 2] Observe and write a report on currents, seabed mining, beach sand mining, anthropogenic impacts: Overfishing	Organise Field work	How can ocean dumping be prevented?

		reef bleaching				
	General Objective 5: Understand Coastal and Marine resource management					
9-10	5.1 Define coastal and marine resources management 5.2 Explain legislation for coastal and marine resources management 5.3 Explain conflicting interests with other coastal and marine activities 5.4 Describe ecotourism 5.5 Enumerate coastal and marine resources management tools 5.6 Explain ecosystem health and protection of biological diversity 5.7 Analyse international conventions related to coastal and marine resources management (e.g. UNCLOS, CBD) 5.8 Explain future uses of the oceans.	Define coastal and marine resources management Explain legislation for coastal and marine resources management Explain conflicting interests with other coastal and marine activities Describe ecotourism Enumerate coastal and marine resources management tools Explain ecosystem health and protection of biological diversity, international conventions related to coastal and marine resources management (e.g. UNCLOS,	Video tapes , Overhead projector			List the ways by which coastal and marine resources can be managed

		CBD)				
Programme: ND		**Course Code:**		**Total Contact Hours: 45 hours** **Credit Unit: 3**		
Course Title: GENERAL METEOROLOGY II		**MCM 121**		**Theoretical: 2 hours**		
Semester: 2nd		**Pre-requisite:**		**Practical: 1 hour**		

Goal: This course is designed to give the students the knowledge of thermodynamics, atmosphere and the interpretation of weather

General Objectives:
On Completion of this course the students will be able to:

1] Understand the effect of wind in atmospheric motion
2] Understand the thermodynamics of the atmosphere
3] Appreciate the importance of thermodynamic scales in meteorology
4] Understand air masses, their development and classification
5] Understand the local circulation of air
6] Understand the general circulation of the atmosphere
7] Deduce weather and interpret weather synoptic chart
8] Know the elements of atmospheric optics and electricity

	Course Title:	**Course Code:**		**Total Contact Hours: 45 hours** **Credit Unit: 3**
	GENERAL METEOROLOGY II	MCM 121		**Theoretical: 2 hours**
	Semester: 2nd			**Practical: 1 hour**
	Theoretical Content		**Practical Content**	

	General Objective 1.0 Understand the effect of wind in atmospheric motion					
Week /s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1 – 2	1.1 Define wind 1.2 Explain variation in the surface wind 1.3 Discuss wind velocity and patterns of isobar 1.4 Discuss the forces controlling atmospheric motion 1.5 Explain upper wind and the upper level charts 1.6 Discuss vertical motion 1.7 Explain wind flow over an obstacle and the effect of altitude on the wind field 1.8 Explain atmospheric turbulence and identify their origins	Explain variation in the surface wind, wind velocity and patterns of isobar Discuss the forces controlling atmospheric motion, upper wind and the upper level charts, vertical motion and wind flow over an obstacle and the effect of altitude on the wind field 1.8 Explain atmospheric	Video tapes, Overhead Projector	Demonstrate the effects of obstacle on wind flow using visual observation	Guide and supervise the student in the demonstration of effects of obstacle on wind flow using visual observation	What are the factors affecting atmospheric motion?
	General Objective 2.0 Understand the thermodynamics of the atmosphere					
3 - 4	2.1 Define thermodynamics 2.2 State the laws of thermodynamics 2.3 Explain the thermodynamics of the atmosphere 2.4 Discuss the application of adiabatic transformation of air saturated with water vapour 2.5 Discuss vertical stability and instability of conditional equilibrium, thermal convection and conduction clouds	Explain the thermodynamics of the atmosphere and the application of adiabatic transformation of air saturated with water vapour Explain vertical stability and instability of conditional	Video tapes , Overhead projector			Discuss the thermodynamics of the atmosphere

	2.6 Explain the psychometric formula 2.7 Identify the indicators of moisture	equilibrium, thermal convection and conduction clouds Explain the psychometric formula Identify the indicators of moisture				
	General Objective 3.0 Appreciate the importance of thermodynamic scales in meteorology					
5 – 6	3.1 Explain ideas of scale in meteorology 3.2 Explain Buy's Ballot's Law and its application in atmospheric dynamics 3.3 Describe the effect of geostrophic force and gradient force and their implications on wind and pressure system 3.4 Explain thermal wind: application to horizontal divergence; the existence of vertical velocities.	Explain ideas of scale in meteorology Explain Buy's Ballot's Law and its application in atmospheric dynamics Describe the effect of geotropic force and gradient force and their implications on wind and pressure system Explain thermal wind: application to horizontal divergence; the existence of vertical velocities.	Video tapes, Overhead projector	1] Identify motions on different scales and equations of motion on the synoptic scale. 2] Demonstrate the methods of detecting horizontal convergence regions on synoptic charts.	Demonstrate the methods to the students	Explain ideas of scale in meteorology
	General Objective 4.0: Understand air masses, their development and classification					
7 - 8	4.1 Define air masses 4.2 List the conservative properties of air masses	Explain air masses List the conservative	Video tapes, Overhead			Describe the general circulation of

	4.3 Describe the general circulation of air masses and their development. 4.5 Explain the phenomena of condensation and the influence of orography on fronts and fontal disturbances,	properties of air masses Explain the general circulation of air masses and their development. Explain the phenomena of condensation and the influence of orography on fronts and fontal disturbances,	projector Weather Maps			air masses
	General Objective 5: Describe the local circulation of air					
9 – 10	5.1 Describe the general circulation of the atmosphere including pattern at low latitudes. 5.2 Distinguish between average general circulation. 5.3 Explain the index of zonal circulation 5.4 Discuss jet stream and its application 5.5 Differentiate between trade winds and monsoon air masses	Explain the general circulation of the atmosphere. Explain the difference between average general circulations. Explain the index of zonal circulation and its application Differentiate between trade winds and monsoon air masses	Video tapes, Overhead projector			What is the difference between average general circulation and instantaneous general circulation?
	General Objective 6: Understand the general circulation of the atmosphere					
10 – 11	6.1Explain the elements of	Explain the elements of atmospheric	Video			Discuss the

	atmospheric Optics 6.2 Discuss the application to halo, rainbow, corona and other optical phenomena. 6.3 Explain transparency of atmosphere and visual range 6.4 Explain atmospheric ions and the conductivity of lighting discharge and Thunderstorms	Optics, the application to halo, rainbow, corona and other optical phenomena. Explain transparency of atmosphere ,visual range and atmospheric ions and the conductivity of lighting discharge Explain Thunderstorms	tapes, Overhead projector			transparency of the atmosphere

Programme: ND	**Course Code:**		**Total Contact Hours: 45** **Credit Unit: 3**
Course Title: PLOTTING PRACTICES	MCM 122		**Theoretical: 1 hour**
Semester: 2nd	**Pre-requisite:**		**Practical: 2 hours**

Goal: This course is designed to enable students understand how to plot weather maps and interpolation in meteorology

General Objectives:
On Completion of this course the students will be able to:

1] Understand the general plotting practice
2] Understand how to plot weather map
3] Understand the different methods of interpolation in meteorology

(Please add more content or merge with another related programme and change nomenclature)

	Course Title:	**Course Code:**		**Total Contact Hours: 45** **Credit Unit: 3**		
	PLOTTING PRACTICES	MCM 122		**Theoretical: 1 hours**		
	Semester: 2nd			**Practical: 2 hours**		
	Theoretical Content			**Practical Content**		
	General Objective 1: Understand the general plotting practice					
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1-3	1.1 Discuss the overview of plotting practices in Meteorology 1.2 Explain the relationship between surface METAR Report and Plotting Practices	Discuss the overview of plotting practices in Meteorology Explain the relationship between surface METAR Report and Plotting Practices	Video tapes , Overhead projector, weather maps and plotting models	1] Demonstrate how to identify the large surface weather variables using meteorological maps 2]Show how to plot surface reports using the standard station model 3]Use report from the meteorological weather stations for plotting on a weather report map	Guide and assists the students	What is the need for plotting in meteorology?
	General Objective 2: Understand how to plot weather map					
4-6	2.1 State the objectives of weather	List out the objectives of	Video tapes , Overhead	1] Show how to plot a map of	Demonstrate the procedure for plotting and guide	Describe the procedures for plotting?

	map analysis 2.2 Enumerate procedures for plotting 2.3 Describe other climatological information for optimum interpolation	weather map analysis Explain the procedures for plotting and climatological information for optimum interpolation	projector, weather maps and plotting models	meteorological data and their number codes 2] Show how to collect weather messages from various weather stations.	the students.	
	General Objective 3: Understand the different methods of interpolation in meteorology					
7 – 12	3.1 Describe the optimum interpolation method in plotting practice 3.2 Explain the use of normal charts application in map interpolations 3.3 Explain other methods of objective analysis 3.4 Describe synoptic and asynoptic data 3.5 Explain the concept of initialization and four-dimensional data assimilation and analysis	Explain the optimum interpolation method in plotting practice Explain the use of normal charts application in map interpolations Explain other methods of objective analysis Explain synoptic and asynoptic data Explain the concept of initialization and four-dimensional data assimilation and analysis	Video tapes , Overhead projector, weather maps and plotting models	Use station weather plots and symbols to depict; ccurrent weather conditions; cloud cover; wind speed; wind direction visibility ttemperature dew point	Assists and guide the students	Explain the use of normal charts in map interpolation?

Programme: NATIONAL DIPLOMA IN MARINE METEOROLOGY AND COASTAL MANAGEMENT	**Course Code:**		**Total Contact Hours: 45 hours** **Credit Unit: 3**
Course Title: Introduction to Geographic Information System and Remote Sensing I	MCM 123		**Theoretical: 2 hours**
Semester: 2nd	**Pre-requisite:** **COM 101**		**Practical: 1 hour**

Goal: This course is designed to provide students with the knowledge of GIS systems

General Objectives:
On Completion of this course the students will be able to:

1] Appreciate the Science of Geographic Information System (GIS)
2] Understand vector data models in GIS
3] Understand raster data and its uses in GIS
4] Understand topology in vector data
5] Appreciate remote sensing
6] Know the basic application of remote sensing

	Course Title:	Course Code:		Total Contact Hours: 45 hours Credit Unit: 3
	Introduction to Geographic Information System (GIS) I	MCM 123		Theoretical: 1 hour
	Semester: 2nd			Practical: 2 hours
	Theoretical Content		Practical Content	
	General Objective 1: Appreciate the science of Geographic Information System (GIS)			

Week /s	Specific Learning Outcomes	Teacher's activities	Resources	Specific Learning Outcomes	Teacher's activities	Evaluation
1 – 2	1.1 Discuss the general overview of GIS 1.2 Define GIS and GIS Software and Application 1.3 Explain GIS Data 1.4 List examples of GIS data as Vector and Raster data 1.5 Explain the differences in data as geographical or non-geographical data	Explain the general overview of GIS GIS Software and Application Explain GIS Data List examples of GIS data as Vector and Raster data Explain the differences in data as geographical or non-geographical data	Video tapes, Overhead projector GIS LAB	1] Demonstrate GIS application using Spatial Information. 1] Operate computer and use digital data to explain what GIS stands for.	Guide and assists the students	Differentiate between vector and raster data?
	General Objective 2:Understand Vector Data Models in GIS					

3 - 4	2.1 Define Vector data 2.2 Describe the attributes and features of vector data 2.3 Explain Point Features in details 2.4 Explain Polyline Features in details 2.5 Explain Polygon Features in details 2.6 Describe vector data in layers 2.7 Explain editing and scale in vector data	Define Vector data Explain the attributes and features of vector data Point Features in	Video tapes, Overhead projector GIS LAB	1] Apply point feature to show scale 2] Identify Polyline with its two or more vertices 3] Use map scale to explain GIS vector data	Guide and assists students	Explain the attribute of vector data
5 - 6	2.8 Explain the General Overview of Vector Data 2.9 Explain the use of symbols and colors in GIS	Explain the General Overview of Vector Data and the use of symbols and colors in GIS	Video tapes , Overhead projector GIS LAB	1] Demonstrate how attribute data are associated with vector features and show how it can be use to represent data 2] Apply graduated symbols as useful for clear differences between features with attributes values in different value range .	Guide and assist students	Administer group assignment
7 - 8	2.10 Define Data Capture 2.11 Explain the general overview of how to create and edit vector and attribute data 2.12 Explain GIS data storage processes 2.14 Identify planning processes before data capture and storage 2.15 Describe the process of shape-files creation	Explain the general overview of how to create and edit vector and attribute data Explain GIS data storage processes Identify planning processes before data capture and	Video tapes, Overhead projector GIS LAB	1] Demonstrate the use of data base to store digital data. 2] Use tourism map or map of pollution levels along a river to explain GIS data. 3] Use digitizing table as a tool for professional GIS Users to capture map information		Administer group assignment

	2.16 Explain addition of data to shape-files 2.17 Describe the process of Heads-up digitizing using digitizing table	storage Describe the process of shape-files creation Explain addition of data to shape-files Describe the process of Heads-up digitizing using digitizing table				
	General Objective 3: Understand raster data and its uses in GIS					
9-10	3.1 Discus the general overview of Raster data as composed of rows and columns 3.2 Enumerate the uses of Raster data . 3.3 Descibe Geo-referencing 3.4 List the sources of raster data 3.5 Explain spatial Resolution in GIS 3.6 Explain spectral Resolution 3.7 Explain the Raster to Vector and 3.8 Conversion of Vector to Raster 3.9 Explain Raster Analysis	Explain the general overview of Raster data as composed of rows and columns and their uses Explain Geo-referencing List the sources of raster data Explain spatial Resolution in GIS Explain spectral Resolution Explain the Raster to Vector and Conversion of Vector to Raster Explain Raster Analysis	Video tape, Overhead projector GIS LAB	1] Identify Raster data as grid of regular sized pixels. 2] Use Raster data as tool for showing continually varying information. 3] Use spatial resolution as sizes of pixels in a raster. 4] Identify multi-spectral images as bands from different parts of electromagnetic spectrum. 5] Depict how three of the bands of a multi-spectral image can be shown in Red, Green, and Blue. 6] Identify images with a single band as grayscale images. 6] Demonstrate how Raster images can consume image amount of storage space	Guide and supervise student	Explain spatial resolution in GIS
	General Objective 4: UnderstandTopology in Vector Data					

11- 12	4.1 Describe the General Overview of Topology 4.2 Explain Topology errors, rules and tools 4.3 Describe snapping distance 4.4 Explain search Radius	Explain the General Overview of Topology, errors, rules and tools Describe snapping distance Explain search Radius	Video tapes, Overhead projector GIS LAB	1] Demonstrate how Topology can be used to express the spatial relationship between connecting or adjacent vector features in GIS 2] Demonstrate how Topology in GIS can be use as a tool. 3] Use topology to detect and correct digitizing errors 4] Apply network analysis as essential in topological data	Guide and supervise students	Explain topology errors and tools?
	General Objective 5: Appreciate remote-sensing					
13 – 14	Explain the Concept of Geometrical principles of imagery (air photos, satellite image); Explain the basic topographic features – coastline; continental shelf etc List Remote sensing techniques applicable to Bathymetry and Coastal mapping	Explain the Concept of Geometrical principles of imagery (air photos, satellite image); Explain the basic topographic features – coastline; continental shelf etc List Remote sensing techniques applicable to Bathymetry	Video tapes , Overhead projector	illustrate the Concept of Geometrical principles of imagery (air photos, satellite image); Depict the basic topographic features – coastline; continental shelf etc List Remote sensing techniques applicable to Bathymetry and Coastal mapping	Guide students to Carry out field work Demonstrate the Concept of Geometrical principles of imagery (air photos, satellite image); illustrate the basic topographic features – coastline; continental shelf etc List Remote sensing techniques applicable to Bathymetry and Coastal mapping	Explain the Concept of Geometrical principles of imagery

		and Coastal mapping				
	General Objective 6: Know the basic application of remote sensing					
15	Describe how laser and radar altimetry are used for water surface mapping Explain the uses of remote sensing for Oil Spill mapping Describe how to process remotely sensed data to determine Bathymetry and Map Water surface features.	Describe how laser and radar altimetry are used for water surface mapping Explain the uses of remote sensing for Oil Spill mapping Describe how to process remotely sensed data to determine Bathymetry and Map Water surface features.	Video tapes , Overhead projector GIS LAB	Demonstrate how laser and radar altimetry are used for water surface mapping Demonstrate the use of remote sensing for Oil Spill mapping Demonstrate how to process remotely sensed data to determine Bathymetry and Map Water surface features.	Guide and assists the students	Administer group assignment

Programme: ND NATIONAL DIPLOMA MARINE METEOROLOGY AND COASTAL MANAGEMENT	**Course Code:**		**Total Contact Hours: 30** **Credit Unit: 2**
Course Title: COASTAL HAZARDS MANAGEMENT	MCM 124		**Theoretical: 2 hours/week**
Semester: 2nd	**Pre-requisite:**		**Practical: 0 hour /week**

Goal: This course is designed to enable students understand the environmental harzard management

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

1] Understand the concept of coastal hazard management
2] Understand coastal environmental hazards
3] Understand laws and policies related to coastal environmental hazard management
4] Understand disaster management

	Course Title:	**Course Code:**			**Total Contact Hours: 30** **Credit Unit: 2**	
	Coastal Hazards Management	MCM 124			**Theoretical: 2 hours/week**	
	Semester: 2nd				**Practical: 0 hour /week**	
	Theoretical Content			**Practical Content**		
	General Objective 1: Understand the Concept of Coastal Hazards Management					
Week /s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1-2	1.1 Define Coastal Environmental Hazards. 1.2 Differentiate between Natural and Man-induced hazards 1.3 Describe hazards, disaster, vulnerability, and resilience 1.4 Explain coping mechanisms	Explain Coastal Environmental Hazards, difference between Natural and Man-induced hazards. Hazards, disaster that are vulnerability, and resilience Explain coping mechanisms	Video tapes, Overhead projector	Illustrate Coastal Environmental Hazards Show the Difference between Natural and Man-induced hazards Demonstrate hazards, disaster, vulnerability, and resilience	Show students the difference between Natural and Man-induced hazards . Demonstrate hazards, disaster, vulnerability, and resilience	Examine the relationship between natural and man-made hazards?
	General Objective 2: Understand Coastal Environmental Hazards					

3-4	2.1 Outline various Coastal Environmental Hazards 2.2 Explain the effects of cyclones, earthquakes, tsunami, floods, storm surges, coastal erosion, Sea Level Rise on Coastal Environment 2.3 Explain Technological Hazards 2.4 Describe the causes, responses and mitigation strategies related to Coastal Environmental hazards 2.5 Explain reduction of carbon footprints 2.6 Use case studies to describe coastal hazards in Nigeria.	Outline various Coastal Environmental Hazards Explain the effects of cyclones, earthquakes, tsunami, floods, storm surges, coastal erosion, Sea Level Rise on Coastal Environment Explain Technological Hazards Describe the causes, responses and mitigation strategies related to Coastal Environmental hazards Explain reduction of carbon footprints Use case studies to describe coastal hazards in Nigeria.	Video tapes , Overhead projector	1] use flood detection device 2] Demonstrate how to use them =3] Use case studies to illustrate coastal hazards in Nigeria	Demonstrate the use of early flood detection and warning system	What are the strategies for mitigating coastal hazards? =Examine the need for carbon footprints concept card concept?
	General Objective 3: Understand Laws and Policies related to Coastal Environmental Hazards Management					

5-6	3.1 Explain the rationale for disaster management law and policy 3.2 Analyse paradigm of disaster management 3.3 Describe response and recovery framework 3.4 Explain the role of governmental in coastal environmental hazards management, and challenges related to effective implementation of laws and policies	Explain the rationale for disaster management, law and policy Explain paradigm of disaster management, response and recovery framework Explain the role of governmental in coastal environmental hazards management, and challenges related to effective implementation of laws and policies	Video tapes , Overhead projector			What are the laws and policies pertinent to coastal hazards management?
	General Objective 4: Understand Disaster Management					
7-8	4.1 Explain disaster risk response frameworks 4.2 Describe mapping and planning for disaster management 4.3 Explain the need for capacity building in coastal environmental hazards management 4.4 Analyse risk transfer mechanisms 4.5 Explain community based disaster management systems 4.6 Explain indigenous knowledge for disaster	Explain disaster risk response frameworks, mapping and planning for disaster management Explain the need for capacity building in coastal environmental hazards management Explain risk transfer mechanisms Explain community based disaster management systems Explain indigenous	Video tapes , Overhead projector			Why is indigenous knowledge needed during disaster management?

	management	knowledge for disaster management					
	General Objective 5: Case Studies						
9-12			Lecture	Video tapes, Overhead projector			

Programme: ND	**Course Code:**		**Total Contact Hours: 45**
Course Title: Meteorological Instrumentation	MCM 125		**Theoretical: 1 hour/week**
Semester: 2nd	**Pre-requisite:**		**Practical: 2 hour /week**

Goal: This course is designed to enable students understand of temperature, precipitation, salinity, and visibility measurement

General Objectives:
On Completion of this course the students will be able to:

1] Understand the working principles of meteorological instrument

2] Understand sea surface temperature, precipitation, salinity, and visibility measurement

3] Know how to collect and use data from station automatic weather observing station

	Course Title:	**Course Code:**		**Total Contact Hours: 45**
	Meteorological Instrumentation	MCM 125		**Theoretical: 1 hour/week**
	Semester: 2nd			**Practical: 2 hours /week**
	Theoretical Content		**Practical Content**	

	General Objective 1.0: Understand Meteorological Instrumentation					
Week /s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1	1.1 Define Meteorological Instruments 1.2 Name different types of Meteorological Instrument and their use for observation 1.3 Explain the working principles of meteorological measuring instrument such as thermometer, analogue and digital barometer and etc 1.4 Identify likely error/fault emanating from meteorological measuring instrument using field calibration.	List out Meteorological Instruments and types of Meteorological Instrument explain their use Explain the working principles of meteorological measuring instrument such as thermometer, analogue and digital barometer and etc Explain error/fault emanating from meteorological measuring instrument using field calibration.	White board for writing, Catalogues of Meteorological Instrument	Identify meteorological instrument Use meteorological instrument to collect weather data Illustrate error/fault emanating from meteorological measuring instrument using field calibration.	Guide and assists the students To Use meteorological instrument to collect weather data Illustrate error/fault emanating from meteorological measuring instrument using field calibration.	Discuss the working principle of digital barometer Explain likely errors emanating from meteorological measuring instrument
2 D	1.5 Describe Sensory Observations, Instrumental Observations, Result of Observation, Standard Time of Observation, 1.6 Describe Data Encoding and	Explain Sensory Observations, Instrumental Observations, Result of Observation,	White board for writing, Catalogues of Meteorological Instrument	Observe safety precautions principles in a meteorological station	Carry out visit to Meteorological station to demonstrate precautions principles	Describe Sensory Observations, Instrumental Observations, Result of

	Reporting of Meteorology Instruments	Standard Time of Observation, 1.6 Describe Data Encoding and Reporting of Meteorology Instruments				Observation, Standard Time of Observation.
	General Objective 2.0 : Measure sea surface temperature					
3	2.1 Describe the general principle of sea Surface Temperature 2.2 Describe the methods of observation and the basic requirements 2.3 Explain the instrument, Exposure and Management 2.4 Explain Remote sensing with infrared Thermometers and Applications of Remote Temperature sensors. 2.5 Define the characteristics of thermometer	Explain the general principle of sea Surface Temperature Explain the methods of observation and the basic requirements Explain the instrument, Exposure and Management Explain Remote sensing with infrared Thermometers and Applications of Remote Temperature sensors. Define the characteristics of thermometer	Infrared Thermometers Remote Temperature	Demonstrate the Remote sensing with infrared Thermometers and Applications of Remote Temperature sensors.	Guide students to use the Remote sensing with infrared Thermometers and Applications of Remote Temperature sensors.	Describe the general principle of sea Surface Temperature
	General Objective 3.0: Understand Salinity at Surface and depth					
4	4.1 Define salinity with the use of Gala hypothesis 4.2 Explain Salinity – Temperature – depth (STD) system. 4.3 Describe the working	Explain salinity with the use of Gala hypothesis Explain Salinity – Temperature – depth (STD) system.	water samples Salinometer instrument	Collect water samples from the creek, lagoon and rivers etc Carry out water salinity test using	Guide and assists students in Collection of water samples from the creek, lagoon and rivers	Explain salinity-temperature-depth system?

	principles of Salinometer	Describe the working principles of Salinometer		Salinometer . ,	etc Carry out water salinity test using Salinometer	
	General Objective 4.0: Understand Ocean current instruments at surface at surface and depth					
5	5.1 Explain the general ocean current measuring instrument. 5.2 Describe the Fixed, Fathered and Shipboard Instrument and Methods 5.3 Describe the methods of data recording 5.4 Explain the types of current meters; Propeller Meters, Ekman Current Meter, Plessy Current Meter, Rotor Meters, etc.	Describe the general ocean current measuring instrument. Explain the Fixed, Fathered and Shipboard Instrument and Methods Explain the methods of data recording Explain the types of current meters; Propeller Meters, Ekman Current Meter, Plessy Current Meter, Rotor Meters, etc.	Catalogues Projectors Practical Observation Charts Reference textbooks RS Soft boards	Observe Ocean current using the current meter Illustrate Ocean current using the current meter	Supervise the students in the Observations Ocean current using the current meter	Describe the working principles of current meter?
6	**General Objective 5:** Understand wind speed and direction					
	6.1 Enumerate the basic requirement and management of wind vane and cup counter anemometer 6.2 Enumerate the rationale for wind instruments	Explain the basic requirement and management of wind vane and cup counter anemometer List the rationale for wind instruments	Catalogue on CIMO Installation manuals and specification on wind instrument	1] Use wind vane and cup counter anemometer to measure wind direction and wind speed respectively 2] Use Beaufort scale to estimate wind speed	Visit meteorological station to carry out the objective 1 and 2	Examine the rationale for the use of wind vane and speed Explain the importance of height of wind vane and anemometer

						installation?
	General Objective 6: Understand the use of atmospheric pressure measuring instrument					
7	7.1 Describe the working principles of barometer (digital and analogue)and barograph 7.2 Explain the general methods of Atmospheric Pressure Observations 7.3 Explain the corrections of barometric readings	Explain the working principles of barometer (digital and analogue)and barograph Explain the general methods of Atmospheric Pressure Observations Explain the corrections of barometric readings	Atlas of Atmospheric Pressure Catalogue of Pressure Equipment Recommended Textbooks	1] Identify the basic instrument used for measuring pressure 2] Use barometer (analogue and digital)and barograph to determine atmospheric pressure	Visit Meteorological station	Explain the working principle of barometer (analogue and digital) and barograph?
8	**General Objective 7:** Understand the measurement of air temperature and humidity					
	8.1 Explain the working principle of thermometer and psychrometer 8.2 Understand the working principle of minimum and maximum thermometer; dry and wet bulb thermometer	Explain the working principle of thermometer and psychrometer Understand the working principle of minimum and maximum thermometer; dry and wet bulb thermometer	Thermometer (wet bulb, dry bulb, minimum and maximum)	Derive the value of humidity using dry and wet bulb thermometer	Visit an established meteorological station	Explain the working principle of thermometer?
9	**General Objective 8:** Understand how to measure precipitation and estimate visibility					
	9.1 Explain the working principle of ordinary rain-gauge and automatic rain gauge	Explain the working principle of ordinary rain-	Rain-gauge visibility target	1] Identify the meteorological instrument to	Visit meteorological station	Describe how to use rain gauge?

	9.2 Describe the estimation of visibility through the use of visibility targets.	gauge and automatic rain gauge Describe the estimation of visibility through the use of visibility targets.	Recommended texts Maps and charts Installation manuals	measure precipitation 2] Measure precipitation using rain gauge 3] Estimate visibility through visual observation		
10	**General Objective 9:** know how to measure sunshine hours and observe clouds					
	10.1 Describe the basic principles of sunshine recorder instrument 10.2 Describe the techniques of cloud cover Estimations 10.3 Explain the working principles of ceiliometer 10.4 Explain the basic principles of Automatic Weather Observing System (AWOS)	Explain the basic principles of sunshine recorder instrument Describe the techniques of cloud cover Estimations Explain the working principles of ceiliometer Explain the basic principles of Automatic Weather Observing System (AWOS)	Campbell Stoke Sunshine recorder and Ceiliometer Visual observation	1] Identify instrument used for measuring sunshine hours 2] Use Campbell Stoke sun shine recorder, using the right card at the right time to measure sun shine	Visit meteorological station (instrumental observation) Field work carrying out visual observation	Describe the technique cloud cover estimation?

	General Objective 3.0 Explain the Importance of thermodynamic scales in meteorology

3	Define scale in meteorology Explain motions on different scales and equations of motion on the synoptic scale Explain Buy's Ballot's Law and its application in atmospheric dynamics Describe the effect of geostrophic force and gradient force and their implications on wind and pressure system Explain thermal wind: application to horizontal divergence and convergence; the existence of vertical velocities Demonstrate the methods of detecting horizontal convergence and divergence regions on synoptic charts	Explain the ideas of scale in meteorology Explain motions on different scales and equations of motion on the synoptic scale Explain Buy's Ballot's Law and its application in atmospheric dynamics Describe the effect of geostrophic force and gradient force and their implications on wind and pressure system Explain thermal wind: application to horizontal divergence and convergence; the existence of vertical velocities Demonstrate the methods of detecting horizontal convergence and divergence regions on synoptic charts	Video tapes, Overhead projector	See the ideas of scale in meteorology Relate motions on different scales and equations of motion on the synoptic scale Demonstrate Buy's Ballot's Law and its application in atmospheric dynamics show the effect of geostrophic force and gradient force and their implications on wind and pressure system show thermal wind: application to horizontal divergence and convergence; the existence of vertical velocities Demonstrate the methods of detecting horizontal convergence and divergence regions on synoptic charts	Guide and supervise students	Explain the equation of motion on synoptic scale
	General Objective 4-0: Understand air masses and fronts their development and classifications					

4	Define air masses Appreciate conservative properties of air masses Describe the general circulation of air masses, their development and classification Explain the meaning of fronts, their types, formation and development Explain the phenomena of condensation and the influence of orography on fronts and fontal disturbances,	Explain air masses Appreciate conservative properties of air masses Describe the general circulation of air masses, their development and classification Explain the meaning of fronts, their types, formation and development Explain the phenomena of condensation and the influence of orography on fronts and fontal disturbances,	Video tapes , Overhead projector Weather Maps	Test the general circulation of air masses, their development and classification condensation and the influence of orography on fronts and fontal disturbances,	Test the general circulation of air masses, their development and classification condensation and the influence of orography on fronts and fontal disturbances,	Describe the general circulation of air masses, their development and classification
	General Objective 5-0: Understand the general circulation of the atmosphere					

5	Describe the general circulation of the atmosphere including pattern at low latitudes Distinguish between average general circulation and instantaneous general circulation Explain the index of zonal circulation Discuss jet stream and its application Differentiate between trade winds and monsoon air masses	Explain the general circulation of the atmosphere including pattern at low latitudes Distinguish between average general circulation and instantaneous general circulation Explain the index of zonal circulation Discuss jet stream and its application Differentiate between trade winds and monsoon air masses	Video tape , Overhead projector			What is the different between average general circulation and instantaneous general circulation ?
	General Objectives 6.0Understand the element of atmospheric optic and electricity					
7	Describe the elements of atmospheric Optics Discuss the application to halo, rainbow, corona and other optical phenomena Explain transparency of atmosphere and visual range Describe the atmospheric ions and the conductivity of lighting discharge and Thunderstorms	Explain the elements of atmospheric Optics Discuss the application to halo, rainbow, corona and other optical phenomena Explain transparency of atmosphere and visual range Describe the atmospheric ions and the conductivity of lighting discharge and Thunderstorms	Video tapes, Overhead projector	illustrate the elements of atmospheric Optics Depicts the application to halo, rainbow, corona and other optical phenomena Demonstrate transparency of atmosphere and visual range	Guide and supervise	Discuss the transparency of the atmosphere

				Describe the atmospheric ions and the conductivity of lighting discharge and Thunderstorms		

	General Objective 5: Understand Coordinate Reference Systems					
7-8	Describe the general overview of coordinate reference systems as it relates to map projections State the three categories of M projections Explain map projections with - Angular conformity - equal distance - and equal areas Describe Cordinate Reference Systems (CRS) and Geographic Coordinate Systems Explain projected coordinate reference systems, Universal Transverse Mercator (UTM) CRS and On-the Fly projection	Explain the general overview of coordinate reference systems as it relates to map projections State the three categories of M projections Explain map projections with	Video tapes, Overhead projector GIS LAB	Identify map projections to show the surface of the earth on a 2-dimentional, flat paper or screen Describe map projections as never accurate but shows distortions of angular conformity distance and area Show coordinate reference system (CRS) as relating to real locations on earth with the help of coordinates Describe two types of coordinate system, Geographic Coordinate Systems and Projected Coordinate Systems Describe on the fly projection as functionally in	Guide and supervise student	Describe coordinate reference system and the geographic reference system?

				GIS that allows an overlay layers		
	General Objectives 6: Understand Map Production for Spatial Data					
9	Describe features of Map Productions Explain map productions e.g. Title, Border, Legend, North Arrow Define Map Scale and use of Scales in Map production Appreciate different types of map Scales Explain Graticules, Acknowledgement, name of Map Production	Explain features of Map Productions Explain map productions e.g. Title, Border, Legend, North Arrow Define Map Scale and use of Scales in Map production Appreciate different types of map Scales Explain Graticules, Acknowledgement, name of Map Production	Video tapes, Overhead projector	Use map title, map body, map border, legend, scale North arrow, and the acknowledgement to produce a map show scale as representing distances on the real world using ratio lines or stamen	Guide and assists the students during the field work	What are the features of a quality map?
10	Explain the Use of Buffering in Vector Spatial Analysis Describe variations in buffering Explain Multiple Buffer zones Describe Buffering with Intact or dissolved boundaries and outward and Inward Buffering Explain spatial analysis tools	Explain the Use of Buffering in Vector Spatial Analysis Describe variations in buffering Explain Multiple Buffer zones Describe Buffering with Intact or dissolved boundaries and outward and Inward Buffering Explain spatial analysis tools	Video tape , Overhead projector	Describe Buffer zones using Vector Polygons Compute buffer distance/ floating point value	Guide and assists the students	. Administer group assignment
	General Objective 7: Understand Interpolation as Part of Spatial Analysis					
11	Describe the general overview of spatial analysis Explain spatial Interpolation	Explain spatial Interpolation Explain Inverse	Video tape, Overhead projector	Use vector point with known value for interpolation Describe Interpolation result	Guide and assist to use vector point with known value for	

	Explain Inverse Distance Weighted (IDW) Describe the Triangulated irregular Network (TIN) Identify other Interpolation Methods	Distance Weighted (IDW) Describe the Triangulated irregular	GIS LAB	as a typical raster layer. Describe its importance to find a suitable Interpolation method to optimally estimate values for unknown locations. Describe IDW Interpolation as giving weights to sample points Describe TIN Interpolation as using sample points to create surface formed by triangles.	interpolation Interpolation result as a typical raster layer. Describe its importance to find a suitable. Describe IDW Interpolation as giving weights to sample points use sample points to create surface formed by triangles.	

Programme: ND	**Course Code: MCM 211**		**Total Contact Hours: 60** **Credit Unit: 4**
Course Title: Synoptic Meteorology			**Theoretical: 2 hours**
Semester: 3rd	**Pre-requisite:**		**Practical: 2 hours**

Goal: This course is designed to acquaint students with the knowledge of air masses, production, transformation and classification

General Objectives:
On Completion of this course the students will be able to:

1] Explain air masses, production, transformation and classification
2] Describe structure and classification of fronts
3] Explain extra tropical cyclone and anticyclone
4] Appreciate the formation tropical storms
5] Describe jet stream and its characteristics
6] Explain synoptic features in the equatorial regions

	Course Title:	**Course Code:**		**Total Contact Hours: 60 hours** **Credit Unit: 4**

	SYNOPTIC METEOROLOGY	**MCM 211**			**Theoretical: 2 hours**	
	Semester: 3rd				**Practical: 2 hours**	
	Theoretical Content			**Practical Content**		
	General Objective 1: Understand air masses, production, transformation and classification					
Week /s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1	1.1 Define air masses 1.2 Describe the production, transformation and classification of air masses 1.3 Appreciate the conservative properties of air masses 1.4 List the sources of air masses	1.1 Explain air masses 1.2 Describe the production, transformation and classification of air masses 1.3 Appreciate the conservative properties of air masses 1.4 List the sources of air masses	Video tapes , Overhead projector	Demonstrate how to analyse weather chart	Guide and assists the students	What are the sources of air masses?
	General Objective 2: Understand structure and classification of fronts					
2	2.1 Describe fronts 2.2 Explain the structure and classification of fronts 2.3 Explain surface of discontinuity 2.4 Describe kinematic and dynamic boundary condition 2.5 Explain frontogenesis and frontolysis, including principal front zones 2.6 Explain effects of front on weather 2.7 Describe occlusions and	Explain the structure and classification of fronts Explain surface of discontinuity Describe kinematic and dynamic boundary condition Explain frontogenesis and frontolysis, including principal front zones Explain effects of	Video tapes , Overhead projector	Demonstrate how to analyse weather chart	Guide and assists the students	Differentiate between frontogenesis and frontolysis?

	thermal structure of cyclones	front on weather 2.7 Describe occlusions and thermal structure of cyclones				
	General Objective 3: Understand tropical and extra tropical cyclone and anticyclone					
3	3.1 Explain extra tropical cyclone and anticyclone 3.2 Describe cyclone models, and life cycle of cyclones 3.3 Explain the theory of cyclone development 3.4 Describe cut off cyclone and anticyclones	Explain extra tropical cyclone and anticyclone Describe cyclone models, and life cycle of cyclones Explain the theory of cyclone development Describe cut off cyclone and anticyclones	Video tapes , Overhead projector	Demonstrate the appearance of a cyclone using stimulation	Guide, supervise and assists the students	Explain conditions that might result to cyclone?
	General Objective 4: Understand the formation tropical storms					
4	4.1 Describe the formation of tropical storm 4.2 Explain the theories of formation, intensification and motion of tropical storms 4.3 Explain surface and upper air structure using pressure, temperature, wind, humidity and cloud fields	Explain the formation of tropical storm Explain the theories of formation, intensification and motion of tropical storms Explain surface and upper air structure using pressure, temperature, wind, humidity and cloud fields	Video tapes , Overhead projector	Illustrate the appearance of a tropical storm using stimulation	Demonstrate the appearance of a tropical storm using stimulation	What are the conditions that might result to tropical storm?
	General Objective 5: Understand jet stream and its characteristics					
5	5.1 Define jet stream 5.2 Explain polar front jet stream, sub-tropical jet stream, and easterly jet stream 5.3 Identify the characteristics of various jet stream	Explain polar front jet stream, sub-tropical jet stream, and easterly jet stream Identify the characteristics of various jet stream	Video tapes , Overhead projector			What are the main features of jet stream?

	5.4 Explain the theories of formation, weather development of clouds and clear air turbulence	Explain the theories of formation, weather development of clouds and clear air turbulence				
	General Objectives 6: Understand synoptic features in the equatorial regions					
6	6.1 Infer synoptic features in the equatorial regions in different seasons of year 6.2 Describe the need for radar and satellite meteorology with reference to cyclone detection	Explain synoptic features in the equatorial regions in different seasons of year Describe the need for radar and satellite meteorology with reference to cyclone detection	Video tapes , Overhead projector			
7	6.3 Explain the synoptic weather charts analysis 6.4 Discuss the evolution of stream line on synoptic chart 6.5 Discuss how to deduce weather associated with synoptic system	Explain the synoptic weather charts analysis Discuss the evolution of stream line on synoptic chart Discuss how to deduce weather associated with synoptic system	Video tapes, synoptic charts	Demonstrate the use of weather map to show different meteorological weather element	Guide and assists the students to Demonstrate the use of weather map to show different meteorological weather element	Discuss the evolution of stream line on synoptic chart?

Programme: ND	**Course Code:** MET		**Total Contact Hours: 45** **Credit Unit: 3**
Course Title: DYNAMIC METEOROLOGY	MCM 212		**Theoretical: 2 hours**
Semester: 3rd	**Pre-requisite:**		**Practical: 1 hour**

Goal: This course is designed to provide students with the basic knowledge of meteorological equations

General Objectives:

On Completion of this course the students will be able to

1] Understand the basic meteorological equations
2] Explain the concept of gravity
3] Describe ionosphere
4] Explain balanced motion
5] Explain atmospheric disturbance
6] Describe the general circulation of the atmosphere
7] Explain atmospheric turbulence

	Course Title:	Course Code:		Total Contact Hours: 45		
	DYNAMIC METEOROLOGY	MCM 212		**Theoretical: 2 hours**		
	Semester: 3rd			**Practical: 1 hour**		
	Theoretical Content			**Practical Content**		
	General Objective 1: Appreciate the basic meteorological equations					
Weeks	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1	1.1 Derive the vector form of equations of motion from Newton's Laws 1.2 Explain force, pressure, fields and solve problems involving gravitational force and field 1.3 Discuss centripetal force, pressure gradient and coriolis force	Derive the vector form of equations of motion from Newton's Laws Explain force, pressure, fields and solve problems involving gravitational force and field Discuss centripetal force, pressure gradient and coriolis force	Video tapes , Overhead projector	Measure atmospheric pressure using meteorological measuring instruments such barometer (digital and analogue) barometer and barograph	Guide and assists the students in the measurement of atmospheric pressure using meteorological measuring instruments such barometer (digital and analogue) barometer and barograph	Discuss centripetal force
	General Objective 2: Appreciate the concept of gravity					
2	2.1 State equations of motion in Cartesian co-ordinates and in spherical co-ordinates 2.2	State equations of motion in Cartesian co-ordinates and in spherical co-ordinates Explain	Video tapes , Overhea			Explain the equation of continuity for

	Explain hydrostatic approximation and its justification 2.3 Derive the equation of quasi-hydrostatic motion using pressure as vertical co-ordinate 2.4 Derive the equation of continuity for homogeneous and incompressible fluid	hydrostatic approximation and its justification Derive the equation of quasi-hydrostatic motion using pressure as vertical co-ordinate Derive the equation of continuity for homogeneous and incompressible fluid	d projecto r	Derive the equation of quasi-hydrostatic motion using pressure as vertical co-ordinate Derive the equation of continuity for homogeneous and incompressible fluid	Take student through to drive the equation of quasi-hydrostatic motion using pressure as vertical co-ordinate Derive the equation of continuity for homogeneous and incompressible fluid	homogeneo us and incompressi ble fluid?
	General Objective 3: Understand the Atmosphere and Ionosphere					
3	3.1 Explain Theoretical and empirical minor constituents of the Atmosphere 3.2 Explain Atmospheric radiation Airglow and Aurora 3.3 Explain atmospheric effects 3.4 Explain ionospheric phenomena, flare effects and irregularities	Explain Theoretical and empirical minor constituents of the Atmosphere Explain Atmospheric radiation Airglow and Aurora Explain atmospheric effects Explain ionospheric phenomena, flare effects and irregularities	Video tapes, Overhead projector			Differentiat e between airglow and aurora?
	General Objective 4: Appreciate balanced motion					
4	4.1 Explain horizontal balanced motion 4.2 Discuss geostrophic motion of the wind 4.3 Compare geostrophic and gradient winds with actual winds 4.4 Explain the divergence velocity of the geostrophic wind	Explain horizontal balanced motion, Discuss geostrophic motion of the wind Compare geostrophic and gradient winds with actual winds Explain the divergence velocity of the geostrophic wind	Video tapes , Overhead projector			Explain the essence of unstable and neutral condition in the atmosphere ?

	4.5 Discuss geostrophic thermal wind and stationery circular vortex 4.6 Explain unstable and neutral conditions in the atmosphere	Discuss geostrophic thermal wind and stationery circular vortex Explain unstable and neutral conditions in the atmosphere				
	General Objective 5: Understand atmospheric disturbances					
5	5.1 Describe hydrostatic equilibrium of gravity field (static stability) 5.2 Explain compressibility and gravity waves in the atmosphere 5.3 Discuss waves in a surface of discontinuous flow and discontinuous specific mass	Explain hydrostatic equilibrium of gravity field (static stability) Explain compressibility and gravity waves in the atmosphere Discuss waves in a surface of discontinuous flow and discontinuous specific mass	Video tapes , Overhead projector			Explain compressibility and gravity waves in the atmosphere?
6	5.4 Explain disturbances superimposed on a rectilinear flow 5.6 Explain baroscopic waves and two dimensional disturbances 5.7 Explain Ross by long waves, baroclinic waves and baro clinic instability	Explain disturbances superimposed on a rectilinear flow Explain baroscopic waves and two dimensional disturbances Explain Ross by long waves, baroclinic waves and baro clinic instability	Video tapes, Overhead projector			
	General Objectives 6: Describe the general circulation of the atmosphere					
7	6.1 Explain angular momentum of the atmosphere 6.2 Explain relative and absolute momentum. Discuss meridional transport by atmospheric disturbances 6.3 Relate meridional transport with zonal circulation	Explain angular momentum of the atmosphere Explain relative and absolute momentum. Discuss meridional transport by atmospheric disturbances Relate meridional transport with zonal circulation	Video tapes , Overhead projector			Discuss the nature of angular momentum of the atmosphere?

8	6.4 Explain the atmospheric kinetic energy 6.5 Discuss the influence of oceans, continents and orographic features on atmospheric circulation	Explain the atmospheric kinetic energy Discuss the influence of oceans, continents and orographic features on atmospheric circulation	Video tapes , Overhead projector			
9	6.6 Explain vorticity and circulation State the Bjerknes circulation 6.7 Explain divergence of the three dimensional and horizontal wind field	Explain vorticity and circulation State the Bjerknes circulation Explain divergence of the three dimensional and horizontal wind field	Video tapes , Overhead projector			
10	6.8 State vorticity and divergence equation in co-ordinate systems 6.9 State helmet theorem 6.10 Explain streamlines and trajectories	State vorticity and divergence equation in co-ordinate systems State helmet theorem Explain streamlines and trajectories	Video tapes , Overhead projector			
	General Objective 7: Appreciate atmospheric turbulence					
11	7.1 Explain Eddy transport, heat and water vapour and pollutants in planetary atmospheric layer 7.2 State the Taylor-Ekman theory of wind in boundary layer 7.3 Explain heat flux equation 7.4 Discuss Richardson criterion 7.5 Explain forced and free convection	Explain Eddy transport, heat and water vapour and pollutants in planetary atmospheric layer State the Taylor-Ekman theory of wind in boundary layer Explain heat flux equation Discuss Richardson criterion Explain forced and free convection	Video tapes , Overhead projector			Explain heat flux equation

Programme: ND NATIONAL DIPLOMA MARINE METEOROLOGY AND COASTAL MANAGEMENT	**Course Code:**		**Total Contact Hours: 75** **Credit Unit: 5**
Course Title: INTRODUCTION TO OIL SPILL CONTIGENCY PLANNING AND OPERATIONS MANAGEMENT	MCM 213		**Theoretical: 2 hours/week**
Semester: 3rd	**Pre-requisite:**		**Practical: 3 hours /week**

Goal: This course is design to provide students with knowledge of managing and controlling of oil spill

General Objectives

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

1. Understand basic equipment used in recovering, managing and controlling oil spill via physical, chemical, biological and Geographical Information System
2. Explain the fundamentals and scope of contingency planning and operations management
3. Understand personnel, skill and facilities required – logistic for mobilization and demobilization in managing oil spill

	Course Title:	Course Code:		Total Contact Hours: 75		
	OIL SPILL CONTIGENCY PLANNING AND OPERATIONS MANAGEMENT	MCM 213		**Theoretical: 2 hours/week**		
	Semester: 3rd			**Practical: 3 hours /week**		
	Theoretical Content			**Practical Content**		
	General Objective 1: Understand Operational Techniques in Oil Spill Management and Contingency Plan					
Week /s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1-4	1.1 Discribe the physical method of managing the oil spill 1.2 Discuss the chemical method of managing oil spill 1.3 Explain the biological method of managing the oil spill 1.4 Appreciate the use of GIS in managing oil spill	Explain the physical method of managing the oil spill Discuss the chemical method of managing oil spill Explain the biological method of managing the oil spill Appreciate the use of GIS in managing oil spill	Video tapes , Overhead projector	Demonstrate how to manage oil spill through physical method using boom, skimmer, in-situ burning and manual method Demonstrate how to manage oil spill through chemical method using dispersant Demonstrate how to manage oil spill through biological method using bioremediation process Apply Geographical Information System to manage oil spill	.Guide and assists the students during the field work	Demonstrate how in-situ burning is carried out?
	General Objective 2: Understand Response Techniques in Oil Spill					
5-6	2.1 State the preferred response techniques to address floating oil and any restriction on their usage 2.2 Determine the importance of an ability to protect sensitive resources 2.3 List the weather	Outline the preferred response techniques to address floating oil and any restriction on their usage Determine the importance of an ability to protect sensitive	Video tapes, Overhead projector	Demonstrate how to carry out a successful clean up exercise by using the right meteorological measuring instrument to prevent the impact of wind, current and tide Demonstrate how to use		What are the appropriate clean up techniques- for shoreline oil spill?

	parameters that can affect response techniques- wind direction, current, and tide 2.4 Determine the appropriate clean up techniques- for shoreline type within area 2.5 Identify response resources, leadership, command and management	resources List the weather		ballast water equipment (e.g. ballast tank) during the field work Demonstrate how to operate oil reception facilities during the field work		
	General Objective 3: Understand Strategic Policy and Response Strategies					
7	3.1 Bring out the role of organisations that are involved in oil spill response 3.2 Outline the regulatory framework and jurisdiction 3.3 Appreciate the geographical area of the plan 3.4 Define the interaction with other plans- scaling of tier response	Explain the role of organisations that are involved in oil spill response Outline the regulatory framework and jurisdiction Appreciate the geographical area of the plan Define the interaction with other plans- scaling of tier response	Video tapes , Overhead projector			Outline the regulatory framework needed for OSCP?
4	**General Objective 4:** Understand the Operational Procedures in Oil Spill Contingency Plan					
8-9	4.1 Establish notification route in oil spill response 4.2 Explain the source of oil spill and establish the oil slick trajectory 4.3 Explain the role of	Describe notification route in oil spill response Explain the source of oil spill and establish the oil slick trajectory	Video tapes, Overhead projector			Discus the mobilization and demobilization procedures including

	response team members 4.4 Appreciate the logistic support needed in the operation 4.5 Explain the need for mobilization and demobilization procedures	Explain the role of				challenges against their full implementation?
	General Objective 5: Understand the role of Government implementing Agencies in Oil Spill Management					
10-12	5.1 Enumerate the role of government implementing agencies at all levels in managing oil spill 5.2 Explain the role of Non-Government Organisation in managing oil spill 5.3 Describe the need for NOSDRA Act and International Convention on Oil Pollution 5.4 Preparedness and Cooperation (OPRC), and MARPOL Convention 5.5 Explain the role Marine Surveyor 5.6 Explain challenges related to oil spill management in Nigeria	Explain the role of government implementing agencies at all levels in managing oil spill Explain the role of Non-Government Organisation in managing oil spill Describe the need for NOSDRA Act and International Convention on Oil Pollution 5.4 Preparedness and Cooperation (OPRC), and MARPOL Convention Explain the role Marine Surveyor Explain challenges related to oil spill management in Nigeria	Video tapes, Overhead projector			Explain the roles of government implementing agencies in oil spill management, including the challenges they face ?

Programme: **ND MARINE METEOROLOGY AND COASTAL MANAGEMENT**	**Course Code:**		**Total Contact Hours: 45** **Credit Unit: 3**
Course Title: MARINE METEOROLOGY I	MCM 214		**Theoretical: 2 hours/week**
Semester: 3rd	**Pre-requisite:**		**Practical: 1 hour**

Goal: This course is design to provide students with knowledge of measurement of wind.

General Objectives:
On completion of this course the students will be able to:

1] Understand Ship Borne Meteorological Instruments
2] Describe the use of Wind Measuring Instruments.
3] Describe the use of Temperature and Humidity instrument
4] Appreciate the Functions of Port Meteorological Office (PMO)
5] Use Ship Weather Code
6] Describe Weather Bulletin for Merchant Shipping
7] Describe Automation of Weather Observation on Board Ship.

	Course Title:	**Course Code:**		**Total Contact Hours: 45** **Credit Unit: 3**
	MARINE METEOROLOGY I	MCM 214		**Theoretical: 2 hours/week**
	Semester: 3rd			**Practical: 1 hour**
	Theoretical Content		**Practical Content**	

	General Objective 1: Understand marine related Meteorological instrument					
Week /s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1-4	1.1 List out marine related Meteorological Measuring Instruments 1.2 Explain the Principles of operating the instruments. 1.3 Explain the procedure for maintenance of the instrument 1.4 Explain corrections to the readings	Explain marine related Meteorological Measuring Instruments Explain the Principles of operating the instruments. Explain the procedure for maintenance of the instrument Explain corrections to the readings	Video tapes , Overhead projector	Identify the use meteorological measuring instrument	Guide and assists students	What are the meteorological measuring instrument?
	General Objective 2: Understand the functions of Port Meteorological Officers (PMO)					
5	2.1 Tell the roles of PMO and their essential services; 2.2 List the Location of PMO and functions , 2.3 Explain the relationship between PMO and Ship Meteorological Observation (SMO) 2.4 Explain the role of a marine surveyor	Explain the roles of PMO and their essential services; List the Location of PMO and functions , Explain the relationship between PMO and Ship Meteorological Observation (SMO) Explain the role of a marine surveyor	Video tapes , Overhead projector			What is the relationship between PMO and SMO?

	General Objectives 3: Understand the use Ship Weather Code and Decode Book					
6-7	3.1 Describe weather Code Forms and explanatory notes to code: 3.2 Describe ship's code and decode book. 3.3 Describe and use Beaufort letter abbreviations for present and past weather;	Discuss weather Code Forms and explanatory notes to code: Describe ship's code and decode book. Describe and use Beaufort letter abbreviations for present and past weather;	Video tapes, Overhead projector	Use Ship's code and decode book to code and decode full report .	Guide and assists the students to use Ship's code and decode book to code and decode full report	Describe ship code and decode book?
	General Objective 4: Understand Weather Bulletin for Merchant Ship					
8-9	4.1 Explain the usefulness of weather bulletin to safety of ship and cargo. 4.2 List the issuing offices and area of responsibility; sea areas. 4.3 List Code names: Aurora, Baloon, Electron etc. 4.4 Explain the Content of sea area bulletins and ; coastal bulletin, 4.5 Use Gulf of Guinea and West Africa examples to explain Storm warning signals.	Explain the usefulness of weather bulletin to safety of ship and cargo. List the issuing offices and area of responsibility; sea areas. Explain the usefulness of weather bulletin to safety of ship and cargo. List the issuing offices and area of responsibility; sea areas.	Video tapes , Overhead projector			What is the need for weather bulletin?
	General Objective 5: Understand Automatic Weather Observing Station					
10-12	5.1 Explain the general overview of automatic weather observation system 5.2 Explain the components and transmission methods 5.3 Explain the Installation procedure; recording of meteorological observations through Turbowin version	Explain the general overview of automatic weather observation system Explain the components and transmission methods Explain the Installation procedure; recording of meteorological observations through Turbowin version		Use weather simulator i.e full mission to illustrate automatic weather observing system	Guide students to use weather simulator i.e full mission to illustrate automatic weather observing system	Describe the essence of automatic weather observing station?

	5.4 Explain the maintenance procedure of automatic weather observing station	Explain the maintenance procedure of automatic weather observing station				

Programme: ND NATIONAL DIPLOMA MARINE METEOROLOGY AND COASTAL MANAGEMENT	**Course Code:**		**Total Contact Hours: 30** **Credit Unit: 2**
Course Title: INTEGRATED COASTAL MANAGEMENT (ICM)	MCM 215		**Theoretical: 2 hours/week**
Semester: 3rd	**Pre-requisite:**		**Practical: 0 hour /week**

Goal: This course is design to acquaint students with understanding of environmental functions of the components and their relationships.

General Objectives

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

1] Explain the features and components of the natural, built and human aspects of the coastal environment, the functions of the components and relationships between them.

2] Identified coastal issues to determine appropriate approaches to manage the humans and the coastal environment

	Course Title:	**Course Code:**		**Total Contact Hours: 3** **Credit Unit: 2**
	Integrated Coastal Management (ICM)	MCM 215		**Theoretical: 2 hours/week**
	Semester: 3rd			**Practical: 0 hour /week**
	Theoretical Content		**Practical Content**	

	General Objective 1: Understand the need for ICM and Fundamental Concepts					
Week /s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1-2	1.1 Enumerate the need for ICM 1.2 Describe the interactions between Coastal and Ocean Uses and their Environments 1.3 Explain early efforts at Coastal Environmental Management 1.4 Analyse ICM goals, integration, functions and principles 1.5 Identify stages in developing an ICM Program	Explain the need for ICM Describe the interactions between Coastal and Ocean Uses and their Environments Explain early efforts at Coastal Environmental Management Analyse ICM goals, integration, functions and principles Identify stages in developing an ICM Program	Video tapes, Overhead projector		.	What are the stages required in developing an ICM program
	General Objective 2: Understand the Framework and Processes in ICM					
3-4	2.1 Discuss the concepts, framework and processes in ICM 2.2 Describe tools and techniques for ICM 2.3 Explain ICM Processes describe stakeholder analysis 2.4 Determine the need for conflict resolution 2.5 Describe risk evaluation 2.6 Explain Cost Benefit Analysis	Explain the concepts, framework and processes in ICM Describe tools and techniques for ICM Explain ICM Processes describe stakeholder analysis Determine the need for conflict resolution Describe risk	Video tapes , Overhead projector			What are the tools and techniques for ICM?

		evaluation Explain Cost Benefit Analysis				
	General Objective 3: Understand Coastal Environmental Laws, Policies, Institutions and Governance					
5-6	3.1 Explain Law of the Sea [UNCLOS] 3.2 Describe coastal regulation zones including small islands 3.3 Explain Environmental policies 3.4 Analyse spatial planning in Coastal 3.5 Environmental Management 3.6 Describe administrative and legal situations and Institutions and Governance Mechanisms	Explain the concepts, framework and processes in ICM Describe tools and techniques for ICM Explain ICM Processes describe stakeholder analysis Determine the need for conflict resolution Describe risk evaluation Explain Cost Benefit Analysis	Video tapes , Overhead projector			Examine the need for spatial planning in Coastal Environmental Management?
	General Objective 4: Understand the Concepts of Integrating Disciplinary Perspectives in ICM					
7-8	4.1 List out social insights to ICM 4.2 Describe the natural sciences insights to ICM 4.3 Differentiate between horizontal and vertical integration	Describe social insights to ICM Describe the natural sciences insights to ICM	Video tapes , Overhead projector			In what way could effective monitoring be achieved

	4.4 Explain monitoring and evaluation in ICM	Differentiate between horizontal and vertical integration Explain monitoring and evaluation in ICM				in ICM?
	General Objective 5: Understand Practice Oriented Learning in ICM					
9-10	4.6 Describe learning through observation (Observing in practice, Participatory observation and Focus group discussions).	Expose the students through case studies and field work Describe learning through observation (Observing in practice, Participatory observation and Focus group discussions).	Video tapes , Overhead projector	Use case studies and field work to describe learning through observation (Observing in practice, Participatory observation and Focus group discussions).	Use case studies and field work to describe learning through observation (Observing in practice, Participatory observation and Focus group discussions).	Discuss experience gathered during the field work?

Programme: ND NATIONAL DIPLOMA MARINE METEOROLOGY AND COASTAL MANAGEMENT	**Course Code:**		**Total Contact Hours: 75** **Credit Unit: 5**
Course Title: COASTAL ENVIRONMENTAL IMPACT ASSESSMENT	MCM 221		**Theoretical: 2 hours/week**
Semester: Four	**Pre-requisite:**		**Practical: 3 hours /week**

Goal: This course is design to acquaint students with understanding of socio-economic of a project of an environment.
General Objectives

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

1] Understand the existing natural and socio-economic environments within the area of influence of a project
2] Identify project components which might have a significance impact on the existing natural and socio-economic environment and the potential impacts of these project components on a local and regional scale
3] Analyze an Environmental Impact Statement taken into consideration mitigation and management measures

	Course Title:	**Course Code:**		**Total Contact Hours: 75** **Credit Unit: 5**
	COASTAL ENVIRONMENTAL IMPACT ASSESSMENT	MCM 221		**Theoretical: 2 hours/week**
	Semester: 4th			**Practical: 3 hours /week**
	Theoretical Content		**Practical Content**	
	General Objective 1: Understand the Concept of Coastal Environmental Impact Assessment			

Week /s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1-2	1.1 Define Environmental Impact Assessment (EIA) 1.2 Explain the principles and requirements of EIA 1.3 Explain environment related legislation in Nigeria 1.4 Explain Coastal regulations	Explain Environmental Impact Assessment (EIA) Explain the principles and requirements of EIA Explain environment related legislation in Nigeria Explain Coastal regulations	Video tapes , Overhead projector	Describe coastal EIA related projects (case study)	. Lecturer should use previous approved EIA report and guide the students	Examine the principles and regulations necessary for the conduct of EIA in Nigeria?
	General Objective 2: Understand the Components and Methods of Assessing Impact					

3-5	2.1 Describe ways of assessing impacts on environment and society (Air, Noise, Water, Soil, Biological and Cultural environments) 2.2 Explain the role of public participation in environmental decision making 2.3 Explain disaster management plans	Explain ways of assessing impacts on environment and society (Air, Noise, Water, Soil, Biological and Cultural environments) Explain the role of public participation in environmental decision making Explain disaster management plans	Video tapes, Overhead projector	Demonstrate how to use checklist and network methods to identify coastal environment related Impacts	Guide and assists the students during the field work	What are the methods of assessing coastal environmental related impact?
	General Objective 3: Understand the Rationale for Quality Control and Institutional Arrangement					
6-7	3.1 Describe the procedures to be followed in screening, scoping, mitigation, environmental management plans. environmental monitoring systems 3.2 Explain the essence of capacity building, quality assurance and adequate funding in EIA 3.3 Explain the role and need for institutional arrangement in EIA	Explain the procedures to be followed in screening, scoping, mitigation, environmental management plans. environmental monitoring systems Explain the essence of capacity building, quality assurance and adequate funding in EIA Explain the role and need for institutional arrangement in EIA	Video tapes, Overhead projector			What is the essence of quality control, capacity building and funding in EIA?

	General Objective 4: Understand the role of Government Implementing Agencies in EIA					
8-9	4.1 Enumerate coastal environment related industries and their activities 4.2 Explain impact assessment requirements for ports and harbours, shoreline change, sewage/industrial outfalls, coastal power plants, thermal impacts on marine ecosystem 4.3 Describe how management of impacts on the coastal and marine ecosystems should be handled	Explain coastal environment related industries and their activities Explain impact assessment requirements for ports and harbours, shoreline change, sewage/industrial outfalls, coastal power plants, thermal impacts on marine ecosystem 4.3 Describe how management of impacts on the coastal and marine ecosystems should be handled	Video tapes, Overhead projector			How should coastal and marine ecosystems be handled?
	General Objective 5: Understand how to Prepare Coastal related EIA Report in Nigeria					
10-12	5.1 Differentiate between cumulative impacts assessment and Strategic Impact Assessment 5.2 Describe case studies of EIA of developmental projects and projects on coastal areas 5.3 Describe the process involved in preparing an EIA in Nigeria for different sectors	Explain the difference between cumulative impacts assessment and Strategic Impact Assessment Describe case studies of EIA of developmental projects and projects on coastal areas Describe the process involved in preparing an EIA in Nigeria for	Video tapes, Overhead projector	Describe the process involved in preparing an EIA report in Nigeria (Maritime sector).	Guide and assists the students	Discuss how EIA report could be prepared?

		different sectors				

Programme: ND NATIONAL DIPLOMA MARINE METEOROLOGY AND COASTAL MANAGEMENT	**Course Code:**		**Total Contact Hours: 30** **Credit Unit: 2**
Course Title: SOCIO-ECONOMIC ASPECTS IN COASTAL MANAGEMENT	MCM 222		**Theoretical: 2 hours/week**
Semester: Four	**Pre-requisite:**		**Practical: 0 hour /week**

Goal: This course is design to acquaint students with understanding of factors in coastal environmental management.

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

1] Understand human factors in coastal environmental management and to recognize that many coastal problems are actually man induced.
2] Develop an approach that will enable them to incorporate man in their understanding of coastal environmental management

	Course Title:	**Course Code:**		**Total Contact Hours: 30** **Credit Unit: 2**		
	Socio- Economic Aspects in Coastal Environmental Management	MCM 222		**Theoretical: 2 hours/week**		
	Semester: 4th			**Practical: 0 hour /week**		
	Theoretical Content			**Practical Content**		
	General Objective 1: Understand the Concepts of social behaviour in Coastal Management					
Week /s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1-2	1.1 Appreciate the background to ICM 1.2 Differentiate between sustainability and Sustainable ICM 1.3 Explain competing Claims and Visions of all stakeholders in coastal environment 1.4 Explain ICM using holistic approach	Ascribe the background to ICM Differentiate between sustainability and Sustainable ICM Explain competing Claims and Visions of all stakeholders in coastal environment Explain ICM using holistic approach	Video tapes , Overhead projector		.	What is the difference between sustainability and sustainable ICM?
	General Objective 2: Understand the role of Inhabitants and the Society in Coastal Environmental Management					
3-4	2.1 List out stakeholders in Coastal Management 2.2 Describe processes of interaction between different stakeholders in Environmental Coastal Management 2.3 Explain social change along the Nigeria Coastal Environment 2.4 Describe the impacts	Explain stakeholders in Coastal Management Describe processes of interaction between different stakeholders in Environmental Coastal Management Explain social change along the Nigeria Coastal Environment Describe the impacts of	Video tapes , Overhead projector			To what extent has calamities affected the coastal environment?

	of urbanization 2.5 Explain industrialization and calamities on coastal societies	urbanization Explain industrialization and calamities on coastal societies				
	General Objective 3: Understand the rationale for livelihood in the Coastal Environment					
5-6	3.1 Describe the livelihoods along the Coast 3.2 Explain the sustainable Livelihood Framework 3.3 Differentiate between vulnerability and resilience 3.4 Explain changing livelihood Dynamics 3.5 Differentiate between Indigenous and traditional knowledge	Explain the livelihoods along the Coast Explain the sustainable Livelihood Framework Differentiate between vulnerability and resilience Explain changing livelihood Dynamics Differentiate between Indigenous and traditional knowledge	Video tapes, Overhead projector			Differentiate between indigenous and traditional-based knowledge

	General Objective 4: Understand the need for Institutions, Properties and Laws in Coastal Environmental Management					
7-8	4.1 Explain property rights in Coastal Environmental Management 4.2 Differentiate between competing property implementing agencies rights and resource claims	Explain property rights in Coastal Environmental Management Differentiate between competing property implementing agencies rights and resource claims	Video tapes, Overhead projector			What are the laws related to coastal environmental management?
	General Objective 5: Understand Policy and Governance of Coastal Environmental Management					
9-10	5.1 Describe existing policies governing the Coastal Environment 5.2 Identify the government implementing agencies at all levels that involves in the management of coastal environment	Describe existing policies governing the Coastal Environment Identify the government implementing agencies at all levels that involves in the management of coastal environment	Video tapes, Overhead projector			What are the existing policies governing the coastal environment?

Programme: National Diploma in Marine Meteorology and Coastal Management **Module: ND**	**Course Code:**		**Total Contact Hours: 45 hours** **Credit Unit: 3**
Course Title: Geographic Information System (GIS) and Remote Sensing II	MCM 223		**Theoretical: 1 hour**
Semester: 4th	**Pre-requisite: MCM 123**		**Practical: 2 hours**

Goal: This course is design to provide students with basic knowledge of principles of GIS and Remote Sensing.

General Objectives:
On Completion of this course the students will be able to:

1] Explain the basic principles of GIS and Remote Sensing

2] Describe Geographic Information Concepts and Spatial Models

3] Identify practical issues associated with managing data capture project

4] Describe Data acquisition and processing

5] Appreciate Spatial Databases

6] Explain Spatial Data Infrastructures

7] Apply Remote Sensing techniques to the study of climate changes

	Course Title:	Course Code:		Total Contact Hours: 45		
	Geographic Information System (GIS) and Remote Sensing II	MCM 223		**Theoretical: 1 hour/week**		
	Semester: 4th			**Practical: 2 hours**		
	Theoretical Content			**Practical Content**		
	General Objective 1: Understand the relationship between GIS and remote sensing					
Week /s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1	1.1 Describe the general overview of GIS and remote sensing 1.2 Explain the functionality, concepts, components, scope and application of GIS and remote sensing; 1.3 Explain the application GIS and remote sensing to other field i.e. Atmospheric sciences, meteorology and oceanography. 1.4 Identify various GIS and their components.	Explain the general overview of GIS and remote sensing Explain the functionality, concepts, components, scope and application of GIS and remote sensing; Explain the application GIS and remote sensing to other field i.e. Atmospheric sciences, meteorology and oceanography. Identify various GIS and their components.	Video tapes , Overhead projector GIS LAB		Guide and assists the students	What are the concepts of GIS and remote sensing
	General Objective 2: UnderstandGeographical Information Concepts and Spatial Model					
2	2.1 Delineate conceptual models of spatial information 2.2 Describe alternative representation of spatial information.	Explain conceptual models of spatial information Describe	Video tapes, Overhead projector GIS LAB	Demonstrate the use of GIS software to create base maps	Guide and assists the students	Administer group assignment

		alternative representation of spatial information.				
	General Objective 3: Understand Geographic data in the computer					
3	3.1 Describe the ways in which spatial data may be efficiently coded into a computer system to support the operation of GIS. 3.2 Explain the topology and its utilization; data quality and data exchange standards;	Exemplify ways in which spatial data may be efficiently coded into a computer system to support the operation of GIS. Explain the topology and its utilization; data quality and data exchange standards;	Video tapes , Overhead projector GIS LAB	1] Perform basic data conversion functions; raster to vector and vice-versa using computer 2] Use GIS software(Arc GIS software or QGIS) to explain geographical data Identify various geographic data formats: ”Open” format (XML, GML SVG) using computer	Guide and supervise the students	Explain how to use computer in explaining geographical data
	General Objective 4: Understand data acquisition and processing					
4	4.1 List the sources of Geographic data; 4.2 Explain methods of data collections and providers; data acquisition (manual, semi automatic, automatic) 4.3 Explain the processes of	Describe the sources of Geographic data; Explain methods of data collections and providers; data	Video tapes , Overhead projector GIS LAB	Demonstrate how to process GIS data using computer.	Guide and assists the students	Explain how to process data acquired?

	preliminary data processing, data storage, retrieval and display; data capture, Geo- referencing, storage, update, retrieval, query and output operations on spatial data sets: 4.4 Explain Data visualization techniques; select appropriate visualization techniques for a specific problem.	acquisition (manual, semi automatic, automatic) Explain the processes of preliminary data processing, data storage, retrieval and display;				
5	**General Objectives 5:** Understand spatial databases					
	5.1 Describe Relational database; 5.2 List out the structural differences between spatial and non- spatial databases; conceptual, logical and physical modeling of spatial databases. 5.3 Design and build a spatial database; 5.4 Describe and use spatial query languages: concept and 5.5 Design principles of metadata, database structuring. 5.6 Formulate database queries using GIS.	Explain Relational database; Explain structural differences between spatial and non- spatial databases; conceptual, logical and physical modeling of spatial databases. Design and build a spatial database; Describe and use spatial query languages: concept and Design principles of metadata, database structuring. Formulate	Video tapes , Overhead projector GIS LAB	Demonstrate how to use spatial query languages in GIS	Guide and assists the students	Explain the rationale for query languages in GIS?

		database queries using GIS.				
6	**General Objective 6:** Understand spatial data infrastructure					
	6.1 Explain spatial data infrastructure; 6.2 List means of facilitating and coordinating exchange and sharing spatial data.	Explain spatial data infrastructure; List means of facilitating and coordinating exchange and sharing spatial data.	Video tapes , Overhead projector GIS LAB	Use fieldwork to show students how to collect data	Guide and assists	Administer fieldwork

Programme: ND	**Course Code:**		**Total Contact Hours: 45** **Credit Unit: 3**
Course Title: MARINE METEOROLOGY II	MCM 224		**Theoretical: 2 hours**
Semester: 4th	**Pre-requisite: Marine Meteorology I**		**Practical: 1 hour**

Goal: This course is design to acquaint students with basic idea of water vapour in the atmosphere

General Objectives:

On Completion of this course the students will be able to:

1] Understand Ice and Icing at sea.
2] Understand the impact of water vapour in the atmosphere
3] Explain the Phenomenon of Thunderstorm
4] Explain the effects of turbulence at Sea
5] Understand Cyclone Detection and Tracking at sea
6] Understand synoptic weather
7] Understand the needs for marine meteorological services

	Course Title:	**Course Code:**		**Total Contact Hours: 45** **Credit Unit: 3**
	Marine Meteorology II	MCM 224		**Theoretical: 2 Hours**
	Semester: 4th			**Practical: 1 Hour**

	Theoretical Content			Practical Content		
	General Objective 1: Understand Ice and Icing at sea					
Wk/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1-2	1.1 List the different types of sea ice 1.2 Differentiate between sea water and fresh water accretion; 1.3 List the effects of icing on sea going ship; 1.4 Explain satellite and radar observation of ice; 1.5 Explain forecasting methods of ice at sea. 1.6 State the IMO requirement under SOLAS Convention as regards Ice at sea. 1.7 State basic precautions in ice navigation	Explain the different types of sea ice Differentiate between sea water and fresh water accretion; 1.3 Explain the effects of icing on sea going ship; Explain satellite and radar observation of ice; Explain forecasting methods of ice at sea. 1.6 State the IMO requirement under SOLAS Convention as regards Ice at sea. State basic precautions in ice navigation	Video tapes , Overhead projector	Show on video and pictures different ice types encountered at sea. Use Simulator to demonstrate ice and its effects on ship. State WMO and IMO guidelines in ice navigation.	Guide and assists the students	What are the effects of icing on ship?
	GENERAL OBJECTIVE 2: Understand the Impact of Water Vapour in the Atmosphere					
3-4	2.1 Explain water vapour in the atmosphere: evaporation, condensation, precipitation, relative humidity, saturation and dew point, 2.2 Describe Foehn wind effects, formation of dew, hoar frost, glazed frost, and rime. 2.3 Differentiate between drizzle, rain, shower, snow, hail.	Explain water vapour in the atmosphere: evaporation, condensation, precipitation, relative humidity, saturation and dew point, Describe Foehn wind effects, formation of dew, hoar frost, glazed frost,	Video tapes , Overhead projector			Explain the essence of water in the atmosphere

		and rime. Explain the differencs between drizzle, rain, shower, snow, hail.				
	General Objective 3: Understand the Phenomenon of Thunderstorm					
5-6	3.1 Enumerate the conditions leading to thunderstorm. 3.2 Explain the life cycle of a thunderstorm cell. 3.3 Describe the effects of thunderstorms on sea going ship; 3.4 Explain the empirical thunderstorm forecasting techniques; 3.5 Explain the use of Numerical Weather Prediction (NWP) methods in thunderstorm forecasting.	Explain the conditions leading to thunderstorm. Explain the life cycle of a thunderstorm cell. Explain the effects of thunderstorms on sea going ship; Explain the empirical	Video tapes , Overhead projector	Demonstrate how thunderstorm can affect shipboard electrical installations using stimulator	Guide and assists the students	Describe the effects of thunderstorm on ship
	General Objective 4: Understand the effects of turbulence at Sea.					
7-9	4.1 Describe the weather associated with turbulence at sea; 4.2 Explain the types of turbulence i.e convective turbulence, mechanical turbulence, clear air turbulence. 4.3 Explain ocean wave and state wave parameters. i.e wave frequencies ,wave spectrum F(f,ø), two dimensional wave spectrum. 4.4 Explain the effects of turbulence on aircraft and sea going ship.	Explain the weather associated with turbulence at sea; Explain the types of turbulence i.e convective turbulence, mechanical turbulence, clear air turbulence. Explain ocean wave and state wave parameters. i.e wave frequencies ,wave spectrum F(f,ø), two dimensional wave spectrum. Explain the effects of turbulence on aircraft and sea going ship.	Video tapes , Overhead projector		Administer field work	Discuss the weather associated with turbulence at sea

	General Objective 5: Understand Cyclone Detection and Tracking at sea					
10	5.1 Describe the weather conditions associated with cyclone; 5.2 Describe detections methods i.e ship observation, swell, atmospheric pressure, wind, clouds, visibility, use of radar, weather satellites, air craft reconnaissance etc; 5.3 Explain avoidance of cyclone at sea: track, path, through line, vortex, vertex, Dangerous Quadrant, Navigable semicircle etc 5.4 Explain the reporting procedures in accordance with SOLAS requirements, contents of message, responsibility of ship masters within the vicinity of cyclone.	Explain the weather conditions associated with cyclone; Describe detections methods i.e ship observation, swell, atmospheric pressure, wind, clouds, visibility, use of radar, weather satellites, air craft reconnaissance etc; Explain avoidance of cyclone at sea: track, path, through line, vortex, vertex Dangerous Quadrant, Navigable semicircle etc 5.4 Explain the reporting procedures in accordance with SOLAS requirements, contents of message, responsibility of ship masters within the vicinity of cyclone.	Video tapes , Overhead projector	Demonstrate how to detect cyclone using simulator	Guide and assists the students	What are the effects of cyclone on ships?
	GENERAL OBJECTIVE 6: Understand the use of Synoptic Weather Chart					
11	6.1 Discuss the process of forecasting fog and low stratus; 6.2 Descibe visible and infrared dust detection techniques. 6.3 State the impacts of weather on marine activities. 6.4 Explain air masses, production and transformation of air masses, conservative properties, air masses sources in winter and summer, classification of air masses.	Explain the process of forecasting fog and low stratus; Explain visible and infrared dust detection techniques. Explain impacts of weather on marine activities. Explain air masses, production and transformation of air masses, conservative properties, air masses sources in winter and summer, classification of air masses. Explain fronts; structure of fronts,	Video tapes, Overhead Projector			Explain the impacts of weather on marine activities?

	6.5 Describe fronts; structure of fronts, classification, kinematic and dynamic boundary conditions, frontogenesis and frontolysis, principal frontal zones. 6.6 Describe jet stream, polar jet stream, subtropical jet stream, polar night jet stream, easterly jet stream, 6.7 Describe characteristic of the various jet streams, weather associated with jet streams.	classification, kinematic and dynamic boundary conditions, frontogenesis and frontolysis, principal frontal zones and jet stream, polar jet stream, subtropical jet stream, polar night jet stream, easterly jet stream, list out the characteristic of the various jet streams, weather associated with jet streams.				
	GENERAL OBJECTIVE 7: Understand the need for Marine Meteorological Service					
12-13	List the various marine activities that require meteorological services. Explain the sources of marine data and the need of data for marine services	Explain the various marine activities that require meteorological services. Explain the sources of marine data and the need of data for marine services	Video tapes	Use automated equipment and Computer based equipment to transmit weather report.	Guide and assists the students to use automated equipment and Computer based equipment to transmit weather report	Examine the rationale for marine services to shipping industry?

MARINE METERROROLOGICAL STATION: CONVENTIONAL INSTRUMENT

S/N	INSTRUMENT	NUMBER REQUIRED
1	THERMOGRAPH	ONE
2	HYGROGRAPH	ONE
3	MARINE BAROGRAPH (ONE) AND IT SHOULD BE INSTALLED IN THE LABORATORY	ONE
4	DIGITAL BAROMETER (ONE) AND IT SHOULD BE INSTALLED IN THE LABORATORY	ONE

5	AMERICAN CLASS A PAN WITH HOOK GAUGE AND STILWELL (ONE)	ONE
6	SOLARIMETER (CMP3)	ONE
7	SUNSHINE RECORDER (CAMPBELL STOKE)	ONE
8	CUP COUNTER ANEMOMETER	ONE
9	WIND VANE	ONE
10	BINOCULAR	ONE
11	STEVENSON SCREEN INCLUDING THE STAND	TWO SETS
12	ORDINARY AWOS (DAVIS AWOS)	ONE
13	PINCH EVAPORIMETER WITH DISC	ONE
14	ORDINARY RAIN GAUGE	ONE
15	SELF RECORDING RAINGAUGE	ONE
16	MINIMUM MARINE THERMOMETER	ONE
17	MAXIMUM MARINE THERMOMETER	ONE
18	ORDINARY MARINE THERMOMETER (WET AND DRY BULB)	ONE
19	REMOTE INDICATING ANEMOMETER	ONE
20	CUP GENERATOR	ONE
21	MEASURING CYLINDER	ONE
22	MARINE INSTRUMENT: i. CANVAS BUCKET (ONE) ii. SEA SURFACE TEMPERATURE THERMOMETER (SSTT) (ONE) iii. TIDAL GAUGE (ONE) iv Automatic Weather Stations or Marine Automatic Weather Stations (ONE)	ONE EACH
23	PRISMATIC COMPASS	
24	WEATHER TRACKER	
25	HAND HELD GPS	
.26	CURRENT METER	
27	MULTIMEDIA PROJECTOR	
28	SEA SEDIMENT GRAB	
29	PH/EC WATER PROOF METER	
30	HYDROMETER BULB	

NOTE:
Requirements and Sitting of Meteorological Station (Enclosure) are listed as below:

1] The size of the enclosure should be 20m by 20m square

2] It should be sited in plain and level ground free from obstruction.

3] It should be covered by wire mesh and have a gate facing South

4] The enclosure should face true North.

5] Carpet Grass should be planted inside the enclosure

6] The two Screens must face through North.

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