



# NATIONAL BOARD FOR TECHNICAL EDUCATION

PLOT B BIDA ROAD, P.M.B. 2239, KADUNA, NIGERIA

## NATIONAL DIPLOMA

IN

## MARINE ENGINEERING TECHNOLOGY PROGRAMME

CURRICULUM AND COURSE SPECIFICATIONS

IN

COLLABORATION WITH

**NIGERIAN MARITIME ADMINISTRATION AND SAFETY AGENCY**

NIMASA TOWERS, 35 ADETOKUNBO ADEMOLA STREET, VICTORIA ISLAND, LAGOS, NIGERIA

MARCH, 2026

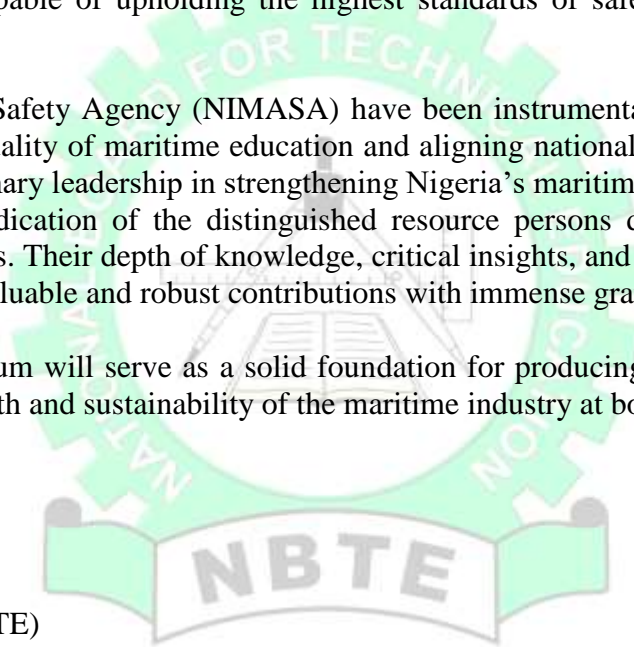
## PREFACE

The National Diploma (ND) and Higher National Diploma (HND) Marine Engineering Technology Curricula was reviewed meticulously to reflect the requirements and standards of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978, as amended, to enable our training programmes meet internationally recognized benchmarks for competence, safety and professional performance in the Marine Engineering discipline. The reviewed curricula are meant to equip cadets with the requisite knowledge, practical skills, and professional attitudes necessary for effective performance in both shipboard and shore-based Marine Engineering roles. By harmonizing academic training with STCW requirements, we are ensuring that our diplomates are not only competitive in the global maritime industry but also capable of upholding the highest standards of safety, environmental stewardship, and technical proficiency.

The Nigerian Maritime Administration and Safety Agency (NIMASA) have been instrumental to the successful completion of this review. Through its commitment to enhancing the quality of maritime education and aligning national training frameworks with global conventions, NIMASA has once again demonstrated visionary leadership in strengthening Nigeria's maritime sector. This accomplishment would not have been possible without the expertise and dedication of the distinguished resource persons drawn from academia, the maritime industry, regulatory authorities, and professional bodies. Their depth of knowledge, critical insights, and collaborative spirit greatly enriched the review process. We sincerely acknowledge their invaluable and robust contributions with immense gratitude.

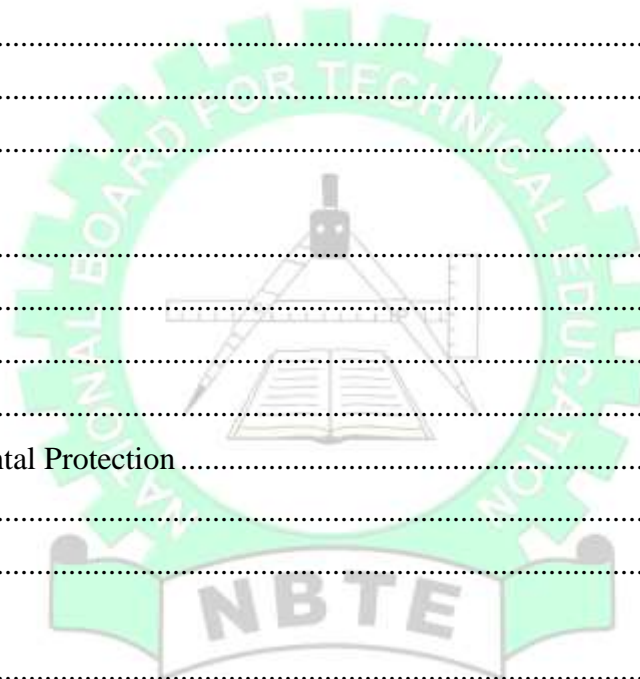
We are confident that this reviewed curriculum will serve as a solid foundation for producing competent Marine Engineering professionals who will contribute meaningfully to the growth and sustainability of the maritime industry at both national and international levels.

**Prof. Idris M. Bugaje**  
Executive Secretary  
National Board for Technical Education (NBTE)  
Kaduna,  
Nigeria  
March, 2026



## TABLE OF CONTENT

General Information.....	iv
Curriculum Table .....	x
Year I Semester I .....	1
French Language.....	2
Engineering Mathematics I.....	18
Introduction to Marine Engineering.....	27
Marine Workshop Practice I.....	33
Year I Semester II.....	40
Engineering Mathematics II.....	41
Engineering Drawing and Graphics.....	49
Marine Workshop Practice II.....	55
Marine Pollution Prevention and Environmental Protection.....	63
Properties of Engineering Materials .....	71
Marine Electro-Technology I.....	76
Year II Semester I.....	81
Marine Engines and Propulsion Systems I.....	82
Marine Auxiliary Machinery I.....	87
Refrigeration, Air-Conditioning and Ventilation.....	91
Naval Architecture and Ship Construction I.....	99
Marine Safety Training.....	105
Maritime Communication in English I.....	120



Research Methodology ..... 126

Year II Semester II..... 131

Marine Engines and Propulsion Systems II ..... 132

Electrical Machines and Shipboard Power Systems ..... 137

Engine-Room Watchkeeping and Resource Management ..... 142

Naval Architecture and Ship Construction II..... 146

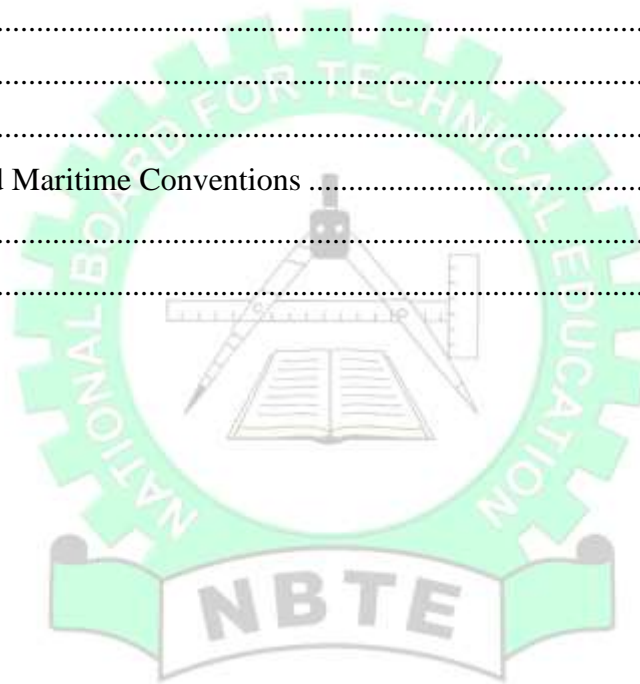
Shipyard Technology ..... 150

Marine Auxiliary Machinery II..... 158

Introduction to Engineering Management and Maritime Conventions ..... 168

List of Minimum Resources..... 174

List of Workshop Participants ..... 186



## GENERAL INFORMATION

### 1. PROGRAMME NOMENCLATURE

*National Diploma (ND) in Marine Engineering Technology Programme.*

### 2. PROGRAMME GOAL

The National Diploma (ND) in Marine Engineering Technology is aimed at producing technically competent, safety-conscious, and professionally disciplined marine engineering technicians capable of carrying out engine-room watch keeping operations under supervision.

### 3. OBJECTIVES OF THE PROGRAMME

At the end of the programme, the diplomates should be able to:

- i. Demonstrate foundational competence in marine engineering principles and practices;
- ii. Assist in the construction, operation, and maintenance of marine machinery;
- iii. Apply basic thermodynamics, mechanics, and electrical principles to marine systems;
- iv. Assist in the operations of propulsion and auxiliary machinery;
- v. Apply engine-room safety, fire prevention, and pollution control procedures;
- vi. Interpret engineering drawings, manuals, and technical documentation;
- vii. Communicate effectively within the engine-room team;
- viii. Exhibit professional discipline, teamwork, and ethical conduct onboard ships.

### 4. ENTRY REQUIREMENTS

The entry requirements into National Diploma in Marine Engineering Technology programme are as follows:

- a. Five (5) O'Level G.C.E., WASC, SSCE, SAISSCE, NECO or NABTEB subjects passed at not more than two sittings. The subjects must be passed at Credit level and should include English Language, Mathematics, Physics, Chemistry and any one (1) other subject from the list contained in the most current Directory of Accredited programmes of Polytechnics and similar tertiary technical institutions in Nigeria;
- b. A minimum admissible score in the Unified Tertiary Matriculation Examination (UTME) as stipulated by JAMB.

### 5. PROGRAMME STRUCTURE AND DURATION

The ND Marine Engineering Technology programme is structured to last for two (2) years (4 semesters) of classroom, workshop, laboratory and simulation activities. The National Diploma is a two-year terminal academic programme.

The duration also incorporates 3-4 months Students' Industrial Work Experience (SIWES) which shall take place at the end of the second semester of the first year. Each semester shall be for 17 weeks, made up of as follows:

- 15 contact weeks of teaching (i.e. lectures and practical sessions etc.) and

- 2 weeks for registration and examinations

## 6. CURRICULUM

6.1 The curriculum of all ND programme consists of four main components. These are

- a. General studies/education
- b. Foundation courses.
- c. Professional/Core courses
- d. Students Industrial work experience scheme (SIWES)

6.2 The General education component shall include courses in:

- Art and Humanities – English Language, communication, History.
- Mathematics and Science (for non-Science based programmes)
- Social Studies – Citizenship Education, Political science, Sociology, Philosophy, geography, and Entrepreneurship Studies.

The courses in citizenship education, entrepreneurship are compulsory. The General Education component shall account for not more than 15% of total contact hours for the programme.

6.3 Foundation Courses include Economics, Mathematics, Pure Sciences, Technical Drawing, Descriptive Geometry, and Statistics, etc. The number of hours will vary and may account for about 10–15% of the total contact hours.

6.4 Professional Courses are courses, which give the students the theory and practical skills they need to practice his field of calling at the Technician/Technologist level.

6.5 Students Industrial Work Experience Scheme (SIWES) shall be taken during vacation following the end of the second semester of the first year. See details of SIWES at paragraph 14.0

## 7. STAFFING REQUIREMENTS

### 7.1 Core Teaching Staff

A minimum of four (4) Core teaching staff who should possess at least Class 2/1 Certificate of Competency (CoC Unlimited), HND or B.Sc. in Marine Engineering or related disciplines.

### 7.2 Technical Staff

Technical staff shall be holders of ND, HND or BSc. in Marine Engineering or related discipline.

### 7.3 Headship of the Department

The Head of Department shall be a holder of Class 2/1 Certificate of Competency (CoC Unlimited), HND/First Degree, and Masters in Marine Engineering or related field. He/she shall not be less than the rank of a Senior Lecturer, and a registered member of a relevant professional body.

### 7.4 Career/Academic Prospects

Diplomates may progress to:

- Structured sea-time leading to Officer-in-Charge of an Engineering Watch certification.
- Entry-level positions in shipping, offshore operations, shipyards, and maritime services.

They can also proceed for further studies in HND or First Degree in Marine Engineering Technology or related engineering programmes.

## 8. CERTIFICATION

A diplomate of this programme shall be awarded ND in Marine Engineering Technology.

## 9. ACCREDITATION

The National Diploma (ND) in Marine Engineering Technology shall be accredited by NBTE before the diplomates can be awarded the diploma certificate. Details about the process of accrediting a programme for the award of the ND are available from the Executive Secretary, National Board for Technical Education (NBTE), Plot 'B', Bida Road, P.M.B. 2239, Kaduna, Nigeria.

## 10. CONDITIONS FOR THE AWARD OF THE ND

10.1 Institutions offering accredited programmes will award the National Diploma to candidates who successfully complete the programme after passing prescribed coursework, examinations, diploma project and the Students' Industrial Work Experience Scheme (SIWES). Such candidates should have completed a minimum of between 72 and 80 semester credit units depending on the programme.

10.2 National Diplomas shall be classified as follows:

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

10.3 Grading of Courses:

Courses shall be graded as follows:

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

**The pass mark for all professional or core courses is 60% in line with STCW Code, and 40% for General Studies and Non-Professional Courses, in line with NBTE Academic Guidelines.**

## **11.0 GUIDANCE NOTE FOR TEACHERS**

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

11.2 In designing the units, the principles of the modular system by product has been adopted; thus making each of the professional modules, when completed provide the students with technician operative skills, which can be used for employment purposes.

11.3. As the success of the credit unit system depends on the articulation of programmes between the institutions and industry, the curriculum content has been written in the behavioral objectives, so that is clear to all, the special Learning objective of the student who successfully completed some of the courses or the diplomates of the programme. There is a slight departure in the presentation of the performance based curriculum which state categorically, the special learning objective for the students, also, there is a deliberate attempt to further involve the staff of the department teaching by having another column called Teachers activities. This is to ensure that the teachers deliver the required learning objectives. There is a third column for the Resources required for each learning objective. Each department is expected to develop its own teaching curriculum from this minimum Guide curriculum and ensure that the resources required are available. The Academic Board of the institution may vet departmental submission on the final curriculum. Our aim is to continue to see to it that a solid internal evaluation system exists in each institution for ensuring minimum standard and quality of education in the programmes offered throughout the TVET Institutions.

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

## **12. PRACTICAL LOGBOOK**

Practical Logbooks to be kept by each student shall contain all day-to-day, weekly summary and semester summary of all the practical activities from day one to the end of the programme. These are to be checked, marked, endorsed and recorded by the Academic Staff concerned at the end of every week.

## **13. FINAL PROJECT**

Final year students in this programme are expected to carry out a project work. This could be on individual basis or group work, but reporting must be undertaken individually. The project should, as much as possible be related to the programme and core professional discipline. Project reports should be well presented and should be properly supervised. The department should make its own arrangement of schedules for project work.

## **14. GUIDELINES ON SIWES PROGRAMME**

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

14.1 Responsibility for placement of Students.

- a. Institution offering the ND programme shall arrange to place the students in industry. By the end of second semester of the first academic session, six copies of the master list showing where each student has been placed shall be submitted to the Executive Secretary, NBTE, who shall, in turn authenticate the list and forward it to the Industrial Training Fund, Jos. The Placement Officer should discuss and agree with industry on the following
- b. The Placement Officer should discuss and agree with industry on the following:
  - i. A task inventory of what the student is expected to experience during the period of attachment. It may be wise to adopt the one already approved for each field by the industry-based supervisor.
  - ii. The evaluation of the student by the industry-based supervisor and the institution-based supervisor.
  - iii. The final grading of the student during the period of attachment should be weighted more on the evaluation by industry-based supervisor.

#### 14.2 Evaluation of Student during the SIWES

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

- i. Punctuality
- ii. Attendance
- iii. General attitude to work
- iv. Respect for authority
- v. Interest in the field/technical area
- vi. Technical competence as a potential officer in his field.
- vii. Minimum number of watchkeeping hours
- viii. Number of maintenance tasks observed/performed

#### 14.3 Grading of SIWES

To ensure uniformity of grading scales, the institution should ensure that the uniform grading of students work, which has been agreed to by all TVET Institutions is adopted.

#### 14.4 The Institution based Supervisor

The institution-based supervisor should initial the logbook during each visit. This will enable him to check and determine to what extent the objectives of the scheme are being met and to assist students having any problems regarding the specific given to them by their industry-based supervisor.

#### 14.5 Frequency of visit

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

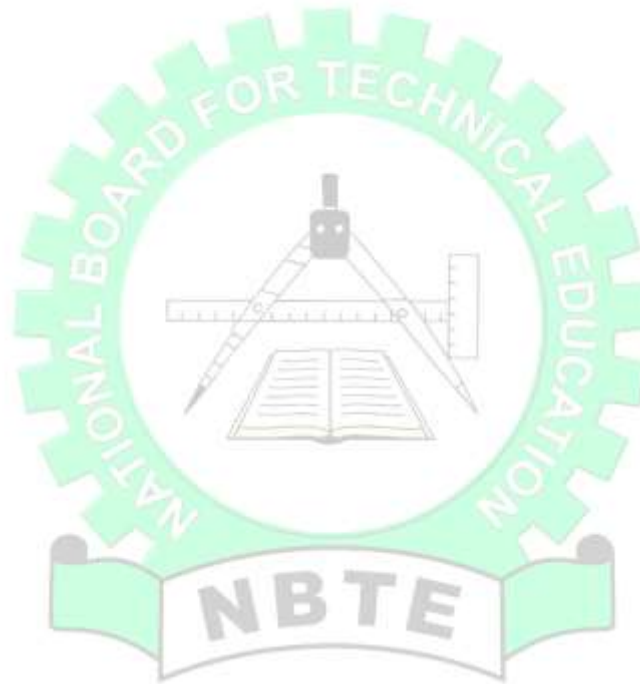
- i. There is another visit six weeks after the first visit; and
- ii. A final visit in the last month of the attachment.

#### 14.6 Stipend for Students in SIWES

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

#### 14.7 SIWES as a component of the Curriculum

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



## CURRICULUM TABLE

### YEAR I – SEMESTER I

S/N	Course Code	Course Title	L	T	P	CU	CH
1.	GNS 101	Use of English I	2	0	0	2	2
2.	GNS 111	Citizenship Education I	2	0	0	2	2
3.	COM 111	Introduction to Computing	1	0	2	3	3
4.	MEC 111	Technical Drawing	1	0	3	4	4
5.	MEC 112	Engineering Mechanics I (Statics)	2	0	2	4	4
6.	EEC 114	Electrical Engineering Science I	1	0	2	3	3
7.	MSQ 111	Mandatory Skills Qualification	1	0	1	2	2
8.	FRL 111	French Language	2	0	0	2	2
9.	MAR 111	Engineering Mathematics I	1	1	0	2	2
10.	MAR 112	Introduction to Marine Engineering	1	0	2	3	3
11.	MAR 113	Marine Workshop Practice I	2	0	2	4	4
<b>Total</b>			<b>16</b>	<b>1</b>	<b>14</b>	<b>31</b>	<b>31</b>

### YEAR I – SEMESTER II

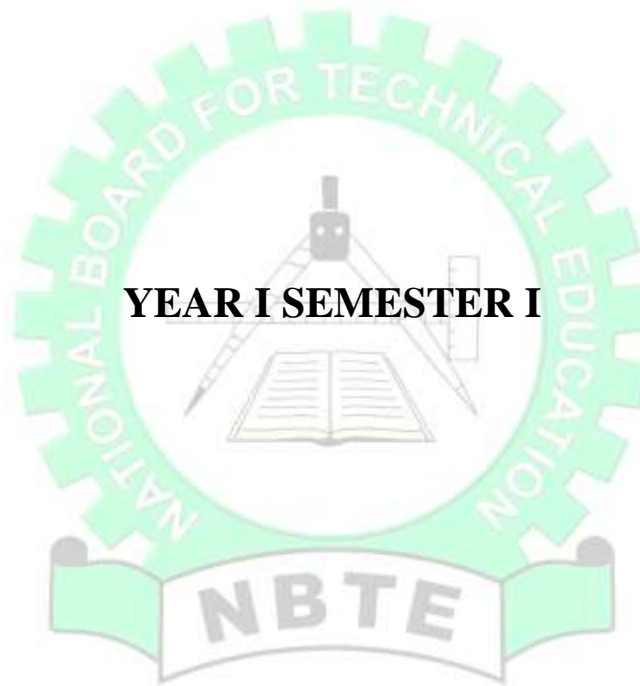
S/N	Course Code	Course Title	L	T	P	CU	CH
1.	GNS 102	Citizenship Education II	2	0	0	2	2
2.	ENT 126	Introduction to Entrepreneurship I	2	0	1	3	3
3.	MEC 122	Thermodynamics I	2	0	2	4	4
4.	MEC 124	Engineering Mechanics (Dynamics) II	2	0	2	4	4
5.	NSC 111	Introduction to Nautical Science	2	0	0	2	2
6.	MAR 121	Engineering Mathematics II	1	1	0	2	2
7.	MAR 122	Engineering Drawing and Graphics	1	0	3	4	4
8.	MAR 123	Marine Workshop Practice II	1	0	3	4	4
9.	MAR 124	Marine Pollution, Prevention and Environmental Protection	2	0	0	2	2
10.	MAR 125	Properties of Engineering Materials	1	0	2	3	3
11.	MAR 126	Marine Electro-Technology I	2	0	2	4	4
<b>Total</b>			<b>18</b>	<b>1</b>	<b>15</b>	<b>34</b>	<b>34</b>

**YEAR II – SEMESTER I**

S/N	Course Code	Course Title	L	T	P	CU	CH
1.	ENT 216	Introduction to Entrepreneurship II	2	0	1	3	3
2.	MEC 214	Fluid Mechanics	2	0	2	4	4
3.	MAR 211	Marine Engines and Propulsion Systems I	2	0	2	4	4
4.	MAR 212	Marine Auxiliary Machinery I	2	0	2	4	4
5.	MAR 213	Refrigeration, Air Conditioning and Ventilation	1	0	2	3	3
6.	MAR 214	Naval Architecture and Ship Construction I	2	0	2	4	4
7.	MAR 215	Marine Safety Training	1	0	2	3	3
8.	MAR 216	Maritime Communication in English I	2	0	2	4	4
9.	MAR 217	Research Methodology	2	0	1	3	3
10.	MAR 218	SIWES	0	0	4	4	4
Total			<b>16</b>	<b>0</b>	<b>20</b>	<b>36</b>	<b>36</b>

**YEAR II – SEMESTER II**

S/N	Course Code	Course Title	L	T	P	CU	CH
1.	MEC 222	Strength of Materials	2	0	2	4	4
2.	MAR 221	Marine Engines and Propulsion Systems II	2	0	2	4	4
3.	MAR 222	Electrical Machines and Shipboard Power Systems	2	0	2	4	4
4.	MAR 223	Engine-Room Watch Keeping and Resource Management	2	0	0	2	2
5.	MAR 224	Naval Architecture and Ship Construction II	2	0	2	4	4
6.	MAR 225	Shipyards Technology	2	0	2	4	4
7.	MAR 226	Marine Auxiliary Machinery II	2	0	2	4	4
8.	MAR 227	Introduction to Engineering Management and Maritime Convention	2	0	0	2	2
9.	MAR 228	Final Year Project	0	0	4	4	4
Total			<b>16</b>	<b>0</b>	<b>16</b>	<b>32</b>	<b>32</b>



**YEAR I SEMESTER I**

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: FRENCH LANGUAGE</b>	<b>COURSE CODE: FRL 111</b>	<b>CONTACT HOURS: 2 Hours/Week</b>
<b>Year: I Semester: I</b>	<b>CREDIT UNIT: 2</b>	<b>THEORETICAL: 2 Hrs/Week</b>
	<b>Pre-requisite: -</b>	<b>PRACTICAL: 0</b>
<b>Goal: The course is to equip students with fundamental skills and competence that will enhance effective communication in French Language, using various modern teaching methods and furnish them with adequate oral/written expressions that would empower them to attain the required basic communication skills and competence in French language.</b>		
<b>GENERAL OBJECTIVES</b>		
At the end of this course, the student should be able to:		
1.0	Know Basic Similarities and Differences Between French and English Languages;	
2.0	Know How to Greet;	
3.0	Know How to Introduce Self and Others in French;	
4.0	Know how to describe in French;	
5.0	Know Numbers, Dates and Seasons;	
6.0	Express family relationship in French;	
7.0	Know professions and nationalities in French;	
8.0	Know Basic Telephone Expressions;	
9.0	Know Short Notices in French;	
10.0	Know the Types and Components of a Ship in French;	
11.0	Understand how to receive and produce French sound patterns;	
12.0	Write Simple Sentences in French.	

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>						
<b>COURSE: FRENCH LANGUAGE</b>		<b>COURSE CODE: FRL 111</b>		<b>CREDIT UNIT: 2</b>	<b>CONTACT HOURS: 2 HRS/WEEK</b>	
<b>YEAR: I SEMESTER: I</b>		<b>PRE-REQUISITE:</b>		<b>THEORETICAL: 2 HRS/WEEK</b>		
<b>Course Specification: Theoretical content</b>						
<b>Theoretical Content</b>				<b>Practical Content</b>		
<b>WEEK</b>	<b>SPECIFIC LEARNING OUTCOMES</b>	<b>TEACHER'S ACTIVITIES</b>	<b>RESOURCES</b>	<b>SPECIFIC LEARNING OUTCOMES</b>	<b>TEACHER'S ACTIVITIES</b>	<b>RESOURCES</b>
<b>General Objective 1.0: Know Basic Similarities and Differences Between French and English Languages</b>						
1	1.1 Identify genders in French. 1.2 Differentiate between 'tu' and 'vous'. 1.3 Identify "faux amis" 1.4 Identify "liaison" between words in French. 1.5 Identify "accords" in French. 1.6 Identify different "accents" French.	<ul style="list-style-type: none"> <li>Lead a discussion on the history of French language in Nigeria.</li> <li>Lead a discussion on the importance of French language in the World, Nigeria and in the Maritime industry.</li> <li>Explain that there are masculine and feminine genders in French for both human and non-human objects/nouns..</li> <li>Introduce definite and indefinite</li> </ul>	<ul style="list-style-type: none"> <li>Prescribed texts as enumerated above.</li> <li>White board, pictures, drawings, CDs (Audio and video).</li> </ul>			

		<p>articles.</p> <ul style="list-style-type: none"><li>• State the difference between ‘tu’ and ‘vous’.</li><li>• Let the students know the existence of “faux amis” in French.</li><li>• Explain the meaning of “faux amis” with examples.</li><li>• Introduce “liaison” between words in French.</li><li>• Introduce “accords” in French.</li><li>• Identify different “accents” in French.</li><li>• Identify countries where French is spoken in Africa, Europe, Asia, America, etc.</li><li>• Define the word Francophone</li><li>• With the use of a map, identify francophone countries.</li></ul>				
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**General Objective 2.0: Know How to Greet**

<p>2</p>	<p>2.1 Say the French Alphabets.                  2.2 Spell names of Persons and objects in French.                  2.3 Identify basic French greetings.                  2.4 Greet in French formally and informally.                   2.5 Greet using titles in French say other general greetings in French.                  2.6 Express sentiments in French.</p>	<ul style="list-style-type: none"> <li>• Refresh students' memories of alphabets earlier learnt in English language write out the French alphabets.</li> <li>• Pronounce the alphabets correctly.</li> <li>• Expose students to the sounding of alphabets.</li> <li>• Use the alphabets to spell names of persons and objects.</li> <li>• Identify basic French greetings.</li> <li>• Show ways of greetings formally and informally.</li> <li>• Introduce official titles in French.</li> <li>• Mention other ways of greeting generally in French.</li> <li>• Give examples of expressing Sentiments in French.</li> </ul>	<ul style="list-style-type: none"> <li>• Prescribed French texts as enumerated above.</li> <li>• Students in the classroom</li> <li>• French language</li> <li>• Laboratory.</li> <li>• Pictures of Francophone people greeting themselves.</li> </ul>			
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**General Objective 3.0: Know How To Introduce Self and Others in French**

<p><b>3-4</b></p>	<p>3.1 Use operational verbs for introductions' appeller, être, habiter, avoir, venir de, parler, etc.</p> <p>3.2 Explain how to ask identification questions (comment tu t'appelles? etc)</p> <p>3.3 Respond to identification questions.</p> <p>3.4 Introduce oneself orally and in writing (name, residence, age, likes and dislikes).</p> <p>3.5 Introduce others (friends, family members, superiors, etc.)</p>	<ul style="list-style-type: none"> <li>• Introduce yourself to the hearing of the students.</li> <li>• Apply the verbs s'appeller, être, habiter, avoir, venir de, parler, etc. during the introduction.</li> <li>• Engage the students to do likewise</li> <li>• Introduce the questions, comment tu t'appelles? Comment ça va? Comment vous appelez vous?, etc.</li> <li>• Introduce Et toi? Moî and Et vous?</li> <li>• Respond to questions in Number 4 and 5 above.</li> <li>• Introduce yourself orally and in writing.</li> <li>• Introduce friends, family members, superiors, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Prescribed texts as enumerated above.</li> <li>• The board, pictures, drawings, the students themselves.</li> </ul>			
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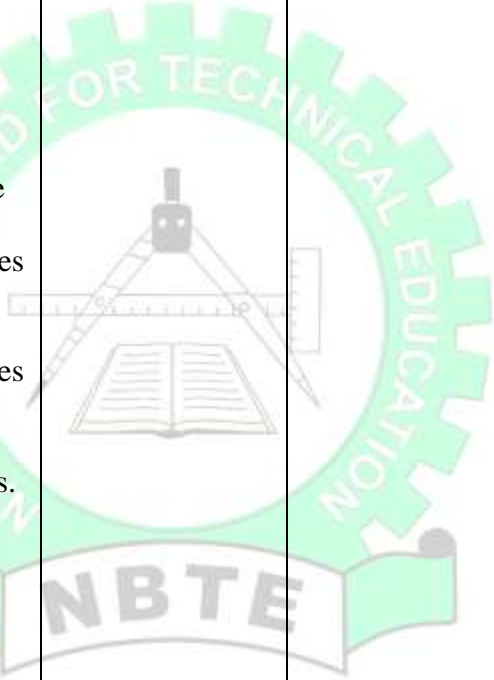
**General Objective 4.0: Know how to describe in French**

<p>5</p>	<p>4.1 Name parts of the body.                  4.2 Identify places in their immediate environment (cabin, hostel, classroom, offices, the school, ship, etc).                  4.3 List fruits and fruit trees.                  4.4 Identify colours.</p>	<ul style="list-style-type: none"> <li>• Mention parts of the body in French</li> <li>• Get the students to pronounce them correctly in French</li> <li>• Make a list of nouns in the students' immediate environment.</li> <li>• Pronounce them correctly to the hearing of the students.</li> <li>• Mention fruits and their fruit trees that are common to the students.</li> <li>• Refresh the students' previous knowledge on articles.</li> <li>• Introduce masculine and feminine colours</li> <li>• Introduce singular and plural colours.</li> <li>• Pronounce them correctly</li> </ul>	<ul style="list-style-type: none"> <li>• Presence of a human being in the class</li> <li>• Diagram of a human being.</li> <li>• Pictures showing different parts of the body.</li> <li>• Pictures/drawing of a ship or boat.</li> <li>• Mention fruits and fruit trees.</li> </ul>			
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General Objective 5.0: Know Numbers, Dates and Seasons						
6-7	<p>5.1 Count in French</p> <p>5.2 Tell dates and time in French.</p> <p>5.3 Name seasons in French.</p> <p>5.4 Tell age in French (age, date of birth, birthday)</p> <p>5.5 Exchange phone numbers and address in French.</p> <p>5.6 Bargain in French.</p> <p>5.7 Express measurement in French.</p> <p>5.8 Make short sentences on daily activities in French.</p>	<ul style="list-style-type: none"> <li>• Write number 1 – 20, both figures and words on the board</li> <li>• Let the students try to pronounce each number after you.</li> <li>• Introduce, hundred, thousand and million</li> <li>• Apply the numbers to tell dates in French</li> <li>• Apply the numbers to tell time in French.</li> <li>• Introduce seasons in French</li> <li>• Use the verb avoir to tell age</li> <li>• Ask the students to tell their ages following your example.</li> <li>• Tell your date of birth and birthday.</li> <li>• Permit the student to do same.</li> </ul>	<ul style="list-style-type: none"> <li>• Prescribed texts as enumerate above, calendar and clock.</li> <li>• Concrete objects in and around the classroom</li> <li>• French calendar</li> <li>• French birthday</li> <li>• Card.</li> <li>• Telephone</li> <li>• Measuring tape.</li> </ul>			

		<ul style="list-style-type: none"> <li>• Discuss how to exchange phone numbers.</li> <li>• Introduce expressions used in buying and selling.</li> <li>• Use numbers to express measurement.</li> <li>• Express daily activities in French using appropriate verbs, etc.</li> </ul>				
<b>General Objective 6.0: Express family relationship in French</b>						
8	<p>6.1 Name members of the family.</p> <p>6.2 State relationship with members.</p> <p>6.3 Describe one's family.</p> <p>6.4 State information about members of the family.</p>	<ul style="list-style-type: none"> <li>• Let students know family exists in French communities.</li> <li>• State that family members are both masculine and feminine.</li> <li>• Distinguish masculine and members articles and feminine members articles.</li> <li>• List the family members that belong to the nuclear family</li> <li>• List family</li> </ul>	<ul style="list-style-type: none"> <li>• Photographs and pictures of different types of family.</li> <li>• Photographs of masculine family members.</li> <li>• Photographs of feminine family members.</li> <li>• Video showing family members discussing.</li> </ul>			

		<p>members of the extended family.</p> <ul style="list-style-type: none"> <li>• Make simple sentences to give information about members of the family.</li> </ul>				
<b>GENERAL OBJECTIVE 7.0: Know professions and nationalities in French</b>						
9	<p>7.1 Mention professions in French.</p> <p>7.2 Identify masculine and feminine professional names.</p> <p>7.3 Make simple sentences with the professions.</p> <p>7.4 Mention nationalities in French</p>	<ul style="list-style-type: none"> <li>• Expose students to the existence of professions in France and Francophone countries.</li> <li>• List masculine professions.</li> <li>• List feminine professions.</li> <li>• Distinguish between masculine and feminine professions.</li> <li>• Introduce masculine and feminine articles to be used with the various professions</li> <li>• Form simple sentences orally with the professions.</li> <li>• Write simple sentences with</li> </ul>	<ul style="list-style-type: none"> <li>• French /English Bilingual Dictionary.</li> <li>• Maps of various Countries.</li> <li>• Textbooks.</li> <li>• Pictures showing citizens of various Countries.</li> <li>• Pictures of people in different professions</li> </ul>			

		<p>the professions.</p> <ul style="list-style-type: none"><li>• Create awareness that different Nations of the world exist in French.</li><li>• State that we have masculine and feminine</li><li>• Nationalities in French.</li><li>• Emphasize that some Nationalities are described with masculine articles and some are described with masculine articles and some are described with feminine articles.</li><li>• List the masculine Nationalities.</li><li>• List the feminine Nationalities. Pronounce them correctly.</li><li>• Form simple sentences/state ments using Nationalities.</li></ul>	 The logo of the National Board for Technical Education (NBTE) is centered in the table. It features a green gear-like border with the text 'NBTE' at the bottom and 'FOR TECHNICAL EDUCATION' on the right side. Inside the gear, there is an illustration of a drafting compass, a pencil, and an open book.		
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**GENERAL OBJECTIVE 8.0 : Know Basic Telephone Expressions**

<p>10</p>	<p>8.1 Exchange telephone numbers. 8.2 Initiate telephone conversation. 8.3 Respond to simple telephone conversation 8.4 Conclude a telephone conversation 8.5 Exchange messages onboard the ship ashore.</p>	<ul style="list-style-type: none"> <li>• Remind the students of numbers in French.</li> <li>• Let the students know how to start interaction in French.</li> <li>• State the expressions that are applicable to telephone conversation: Allô? C'est qui à la ligne? Je parle avec qui?</li> <li>• Initiate a telephone conversation with your French colleague and let the students listen.</li> <li>• Terminate the telephone conversation with your colleague :- Au Revoir, Á la prochaine, etc.</li> <li>• Identify messages onboard the ship and ashore: A bord d'un</li> </ul>	<ul style="list-style-type: none"> <li>• Different types of physical telephone.</li> <li>• Prescribed texts.</li> <li>• Pictures of people engaging in telephone conversation.</li> <li>• Presence of French lecturers in the classroom engaging in telephone conversation.</li> <li>• Pictures of passengers onboard ships and ashore.</li> </ul>			
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		<p>navire Passerelle Pont Barbord. Tribord, Le compte, Rendu, Le Quart du Navire</p> <ul style="list-style-type: none"> <li>• Apply them correctly onboard the ship and ashore</li> <li>• Exchange messages onboard the ship and ashore.</li> </ul>				
<b>General Objective: 9.0: Know Short Notices in French</b>						
11	<p>9.1 Read short notices/instructions in French.</p> <p>9.2 Issue simple notices and instruction in French.</p> <p>9.3 Respond to simple notices and instructions in French.</p> <p>9.4 Sound alarms and alerts in French.</p> <p>9.5 Make distress calls onboard and ashore.</p>	<ul style="list-style-type: none"> <li>• Explain what short notices/instructions mean in English language.</li> <li>• Identify imperative verbs used in issuing notices and instructions.</li> <li>• Issue simple notices in French.</li> <li>• Issue simple instruction in French.</li> <li>• Reply to simple notices and</li> </ul>	<ul style="list-style-type: none"> <li>• Excerpts from Newspapers and French journals</li> <li>• showing short notices and instructions.</li> <li>• Prescribed texts as enumerated above.</li> <li>• Pictures of people issuing and responding to short notices/instru</li> </ul>			

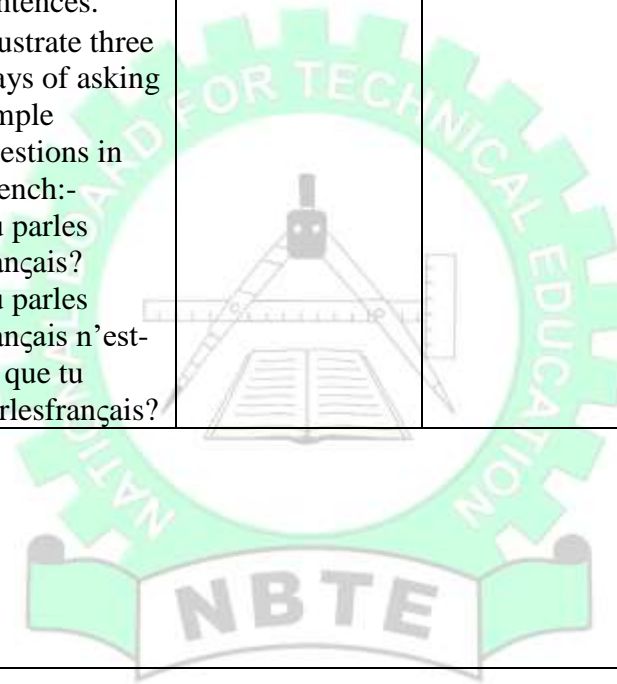
		<p>instructions in French.</p> <ul style="list-style-type: none"> <li>• Identify alarms and alerts in French</li> <li>• Make use of alarms in French</li> <li>• Identify distress calls onboard and ashore.</li> <li>• Make distress calls onboard and ashore:-                             <ol style="list-style-type: none"> <li>i. L'homme par dessus Board</li> <li>ii. Ohè?</li> <li>iii. Va en Amèrè</li> </ol> </li> </ul>	<p>ctions</p> <ul style="list-style-type: none"> <li>• Presence of various types of alarms in the class.</li> <li>• Physical telephone in the class</li> </ul>			
<b>General Objective 10.0 : Know the Types and Components of a Ship in French</b>						
<b>12</b>	<p>10.1 List types of ship in French.</p> <p>10.2 Enumerate parts of the ship in French.</p> <p>10.3 Identify professionals onboard ship in French.</p> <p>10.4 Mention departments onboard ship in French.</p> <p>10.5 Mention activities onboard ship in French.</p>	<ul style="list-style-type: none"> <li>• Identify ships in French.</li> <li>• List the parts of the ship in French.</li> <li>• Mention the professionals onboard ship in French:-                             <ol style="list-style-type: none"> <li>a. Le Capitaine</li> <li>b. L'Ingénieur en chezs</li> <li>c. Alinnenteur, etc.</li> </ol> </li> <li>• List the departments</li> </ul>	<ul style="list-style-type: none"> <li>• Pictures of different types of ship.</li> <li>• Pictures of ships showing the different parts.</li> <li>• Pictures of ship showing professional onboard.</li> <li>• Pictures of departments onboard ship.</li> <li>• Pictures of activities</li> </ul>			

		<p>onboard ship in French:-</p> <ol style="list-style-type: none"> <li>Le Pont</li> <li>La sale des Machines</li> <li>Dept. de la Restauration</li> <li>Poste</li> <li>Radio télégraphique.</li> </ol> <ul style="list-style-type: none"> <li>Mention activities onboard ship in French.</li> </ul>	<p>taking place in the ship.</p>			
<b>General Objective 11.0: Understand how to receive and produce French sound patterns</b>						
13	<p>11.1 Listen to short simple dictation passages in French</p> <p>11.2 Read short passages in French.</p> <p>11.3 Listen to short passages and answer questions on them.</p>	<ul style="list-style-type: none"> <li>Play an audio compact disc (CD) that contains simple dictation passages.</li> <li>Write the words listened to on the board.</li> <li>Play the C.D again for the students to listen to it.</li> <li>Engage the students to write down what they heard.</li> <li>Read short passages for the students in</li> </ul>	<ul style="list-style-type: none"> <li>Audio CD.</li> <li>Extracts of short, simple passages from textbooks, newspapers and</li> <li>Magazines.</li> <li>White board.</li> <li>Textbooks</li> </ul>			

		<p>French.</p> <ul style="list-style-type: none"> <li>• Answer questions from short passages.</li> </ul>				
<b>General Objective 12.0: Write Simple Sentences in French</b>						
14-15	<p>12.1 Answer questions using “Non” or ‘Si’.</p> <p>12.2 Ask questions using “comment” and “combien”.</p> <p>12.3 Rewrite sentences from positive to negative or interrogative and vice versa.</p> <p>12.4 Form and use the imperative from indicative sentences.</p> <p>12.5 Demonstrate three ways of asking simple questions in French</p>	<ul style="list-style-type: none"> <li>• Explain the use of “Oui”, “Non” and “Si</li> <li>• Use “Oui”, “Non” and “Si” in answering questions</li> <li>• Explain “comment” (How?) and “combien” (How much?).</li> <li>• Ask questions using “comment” and “combien”.</li> <li>• Write positive and negative sentences on the board.</li> <li>• Read the sentences and let the students read after you</li> <li>• Rewrite sentences on the board, from positive</li> </ul>	<ul style="list-style-type: none"> <li>• Prescribed texts as enumerated above.</li> <li>○ Extracts from texts, newspapers and magazines.</li> <li>○ The white Board.</li> <li>• Textbooks.</li> </ul>			

		<p>to negative or interrogative and vice versa.</p> <ul style="list-style-type: none"><li>• Introduce indicative sentences and change them to imperative sentences.</li><li>• Illustrate three ways of asking simple questions in French:-<ul style="list-style-type: none"><li>○ Tu parles français?</li><li>○ Tu parles français n'est-ce que tu parles français?</li></ul></li></ul>				
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**Course Assessment:**  
Course work: 20%  
Test/Assignments: 20%  
Examination: 60%  
**Total: 100%**



<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE: ENGINEERING MATHEMATICS I</b>	<b>Course Code: MAR 111</b>	<b>Contact Hours: 2 hours/week</b>
<b>Year: I Semester: I</b>	<b>Credit Unit: 2</b>	<b>Theoretical: 2 hours/week</b>
	<b>Pre-requisite: -</b>	<b>Practical: 0</b>
<p><b>GOAL: This course is designed to enable students acquire foundational mathematical competence required for marine engineering, including algebraic manipulation, trigonometric relationships, and basic engineering calculations, enabling them to apply mathematical principles accurately to machinery operation, power transmission, and system analysis, in accordance with STCW Code, Section A-III/1.</b></p>		
<p><b>GENERAL OBJECTIVES:</b></p> <p>On completion of this course, the students should be able to:</p> <ol style="list-style-type: none"> <li>1.0 Understand Algebraic Foundations for Marine Engineering;</li> <li>2.0 Understand principles underlying the construction of charts and graphs;</li> <li>3.0 Know the Engineering Calculations and Applied Problem-Solving;</li> <li>4.0 Know Accuracy, Units and Engineering Application Readiness;</li> <li>5.0 Comprehend the basic concepts and manipulation of vectors and their applications to the solutions of engineering problems;</li> <li>6.0 Know the concept to solve linear simultaneous equation with two unknown variables;</li> <li>7.0 Understand Trigonometry for Mechanical and Electrical Applications;</li> <li>8.0 Know the Engineering Calculations and Applied Problem-Solving;</li> <li>9.0 Know Accuracy, Units and Engineering Application Readiness.</li> </ol>		
<p><b>COMPETENCES:</b></p> <ul style="list-style-type: none"> <li>• Apply mathematical principles to machinery operations</li> </ul>		

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>						
<b>Course Title: ENGINEERING MATHEMATICS I</b>			<b>Course Code: MAR 111</b>	<b>Contact Hours: 2 hours/week</b>		
			<b>Credit Unit: 2</b>	<b>Theoretical: 2 hours/week</b>		
<b>Year: I Semester: I</b>			<b>Pre-requisite:</b>	<b>Practical: 0</b>		
<b>COURSE SPECIFICATION: Theoretical</b>						
<b>General Objectives 1.0: Understand Algebraic Foundations for Marine Engineering.</b>						
<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>
<b>1</b>	1.1 Explain basic algebraic operations accurately. 1.2 Explain algebraic expressions relevant to engineering formulae. 1.3 Explain linear and simple quadratic equations and solve exercises 1.4 Discuss algebraic methods to solve basic engineering problems. 1.5 Explain the need for accuracy and discipline in mathematical working.	<ul style="list-style-type: none"> <li>• Lecture 1.1-1.5</li> <li>• Worked examples</li> <li>• Analyse the accuracy and discipline in mathematical working</li> <li>• Organize tutorial classes to:                             <ul style="list-style-type: none"> <li>○ Solve algebraic problems related to engineering contexts.</li> <li>○ Interpret algebraic results correctly.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Engineering mathematics texts, Problem sheets, Graph sheets, Whiteboards, markers, Projectors, smart board, course file.</li> </ul>			
<b>GENERAL OBJECTIVE 2.0: Understand principles underlying the construction of charts and graphs</b>						
<b>2</b>	2.1 Explain linear and non-linear function. 2.2 Discuss dependent and independent variables. 2.3 Discuss the importance of coefficient of dependent	<ul style="list-style-type: none"> <li>• Construct graphs of functions.</li> <li>• Prepare lecture notes for the students</li> <li>• Ask the students to perform sample calculations.</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, whiteboard, graph book, Lecture notes, multimedia</li> </ul>			

	<p>variables, intercept and slope of a linear function.</p> <p>2.4 Construct graphs of functions such as <math>y = ax^n + b</math> for <math>n=1, 2, \dots</math> <math>y = ax^k</math></p> <p>2.5 Apply functions on experimental data related to Marine Engineering.</p>	<p>involving 3.1-3.2 of the specific learning outcomes and grade them.</p>	<p>projector, and computer.</p>			
<b>GENERAL OBJECTIVE 3.0: Know the different methods of solving quadratic equations</b>						
<b>3</b>	<p>3.1 Solve quadratic equations by factorization.</p> <p>3.2 Solve quadratic equations by method of completing the square.</p> <p>3.3 Solve quadratic equations by general formula.</p> <p>3.4 Determine the roots of given quadratic equations.</p> <p>3.5 Form quadratic equations from given roots.</p>	<ul style="list-style-type: none"> <li>• Explain how to solve quadratic equations using factorization method.</li> <li>• Explain how to solve quadratic equations by method of completing and by general formula.</li> <li>• Demonstrate formulation of quadratic equations from given roots.</li> <li>• Prepare lecture notes for the students</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, whiteboard, graph book, Lecture notes, multimedia projector, and computer.</li> </ul>			
<b>GENERAL OBJECTIVE 4.0: Understand the binomial theorem and its application in the expansion of expressions.</b>						
<b>4-6</b>	<p>4.1 Explain the method of mathematical induction.</p> <p>4.2 Prove the binomial theorem for a positive integral index.</p> <p>4.3 Expand expressions of the forms <math>(x + y)^2</math>, <math>(x \pm 1)^5</math>, applying binomial theorem.</p> <p>4.4 Find the coefficient of a particular term in the expansion of simple binomial</p>	<ul style="list-style-type: none"> <li>• Explain the method of mathematical induction.</li> <li>• State and prove the binomial theorem for a positive integral index.</li> <li>• Show the expansion of expressions of the forms</li> <li>• Find the coefficient of a particular term in the expansion of simple binomial expressions.</li> <li>• Show how to find the middle</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, white board, Lecture notes, multimedia projector, and computer.</li> </ul>			

	<p>expressions.</p> <p>4.5 Find the middle terms in the expansion of binomial expression.</p> <p>4.6 State the binomial theorem for a rational index.</p> <p>4.7 Expand expressions of the form: <math>(1+x)^{-1}</math>, <math>(1\pm x)^{\frac{1}{2}}</math>, <math>(1\pm x)^{-\frac{1}{3}}</math> applying binomial theorem.</p> <p>4.8 Expand and approximate expressions of the type <math>(1.001)^n</math>, <math>(0.998)^n</math>, <math>(1+x)^{\frac{1}{2}}</math>, <math>(1\pm x)^{\frac{1}{3}}</math> to a stated degree of accuracy.</p>	<p>terms in the expansion of binomial expression.</p> <ul style="list-style-type: none"> <li>• State the binomial theorem for a rational index.</li> <li>• Guide the student to expand and approximate expressions of the type <math>(1.001)^n</math>, <math>(0.998)^n</math>, <math>(1+x)^{\frac{1}{2}}</math>, <math>(1\pm x)^{\frac{1}{3}}</math> to a stated degree of accuracy</li> <li>• Prepare lecture notes for the students.</li> </ul>				
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**GENERAL OBJECTIVE 5.0: Comprehend the basic concepts and manipulation of vectors and their applications to the solutions of engineering problems.**

7-9	<p>5.1 State the definitions and representations of vectors</p> <p>5.2 Identify vector quantities.</p> <p>5.3 Define a position vector.</p> <p>5.4 Define unit vector</p> <p>5.5 Explain scalar multiple of a vector</p> <p>5.6 List the characteristics of parallel vectors</p> <p>5.7 Resolve Vectors into components using vector addition to compute resultant forces in 2-D problems</p> <p>5.8 Compute the modulus of a</p>	<ul style="list-style-type: none"> <li>• Explain vectors and its representations.</li> <li>• Define a position vector.</li> <li>• Define unit vector</li> <li>• Explain scalar multiple of a vector.</li> <li>• List the characteristics of parallel vectors</li> <li>• Demonstrate computation of the modulus of any given vector up to 2 and 3 dimensions.</li> <li>• State the parallelogram law for addition and subtraction of vectors</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, white board, Lecture notes, multimedia projector, and computer, etc.</li> </ul>			
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	<p>given vector up to 2 and 3 dimensions.</p> <p>5.9 State the parallelogram law for addition and subtraction of vectors</p> <p>5.10 Apply the parallelogram law in solving problems.</p> <p>5.11 Explain the concept of components of a vector and the meaning of orthogonal components.</p> <p>5.12 Resolve a vector into its orthogonal components.</p> <p>5.13 List characteristics of coplanar localized vectors.</p> <p>5.14 Define the resultant or composition of coplanar vectors.</p> <p>5.15 Compute the resultant of coplanar forces acting at a point using algebraic and graphical methods.</p> <p>5.16 Apply the techniques of resolution and resultant to the solution of problems involving coplanar forces.</p> <p>5.17 Apply vector techniques in solving problems involving relative velocity.</p> <p>5.18 State the scalar product of two vectors.</p> <p>5.19 Compute the scalar product of given vectors.</p> <p>5.20 Define the cross product of the vector product or two</p>	<ul style="list-style-type: none"> <li>• Apply the parallelogram law in solving problems.</li> <li>• Explain the concept of components of a vector and the meaning of orthogonal components.</li> <li>• Resolve a vector into its orthogonal components.</li> <li>• List characteristics of coplanar localized vectors.</li> <li>• Define the resultant or composition of coplanar vectors.</li> <li>• Compute the resultant of coplanar forces acting at a point using algebraic and graphical methods.</li> <li>• Apply the techniques of resolution and resultant to the solution of problems involving coplanar forces.</li> <li>• Apply vector techniques in solving problems involving relative velocity.</li> <li>• State the scalar product of two vectors.</li> <li>• Compute the scalar product of given vectors.</li> <li>• Define the cross product of the vector product or two vectors.</li> <li>• Calculate the direction ratios of given vectors.</li> <li>• Calculate the angle between</li> </ul>				
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	<p>vectors.</p> <p>5.21 Calculate the direction ratios of given vectors.</p> <p>5.22 Calculate the angle between two vectors using the scalar product.</p>	<p>two vectors using the scalar product.</p> <ul style="list-style-type: none"> <li>• Prepare lecture notes for the students</li> </ul>				
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**GENERAL OBJECTIVE 6.0: Know the concept to solve linear simultaneous equation with two unknown variables**

10-11	<p>6.1 Explain the concept of equation.</p> <p>6.2 List different types of equations; linear, quadratic, cubic, etc.</p> <p>6.3 State examples of linear simultaneous equations in two unknowns and simultaneous equations with at least one quadratic equation.</p> <p>6.4 Apply algebraic and graphical methods in solving two simultaneous equations involving a linear equation and a quadratic equation.</p> <p>6.5 Explain matrices.</p> <p>6.6 Define a determinant of <math>n^{\text{th}}</math> order matrix.</p> <p>6.7 Apply determinants of order 2 and 3 matrices in solving simultaneous linear equation.</p>	<ul style="list-style-type: none"> <li>• Explain the concept of equation.</li> <li>• List different types of equations; linear, quadratic, cubic, etc.</li> <li>• Give examples of linear simultaneous equations in two unknowns and simultaneous equations with at least one quadratic equation.</li> <li>• Apply algebraic and graphical methods in solving two simultaneous equations involving a linear equation and a quadratic equation.</li> <li>• Define a determinant of <math>n^{\text{th}}</math> order.</li> <li>• Apply determinants of order 2 and 3 in solving simultaneous linear equation.</li> <li>• Prepare lecture notes for the students</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, white board, graph book, Lecture notes, multimedia projector, and computer.</li> </ul>			
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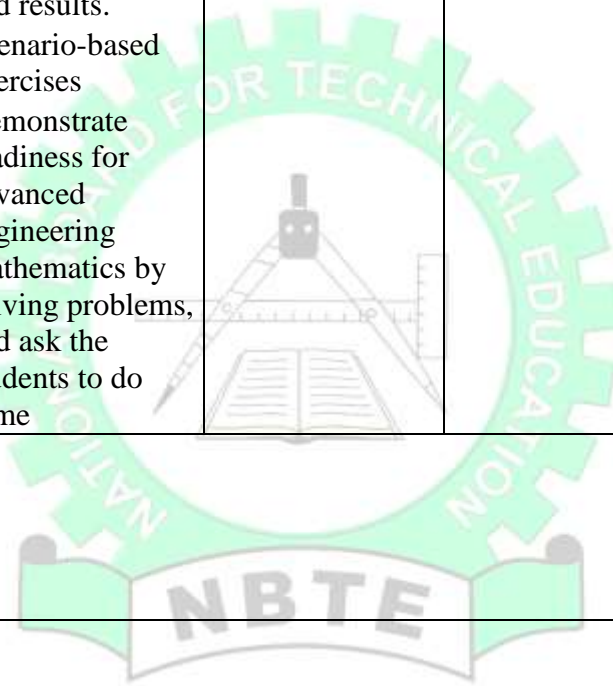
**General Objective 7.0: Understand Trigonometry for Mechanical and Electrical Applications.**

<p><b>12-13</b></p>	<p>7.1 Define trigonometric ratios and functions.</p> <p>7.2 Discuss trigonometric relationships to right-angled triangles.</p> <p>7.3 Explain angle and length problems relevant to engineering systems.</p> <p>7.4 Define the basic trigonometric ratios, sine, cosine and tangent of an angle.</p> <p>7.5 Derive the other trigonometric ratios; cosecant, secant and cotangent using the basic trigonometric ratios in 7.4 above.</p> <p>7.6 Derive identities involving the trigonometric ratios; <math>\text{Cos}^2 \theta + \text{Sin}^2 \theta = 1</math>, <math>\text{Sec}^2 \theta = 1 + \text{tan}^2 \theta</math>, etc.</p> <p>7.7 Derive compound angle formulae for <math>\sin (A+B)</math>, <math>\text{Cos} (A+B)</math> and <math>\text{Tan} (A+B)</math>.</p> <p>7.8 Describe the use of trigonometry in basic mechanical and</p>	<ul style="list-style-type: none"> <li>• Lecture 2.1-2.4</li> <li>• Step-by-step demonstrations</li> <li>• Solve problems, and ask students to do same</li> <li>• Demonstrate correct use of calculators and tables.</li> </ul>	<ul style="list-style-type: none"> <li>• Trigonometric tables</li> <li>• Engineering Mathematics textbooks</li> <li>• Calculators</li> <li>• Graph sheets</li> <li>• Whiteboards, markers, Projectors, smart board, course file</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>		
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	electrical examples.					
<b>General Objective 8.0: Know the Engineering Calculations and Applied Problem-Solving</b>						
<b>14</b>	<p>8.1 Explain mathematical principles to engineering calculations.</p> <p>8.2 Solve problems involving ratios, proportions, and percentages.</p> <p>8.3 Solve calculations related to power, speed, and efficiency.</p> <p>8.4 Analyse numerical results in engineering contexts.</p>	<ul style="list-style-type: none"> <li>• Lecture 8.1—8.4</li> <li>• Solved engineering examples</li> <li>• Carry out engineering-based calculations accurately.</li> <li>• Interpret the meaning of calculated results.</li> <li>• Supervised problem-solving sessions</li> <li>• Demonstrate logical problem-solving approaches and ask students to do same.</li> </ul>	<ul style="list-style-type: none"> <li>• Calculation templates, engineering problem sets, whiteboards, markers, projectors, smart board, course file, etc.</li> </ul>			
<b>GENERAL OBJECTIVE 9.0: Know Accuracy, Units and Engineering Application Readiness</b>						
<b>15</b>	<p>9.1 Explain correct units and conversions in calculations.</p> <p>9.2 Describe calculations for accuracy and consistency.</p> <p>9.3 Discuss the applications of</p>	<ul style="list-style-type: none"> <li>• Revision lectures</li> <li>• Application-based discussions</li> <li>• Describe technical courses through correct</li> </ul>	<ul style="list-style-type: none"> <li>• Unit conversion charts, applied examples, whiteboards,</li> </ul>			

	mathematical principles to routine engine-room scenarios.	<p>numerical reasoning.</p> <ul style="list-style-type: none"><li>• Perform complete engineering calculations correctly.</li><li>• Justify calculation steps and results.</li><li>• Scenario-based exercises</li><li>• Demonstrate readiness for advanced engineering mathematics by solving problems, and ask the students to do same</li></ul>	markers, Projectors, smart board, course file, etc.			
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**Course Assessment:**  
Course work: 20%  
Test/Assignments: 20%  
Examination: 60%  
**Total: 100%**

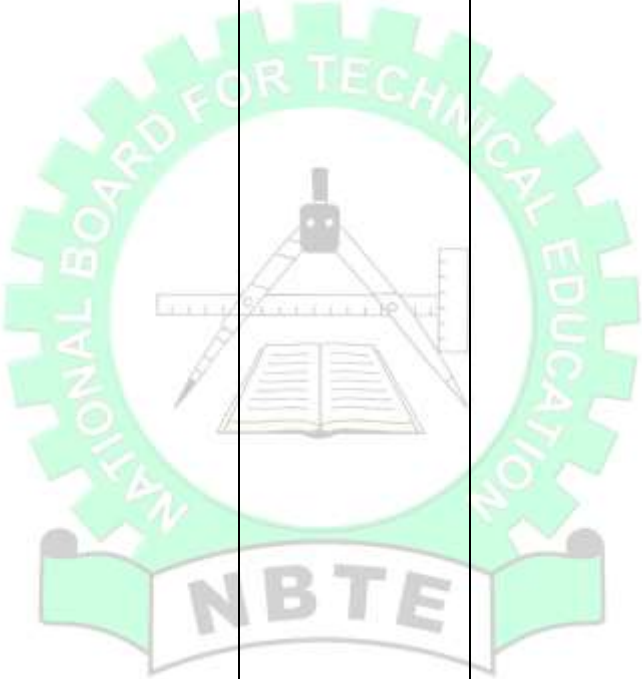


<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE: INTRODUCTION TO MARINE ENGINEERING</b>	<b>Course Code: MAR 112</b>	<b>Contact Hours: 3hours/week</b>
<b>Year: 1 Semester: 1</b>	<b>Credit Units: 3</b>	<b>Theoretical: 1 hour/week</b>
	<b>Pre-requisite: -</b>	<b>Practical: 2 hours/week</b>
<p><b>GOAL:</b> This course is designed to equip the students with the basic knowledge of the marine engineering profession, the scope of marine engineering practice, and the role of the engine-room watchkeeper at the operational level, including engine-room organization, basic propulsion and auxiliary systems, safety culture, and professionalism, in accordance with STCW Code, Section A-III/1.</p>		
<p><b>GENERAL OBJECTIVES:</b> On completion of this course, the students should be able to:</p> <ol style="list-style-type: none"> <li>1.0 Understand the basics of Marine Engineering and Career Scope;</li> <li>2.0 Know Engine-Room Organization and Watch keeping Roles;</li> <li>3.0 Know Ship Propulsion and Auxiliary Machinery Overview;</li> <li>4.0 Understand Safety Culture, Standards of Training, Certification and Watchkeeping (STCW), and Professional Responsibility.</li> </ol>		
<p><b>COMPETENCES:</b></p> <ul style="list-style-type: none"> <li>• Operate and maintain a safe engineering watch</li> </ul>		



<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>						
<b>Course Title: INTRODUCTION TO MARINE ENGINEERING</b>			<b>Course Code: MAR 112</b>		<b>Contact Hours: 3hours/week</b>	
			<b>Credit Unit: 3</b>		<b>Theoretical: 1 hour/week</b>	
<b>Year: 1 Semester: 1</b>			<b>Pre-requisite: -</b>		<b>Practical: 2 hours/week</b>	
<b>COURSE SPECIFICATION:</b>						
<b>General Objectives 1.0: Understand the basics of Marine Engineering and Career Scope.</b>						
<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>
<b>1-3</b>	1.1 Explain the scope and objectives of Marine Engineering as a profession. 1.2 Describe career pathways for Marine Engineers. 1.3 Explain the relationship between Marine Engineering and ship operations. 1.4 List out the roles of Marine Engineers in ship safety and efficiency. 1.5 Explain professional conduct expected of Trainee Officers and Marine Engineers. 1.6 Identify key duties of	<ul style="list-style-type: none"> <li>Lecture 1.1–1.7</li> <li>Guided discussions</li> </ul>	<ul style="list-style-type: none"> <li>Whiteboards, markers, Projectors, smart board, course file.</li> <li>Marine engineering texts, Career pathway charts</li> </ul>	1.1 Write technical report on relevant industrial visit(s).	<ul style="list-style-type: none"> <li>Group discussions</li> </ul>	<ul style="list-style-type: none"> <li>Career pathway charts</li> </ul>

	Marine Engineers. 1.7 Relate engineering functions to ship operations.					
<b>General Objective 2.0: Know Engine-Room Organization and Watch keeping Roles</b>						
4-6	<p>2.1 Describe engine-room organization and hierarchy.</p> <p>2.2 Explain duties of engine-room watchkeepers.</p> <p>2.3 Explain the responsibilities during engineering watchkeeping.</p> <p>2.4 Explain communication between engine room and bridge.</p> <p>2.5 Discuss the need for watchkeeping discipline.</p>	<ul style="list-style-type: none"> <li>Lecture 2.1-2.5</li> <li>Case discussions</li> <li>Explain basic watchkeeping routines.</li> </ul>	<ul style="list-style-type: none"> <li>Engine-room chart, watchkeeping manuals, whiteboards, markers, Projectors, smart board, course file, marine engineering texts, career pathway charts, etc.</li> </ul>	<p>2.1 Identify engine-room watch roles correctly in a simulator.</p> <p>2.2 Write technical report on relevant industrial visit(s).</p>	<ul style="list-style-type: none"> <li>Scenario discussions</li> <li>Organize Industrial visits to relevant firms, organizations, etc.</li> </ul>	<ul style="list-style-type: none"> <li>Engine room responsibility organogram, logbook, engine room simulator, practical manual, etc.</li> </ul>
<b>General Objective 3.0: Know Ship Propulsion and Auxiliary Machinery Overview.</b>						
7-11	<p>3.1 Describe the action of the rudder in steering a ship.</p> <p>3.2 Explain balanced, semi-balanced, 'spade' rudders.</p> <p>3.3 Draw in detail a semi-balanced rudder showing upper and lower bearings,</p>	<ul style="list-style-type: none"> <li>Lecture 3.1-3.17</li> <li>Diagram explanations</li> <li>Relate machinery functions to ship operations.</li> </ul>	<ul style="list-style-type: none"> <li>Propulsion system diagrams</li> <li>Machinery schematics</li> <li>Propulsion System models</li> <li>Whiteboards, markers,</li> </ul>	<p>3.1 Identify propulsion and auxiliary components.</p>	<ul style="list-style-type: none"> <li>Guided identification exercises</li> </ul>	

	<p>internal stiffening, rudder stock connection, and drainage arrangement.</p> <p>3.4 Explain the requirements for the protection of rudder from surface lugs, etc.</p> <p>3.5 Explain the purpose of the rudder steadying block and carrier, and connections to the ship.</p> <p>3.6 Explain the functions of rudder stock gland and trunk.</p> <p>3.7 Enumerate types of propulsion systems.</p> <p>3.8 Explain the main features of propulsion system.</p> <p>3.9 Explain the operational principle of screw propulsion.</p> <p>3.10 Explain propeller dimension and its components.</p> <p>3.11 Compare fixed pitch propellers with controllable (variable) pitch propellers.</p>		<p>Projectors, smart board, course file.</p> <ul style="list-style-type: none"> <li>• Marine engineering texts, Career pathway charts</li> </ul>			
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	<p>3.12 Illustrate connection of propeller to shaft</p> <p>3.13 Explain basic ship propulsion systems.</p> <p>3.14 Describe the function of marine diesel engines.</p> <p>3.15 Identify common auxiliary machinery on-board ships.</p> <p>3.16 Explain how auxiliary systems support propulsion and safety.</p> <p>3.17 Discuss machinery limitations.</p>					
<p><b>Objectives 4.0: Understand Safety Culture, Standards of Training, Certification and Watchkeeping (STCW) and Professional Responsibility.</b></p>						
<p><b>12-15</b></p>	<p>4.1 Explain safety culture in the engine room.</p> <p>4.2 Itemize common engine-room hazard.</p> <p>4.3 Explain the relevance of STCW Regulation III.</p> <p>4.4 Summarize safety and safe working conditions onboard ships.</p> <p>4.5 Explain how accidents can occur through handling and using hand tools, power tools and machines.</p> <p>4.6 Name safety wears and equipment onboard</p>	<ul style="list-style-type: none"> <li>• Lecture 4.1-4.5</li> <li>• Safety case discussions</li> <li>• Whiteboards, markers, Projectors, smart board, course file, Marine</li> </ul>	<ul style="list-style-type: none"> <li>• STCW extracts</li> <li>• Safety manuals</li> </ul>	<p>4.1 Identify safe and unsafe practices in engine-room scenarios.</p> <p>4.2 Demonstrate basic safety awareness principles.</p> <p>4.3 Operate alarm systems and fire detectors.</p> <p>4.4 Observe safety and safe working conditions onboard ships.</p>	<ul style="list-style-type: none"> <li>• Scenario-based discussions</li> </ul>	<ul style="list-style-type: none"> <li>• Ship visit</li> <li>• Mini drills</li> </ul>

	<p>ships</p> <p>4.7 Explain alarm systems and fire detectors onboard ships.</p> <p>4.8 Discuss the following:</p> <ul style="list-style-type: none"> <li>i. Engine-room communications during emergencies.</li> <li>ii. Alarms response procedure.</li> </ul> <p>4.9 Explain importance of regulatory compliance.</p> <p>4.10 Discuss professional attitudes required of Marine Engineering personnel.</p>					
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**Course Assessment:**

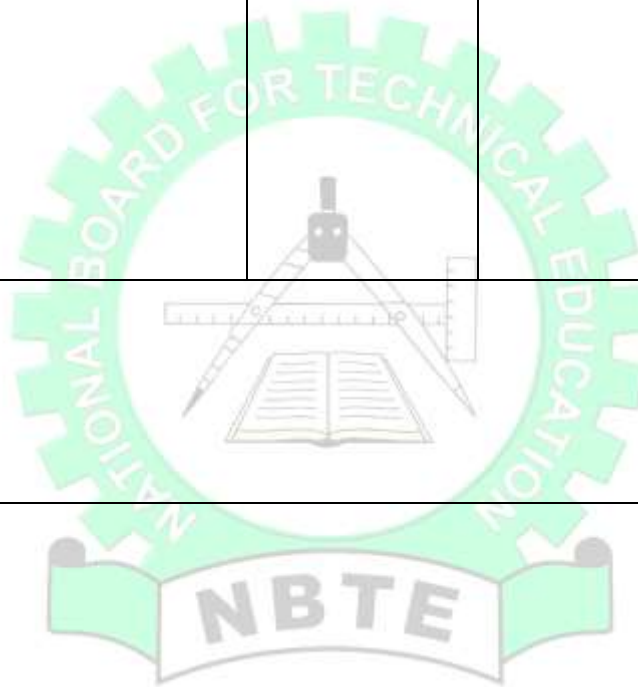
Course work: 10%

Test/Assignments: 10%

Practicals: 40%

Examination: 40%

**Total: 100%**



<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: MARINE WORKSHOP PRACTICE I</b>	<b>Course Code: MAR 113</b>	<b>Contact Hours: 4hours/week</b>
<b>Year: I Semester: I</b>	<b>Credit Unit: 4</b>	<b>Theoretical: 2hours/week</b>
	<b>Pre-requisite:</b>	<b>Practical: 2hours/week</b>
<p><b>GOAL: This course is designed to equip the students with foundational workshop competence required for marine engineering practice, including safe use of tools, basic fitting and machining operations, welding awareness, and workshop safety procedures, enabling them to support fabrication, maintenance, and repair of shipboard machinery in accordance with STCW Code, Section A-III/1.</b></p>		
<p><b>GENERAL OBJECTIVES:</b> On completion of this course, the students should be able to:</p> <ol style="list-style-type: none"> <li>1.0 Understand Workshop Safety, Tools and Materials;</li> <li>2.0 Know Fitting Tools, Measuring Instruments and Bench Work;</li> <li>3.0 Know Machining Basics and Welding Awareness;</li> <li>4.0 Know various metals joining operations;</li> <li>5.0 Know various gas welding operations;</li> <li>6.0 Know various metal arc welding operations.</li> <li>7.0 Understand the application to Marine Engineering Maintenance and Repairs.</li> </ol>		
<p><b>COMPETENCES:</b></p> <ul style="list-style-type: none"> <li>• Appropriate use of hand tools, machine tools and measuring instruments for fabrication and repairs onboard</li> <li>• Maintenance and repairs of shipboard machinery</li> </ul>		

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>						
<b>Course Title MARINE WORKSHOP PRACTICE I</b>				<b>Course Code: MAR 113</b>		<b>Contact Hours: 4Hours/week</b>
				<b>Credit Unit: 4</b>		<b>Theoretical: 2Hours/week</b>
<b>Year: 1 Semester: I</b>				<b>Pre-requisite:</b>		<b>Practical: 2Hours/week</b>
<b>COURSE SPECIFICATION:</b>						
<b>General Objective 1.0 Understand Workshop Safety, Tools and Materials</b>						
<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>
<b>1</b>	1.1 Explain workshop safety rules and hazard control. 1.2 Identify common hand tools and their functions. 1.3 List out appropriate tools for basic workshop tasks. 1.4 Explain common workshop materials and properties.	<ul style="list-style-type: none"> <li>• Safety lectures</li> <li>• Tool demonstrations</li> </ul>	<ul style="list-style-type: none"> <li>• Personal Protective Equipment (PPE), hand tools, safety signage, whiteboard, markers, multimedia, projectors, etc.</li> </ul>	1.1 Use PPE correctly. 1.2 Handle basic tools safely. 1.3 Identify common workshop materials and properties.	<ul style="list-style-type: none"> <li>• Supervise safety drills, tool handling practice</li> <li>• Demonstrate safe behaviour in workshop environments</li> </ul>	<ul style="list-style-type: none"> <li>• PPE, Hand tools, workshop machineries, safety charts</li> </ul>
<b>General Objective 2.0: Know Fitting Tools, Measuring Instruments and Bench Work</b>						
<b>2-3</b>	2.1 Identify fitting tools and measuring instruments. 2.2 Describe how to use measuring tools accurately. 2.3 Explain basic	<ul style="list-style-type: none"> <li>• Lecture 2.1-2.6</li> <li>• Discuss case study</li> </ul>	<ul style="list-style-type: none"> <li>• Vernier calipers, micrometers, bench tools, etc.</li> </ul>	2.1 Measure workpiece accurately. 2.2 Complete simple fitting tasks.	<ul style="list-style-type: none"> <li>• Supervise bench-work practice</li> <li>• Demonstrate accuracy and workshop discipline.</li> </ul>	<ul style="list-style-type: none"> <li>• Vernier calipers</li> <li>• Micrometers</li> <li>• Bench tools</li> <li>• Steel rules, etc.</li> </ul>

	<p>maintenance of tools and instruments.</p> <p>2.4 Explain appropriate storage and safe keeping of tools and measuring instruments.</p> <p>2.5 Discuss basic bench-fitting operations.</p> <p>2.6 Explain tolerances in simple fitting tasks.</p>					
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**General Objective 3.0: Know Machining Basics and Welding Awareness**

<b>4-5</b>	<p>3.1 Explain basic machining operations:</p> <ol style="list-style-type: none"> <li>i. Turning;</li> <li>ii. Drilling;</li> <li>iii. Milling;</li> <li>iv. Knurling;</li> <li>v. Cutting;</li> <li>vi. Reaming;</li> <li>vii. Tap and Die, etc.</li> </ol> <p>3.2 Identify basic machine tools and components.</p> <p>3.3 Describe basic welding processes (awareness level).</p> <p>3.4 Identify hazards associated with machining operations.</p> <p>3.5 Identify welding types</p>	<ul style="list-style-type: none"> <li>• Lecture 3.1-3.5</li> <li>• Visual demonstrations</li> </ul>	<ul style="list-style-type: none"> <li>• Textbooks, online resources, whiteboard, projector, computer, etc.</li> </ul>	<p>3.1 Observe machining operations safely.</p> <p>3.2 Perform turning, and threading operations using lathe machine, CNC machine.</p> <p>3.3 Perform drilling operation using drilling machines.</p> <p>3.4 Perform milling operations using milling machines.</p> <p>3.5 Perform knurling operation using appropriate tools and machinery.</p>	<ul style="list-style-type: none"> <li>• Supervise observation sessions</li> <li>• Demonstrate safe behaviour near machine tools.</li> <li>• Ensure proper logbook sign-on and sign-off.</li> </ul>	<ul style="list-style-type: none"> <li>• PPE adornment, Steel materials, bench work tools, welding machines, lathe/drilling machines, measuring instruments, logbooks, etc.</li> </ul>
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	and uses.			3.6 Perform cutting operation using power hacksaw. 3.7 Perform tap and die using tap and die tools.		
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**General Objective 4.0: Know Various Metals Joining Operations.**

<b>6-7</b>	<p>4.1 Define metal joining processes.</p> <p>4.2 Describe the types of metal joining.</p> <p>4.3 State all the conditions necessary for metal joining.</p> <p>4.4 Explain how to carry out metal joining.</p> <p>4.5 Explain different soldering processes.</p> <p>4.6 List equipment for soldering.</p> <p>4.7 Explain riveting.</p> <p>4.8 Explain bolts and nuts as metal joining method, etc.</p>	<ul style="list-style-type: none"> <li>• Discuss the various joining methods</li> <li>• Distinguish between soldering and brazing</li> <li>• Discuss the importance of using flux.</li> <li>• Explain the various forms of metal joining bolts and nuts, spanner, bending machine, hammer, cutting snips or hand shears.</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, White and magnetic board,</li> <li>• Projectors, videos, diagram</li> <li>• Pictures, Markers.</li> </ul>	<p>4.1 Fabricate metal container by Knock-up joining.</p> <p>4.2 Join metals by grooving technique.</p> <p>4.3 Carryout soft soldering.</p> <p>4.4 Carryout riveting.</p> <p>4.5 Join metals using bolt and nuts.</p>	<ul style="list-style-type: none"> <li>• Demonstrate to the students the various metal joining operations</li> <li>• Fabricate metal container by Knock-up joining</li> <li>• Join metals by grooving technique.</li> <li>• State the correct tapping drill size</li> </ul>	<ul style="list-style-type: none"> <li>• Welding machines, cutting tools, filing tools, wire brush, etc.</li> </ul>
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**General Objective 5.0: Know Various Gas Welding Operations**

<b>8-10</b>	<p>5.1 Describe gas welding operations.</p> <p>5.2 Explain different types of gas welding operations.</p> <p>5.3 Explain the components of oxy-acetylene gas welding.</p> <p>5.4 Explain setting of the flame.</p>	<ul style="list-style-type: none"> <li>• List out all the component parts of an Oxy-acetylene welding plant.</li> <li>• Explain the functions of each component.</li> </ul>	<ul style="list-style-type: none"> <li>• Blow lamps</li> <li>• Soldering iron</li> <li>• Soldering flux</li> <li>• Safety welding goggles</li> <li>• Oxygen gas cylinder</li> <li>• Acetylene gas cylinder</li> </ul>	<p>5.1 Identify the components of gas welding.</p> <p>5.2 Perform different flame settings for cutting and welding operations.</p> <p>5.3 Demonstrate uses of different types</p>	<ul style="list-style-type: none"> <li>• Demonstrate the various metal joining operations</li> <li>• Ask students to fabricate metal container by Knock-up joining</li> </ul>	<ul style="list-style-type: none"> <li>• Oxy-acetylene machines, fillers, flux, grinding machine, filing machines, electro-dryer,</li> </ul>
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	<p>5.5 Explain different types of nozzles and their uses.</p> <p>5.6 Explain safety and hazards associated with gas welding, and gas cylinders handling.</p> <p>5.7 Discuss appropriate use of PPE for gas welding operations.</p> <p>5.8 Describe how to cut and join metals by gas welding.</p>		<ul style="list-style-type: none"> <li>• Regulators, clips, nozzles</li> <li>Hoses, flash gas lighter</li> <li>• Welding nozzles</li> <li>• Gas welding set</li> <li>• Chipping hammer</li> <li>• Wire brush</li> <li>Flame cutting blow pipe (nozzle)</li> </ul>	<p>of nozzles for different gas welding tasks.</p> <p>5.4 Observe safety as regards gas cylinders handling.</p> <p>5.5 Demonstrate appropriate use of PPE for gas welding operations.</p> <p>5.6 Perform cutting and joining of metals by gas welding.</p>	<ul style="list-style-type: none"> <li>• Join metals by grooving technique.</li> <li>• Demonstrate how to Cut and joint metal by gas welding.</li> </ul>	<p>chipping hammer, wire brush</p>
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**General Objective 6.0: Know Various Metal Arc Welding Operations.**

<p><b>11-13</b></p>	<p>6.1 Describe arc welding.</p> <p>6.2 Explain Welding Codes and Standards.</p> <p>6.3 List the types of welded joints.</p> <p>6.4 State the polarity and earthing of arc welding machine.</p> <p>6.5 Discuss electric current settings of arc-welding machines.</p> <p>6.6 List metal arc welding equipment.</p> <p>6.7 Explain the following:</p> <ol style="list-style-type: none"> <li>i. Metallic inert-gas arc-welding</li> <li>ii. Carbon Arc-</li> </ol>	<ul style="list-style-type: none"> <li>• Explain various welding techniques</li> <li>• Describe components of arc-welding machine, and accessories.</li> <li>• List safety precautions and appropriate arc-welding PPEs.</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, White and magnetic board, Chalkboard, recommended textbooks,</li> <li>• Pedestal grinding machine.</li> </ul>	<p>6.1 Regulate current of arc welding machine</p> <p>6.2 Determine polarity for metal arc welding</p> <p>6.3 Perform various arc-welding joints by down and up operations.</p> <p>6.4 Select and prepare metal edges of various thickness for welding techniques.</p>	<ul style="list-style-type: none"> <li>• Distinguish between down welding and up welding operation</li> <li>• Demonstrate the Performance of down and up welding operation</li> <li>• Ask students to prepare appropriate metal edges for various metal thickness.</li> </ul>	<ul style="list-style-type: none"> <li>• Arc Welding machines, electrodes, grinding machine, filing machines, electro-dryer, chipping hammer, wire brush, electric arc welding Machine, Face shield, welding table,</li> </ul>
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	<p>Welding</p> <p>iii. Submerged Arc-Welding</p> <p>iv. Plasma welding</p> <p>v. High-pressure welding</p> <p>6.8 Explain how to test welding joints.</p> <p>6.9 State emerging welding techniques and their use.</p>					<p>Welding chipping, hammer, Wire brush, Hand gloves, Leather apron's, hand grinder, etc.</p>
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**General Objective 7.0: Understand Application of Workshop Practice to Marine Engineering Maintenance and Repairs.**

<b>14-15</b>	<p>7.1 Discuss workshop skills and its applications to simple marine engineering maintenance and repairs tasks.</p> <p>7.2 Explain basic methods of fabrication and repair tasks onboard.</p> <p>7.3 Describe the use of tools and instruments correctly during maintenance and repairs onboard.</p> <p>7.4 Explain safety procedures during workshop operations onboard.</p>	<ul style="list-style-type: none"> <li>• Lecture 7.1-7.4</li> <li>• Case-based discussions</li> <li>• Guided practice</li> </ul>	<ul style="list-style-type: none"> <li>• Workshop job cards</li> <li>• Maintenance examples</li> </ul>	<p>7.1 Perform basic workshop tasks to specification.</p> <p>7.2 Demonstrate safe and correct use of tools and instruments when performing maintenance and repairs tasks.</p>	<ul style="list-style-type: none"> <li>• Practical fabrication tasks</li> <li>• Demonstrate simple fabrication and maintenance skills, and ask the students to do same</li> <li>• Supervise students to ensure they use the right tools to carry out the work accordingly.</li> <li>• Demonstrate readiness for shipboard maintenance</li> </ul>	<p>Job card, PPE adornment, Steel materials, bench work tools, welding machines, lathe/drilling machines, measuring instruments.</p>
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					duties.	
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**Course Assessment:**

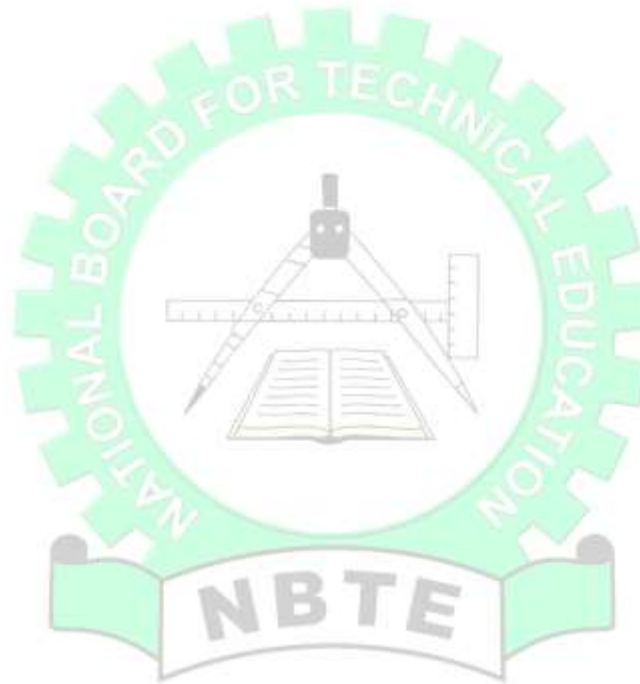
Course work: 10%

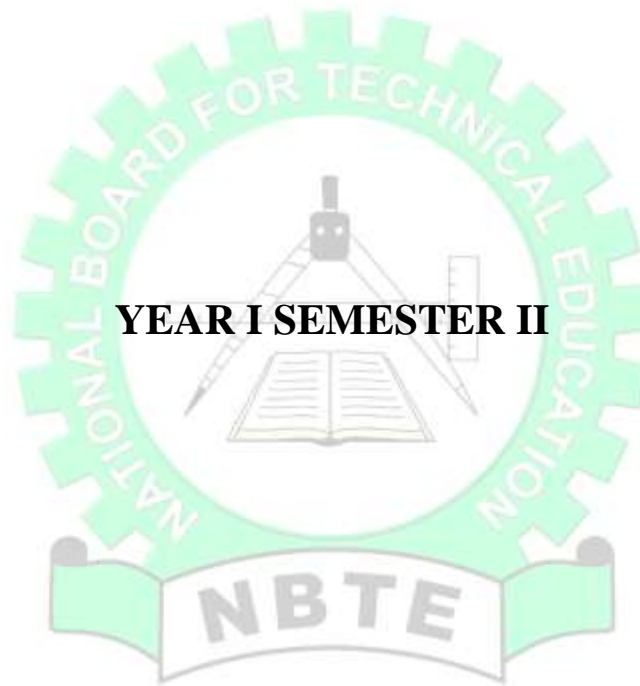
Test/Assignments: 10%

Practical: 40%

Examination: 40%

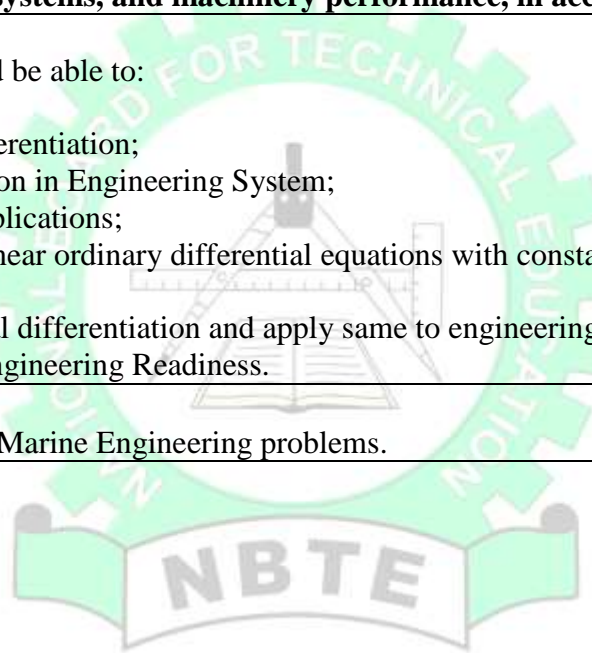
**Total: 100%**





**YEAR I SEMESTER II**

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: ENGINEERING MATHEMATICS II</b>	<b>Course Code: MAR 121</b>	<b>Contact Hours: 2hours/week</b>
<b>Year: 1 Semester: II</b>	<b>Credit Unit: 2</b>	<b>Theoretical: 2hours/week</b>
	<b>Pre-requisite: MAR 111</b>	<b>Practical: 0</b>
<p><b>GOAL:</b> This course is designed to equip students with advanced mathematical competence for marine engineering applications, including differential and integral calculus and analytical methods, enabling them to solve engineering problems related to thermodynamics, fluid mechanics, electrical systems, and machinery performance, in accordance with STCW Code, Section A-III/1.</p>		
<p><b>GENERAL OBJECTIVES:</b>                  On completion of this course, the student should be able to:</p> <ol style="list-style-type: none"> <li>1.0 Understand Functions, Limits and Differentiation;</li> <li>2.0 Know the Applications of Differentiation in Engineering System;</li> <li>3.0 Know Integration and Engineering Applications;</li> <li>4.0 Understand first order homogeneous linear ordinary differential equations with constant coefficients as applied to simple engineering problems;</li> <li>5.0 Understand the basic concepts of partial differentiation and apply same to engineering problems;</li> <li>6.0 Understand Analytical Methods and Engineering Readiness.</li> </ol>		
<p><b>COMPETENCE:</b></p> <ul style="list-style-type: none"> <li>• Apply Mathematical Principles to solve Marine Engineering problems.</li> </ul>		

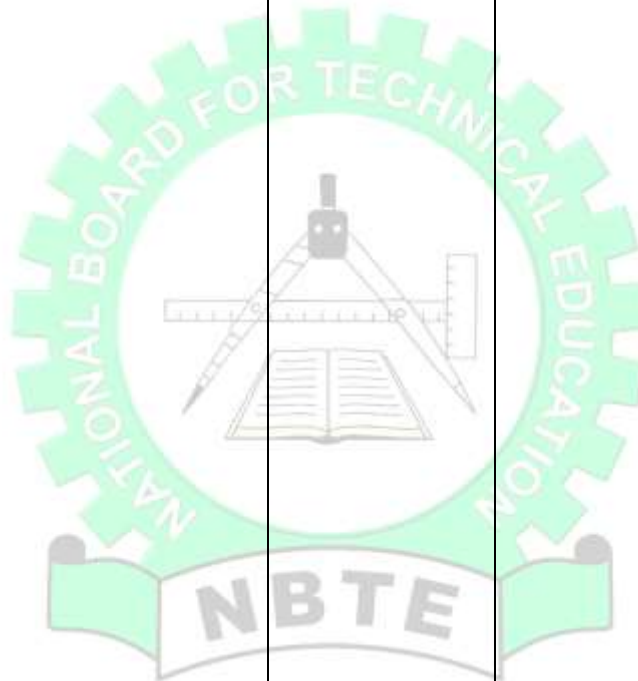


<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>						
<b>Course Title: ENGINEERING MATHEMATICS II</b>			<b>Course Code: MAR 121</b>		<b>Contact Hours: 2hours/week</b>	
			<b>Credit Unit: 2</b>		<b>Theoretical: 2hours/week</b>	
<b>Year: I Semester: II</b>			<b>Pre-requisite:</b>		<b>Practical: 0</b>	
<b>COURSE SPECIFICATION:</b>						
<b>General Objective 1.0: Understand Functions, Limits and Differentiation</b>						
<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>
1-3	1.1 Explain the concept of functions and limits. 1.2 Write mathematical expressions for differentiation. 1.3 Discuss application of differentiation to rate-of-change problems. 1.4 Distinguish among velocity, acceleration, and flow rate. 1.5 Solve velocity, acceleration, and flow rate problems using differentiation. 1.6 Define differentiation as an incremental notation of a function. 1.7 Differentiate a function from first principles. 1.8 Prove the formulae for derivative of functions, function of a function,	<ul style="list-style-type: none"> <li>• Lecture 1.1-1.18</li> <li>• Solved questions</li> <li>• Supervise problem-solving sessions</li> <li>• Demonstrate accuracy and logical mathematical steps, and ask students to do same</li> </ul>	<ul style="list-style-type: none"> <li>• Engineering Mathematics textbook, formula sheets, multimedia, Smart board, Whiteboard, markers, etc.</li> </ul>			

	<p>products, and quotient of functions.</p> <p>1.9 Differentiate simple algebraic, trigonometric, logarithmic, exponential, hyperbolic parametric, inverse and implicit functions.</p> <p>1.10 Derive second derivative of a function.</p> <p>1.11 Apply differentiation to simple engineering and technological problems.</p> <p>1.12 Explain the rate of change of a function.</p> <p>1.13 Explain the condition for turning point of a function.</p> <p>1.14 Distinguish between minimum and maximum value of a function.</p> <p>1.15 Sketch the graph of a function showing its minimum, maximum points and points of inflexion.</p> <p>1.16 Estimate error quantities from the small increment of a function.</p> <p>1.17 Determine the tangent to a curve.</p> <p>1.18 Determine the normal to a curve.</p>					
<b>General Objective 2.0: Know the Applications of Differentiation in Engineering Systems.</b>						
4-5	2.1 Explain applications of differentiation to minima and	<ul style="list-style-type: none"> <li>• Lecture 2.1-2.6</li> <li>• Solve Engineering</li> </ul>	<ul style="list-style-type: none"> <li>• Application worksheets,</li> </ul>			

	<p>maxima problems.</p> <p>2.2 Explain optimization problems in engineering systems.</p> <p>2.3 Solve optimization problems relevant to engineering.</p> <p>2.4 Explain differentiation to machinery performance analysis.</p> <p>2.5 Apply differentiation to machinery performance analysis.</p> <p>2.6 Discuss how results of differentiation guide engineering decisions and designs.</p> <p>2.7 Apply differentiation and integration for rate problems, numerical methods for root finding and interpolation.</p>	<p>problems</p> <ul style="list-style-type: none"> <li>• Guided analytical exercises</li> <li>• Demonstrate disciplined analytical problem-solving.</li> </ul>	<p>case problems, multimedia, Smart board, Whiteboard, markers, etc.</p>			
<b>General Objective 3.0: Know Integration and Engineering Applications</b>						
6-8	<p>3.1 Explain the concept of integration.</p> <p>3.2 Describe basic indefinite and definite integrals.</p> <p>3.3 Explain applications of integration to area, work, and energy calculations.</p> <p>3.4 Explain integration as the reverse of differentiation.</p> <p>3.5 Explain integration as a limit of summation of a function.</p> <p>3.6 Distinguish between definite and indefinite</p>	<ul style="list-style-type: none"> <li>• Lecture 3.1-3.22</li> <li>• Step-by-step solved problems</li> <li>• Supervised calculation exercises</li> <li>• Demonstrate accuracy in integral calculations and ask the students to do same.</li> <li>• Apply integrals to engineering quantities.</li> </ul>	<ul style="list-style-type: none"> <li>• Integration tables, engineering examples, multimedia, smart board, whiteboard, markers, etc.</li> </ul>			

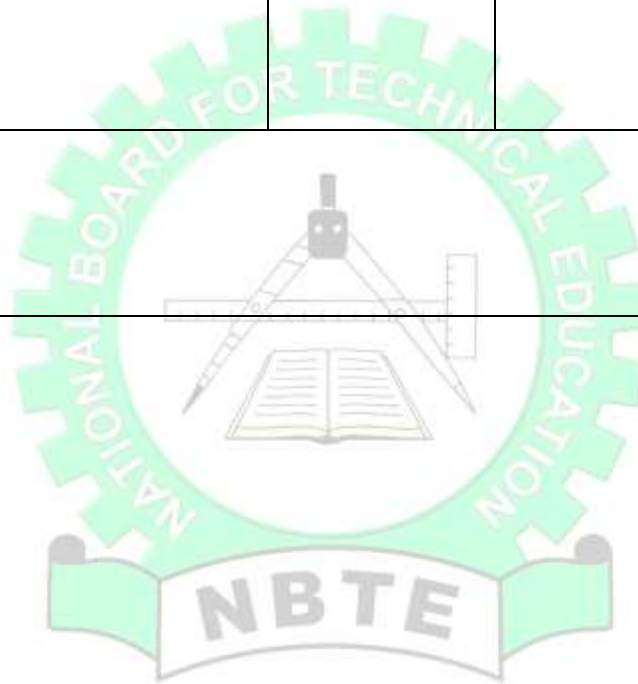
<p>integrals.</p> <p>3.7 Determine definite integrals of functions.</p> <p>3.8 Determine the indefinite integrals of a function.</p> <p>3.9 Integrate algebraic, logarithmic, trigonometric, and exponential simple functions.</p> <p>3.10 List the methods of integration.</p> <p>3.11 Integrate algebraic and trigonometric functions by substitution method.</p> <p>3.12 Integrate trigonometric and exponential functions by parts.</p> <p>3.13 Integrate algebraic functions by partial fraction.</p> <p>3.14 Integrate trigonometric and logarithmic functions applying reduction formula.</p> <p>3.15 State standard forms of some basic integrals.</p> <p>3.16 Calculate length of arc, area under a curve, area between two curves, volume of revolution, centre of gravity, surface area, second moment and moment of inertia.</p> <p>3.17 Define Trapezoidal and Simpson's rule as methods</p>					
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	<p>of approximating areas under given curves.</p> <p>3.18 Find approximate area under a curve applying Trapezoidal method.</p> <p>3.19 Find approximate area under a curve applying Simpson's rule.</p> <p>3.20 Compare result obtained from Trapezoidal and Simpson's rules with the results by direct integration.</p> <p>3.21 Apply integration to kinematics.</p> <p>3.22 Distinguish integration from thermodynamic and fluid systems.</p>					
<p><b>General Objective 4.0: Understand first order homogenous linear ordinary differential equations with constant coefficients as applied to simple engineering problems.</b></p>						
9-11	<p>4.1 Define first order differential equation.</p> <p>4.2 Explain order, degree, general solution, boundary or initial conditions and particular solution of differential equations.</p> <p>4.3 Explain first order linear differential equation.</p> <p>4.4 Explain first order homogenous differential equations.</p> <p>4.5 List the methods of solving differential equations by separation of variables.</p>	<ul style="list-style-type: none"> <li>• Define linear first order linear and first order homogenous differential equations.</li> <li>• Explain the method of solving differential equations by separation of variables.</li> <li>• Solve differential equation reducible to the homogenous form.</li> <li>• Write exact differential equations.</li> <li>• Define integrating</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, white board, Lecture notes, multimedia projector, scientific calculator, computer, etc.</li> </ul>			

	<p>4.6 Identify differential equations reducible to the homogenous form.</p> <p>4.7 Explain exact differential equations.</p> <p>4.8 Solve exact differential equations.</p> <p>4.9 Determine the solution of differential equations using integrating factors.</p>	<p>factors.</p> <ul style="list-style-type: none"> <li>• Determine the solution of differential equations using integrating factors.</li> <li>• Define linear differential equations of the first order.</li> <li>• Prepare lecture notes for the students.</li> </ul>				
<b>GENERAL OBJECTIVE 5.0: Understand the basic concepts of partial differentiation and apply same to engineering problems</b>						
12-13	<p>5.1 Define partial differentiation.</p> <p>5.2 Explain the uses of partial derivatives.</p> <p>5.3 Solve problems on partial differentiation.</p> <p>5.4 Apply partial differentiation to engineering problems.</p>	<ul style="list-style-type: none"> <li>• Summarize applications of partial derivatives.</li> <li>• Solve problems on partial differentiation relating to engineering</li> <li>• Prepare lecture notes for the students</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, whiteboard, Lecture notes, multimedia projector, and computer.</li> </ul>			
<b>Objectives 6.0: Understand Analytical Methods and Engineering Readiness</b>						
14-15	<p>6.1 Describe how to use Calculus to solve engineering problems.</p> <p>6.2 Discuss the application of analytical and computational techniques to machinery and system analyses.</p> <p>6.3 Explain thermodynamics and fluid mechanics calculations mathematically.</p> <p>6.4 Solve complete engineering mathematics problems.</p> <p>6.5 Carryout Differentiation, and integration of functions and apply results to engineering</p>	<ul style="list-style-type: none"> <li>• Lectures 6.1-6.5</li> <li>• Integrate problem sessions.</li> <li>• Scenario-based problem solving.</li> <li>• Demonstrate readiness for advanced engineering courses.</li> <li>• Revisions.</li> <li>• Continuous Assessment.</li> </ul>	<ul style="list-style-type: none"> <li>• Problem sets</li> <li>• Calculation templates</li> <li>• Multimedia, Smart board, Whiteboard, markers</li> </ul>			

	<p>rate problems.</p> <p>6.6 Describe the process and relevance of checking results for correctness in engineering applications.</p> <p>6.7 Use basic numerical methods to solve engineering equations (e.g. Newton-Raphson)</p> <p>6.8 Model simple first-order transient systems and compute time constants.</p>					
<p><b>Course Assessment:</b> Course work: 20% Test/Assignments: 20% Examination: 60% <b>Total: 100%</b></p>						



<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: ENGINEERING DRAWING AND GRAPHICS</b>	<b>Course Code: MAR 122</b>	<b>Contact Hours: 4 Hours/Week</b>
<b>YEAR: I SEMESTER: II</b>	<b>CREDIT UNIT: 4</b>	<b>Theoretical: 1 Hour/Week</b>
	<b>PRE-REQUISITE: NA</b>	<b>Practical: 3 Hours/Week</b>
<b>GOAL: This course is designed to develop students' ability to interpret and produce engineering drawings and graphics (orthographic, isometric, machine, and CAD) for marine machinery and systems, ensuring effective technical communication in line with STCW operational competencies.</b>		
<p><b>GENERAL OBJECTIVES:</b> On completion of this course, the student should be able to:</p> <ol style="list-style-type: none"> <li>1.0 Understand the purpose and role of engineering drawing and graphics in marine engineering practice;</li> <li>2.0 Identify correct use of drawing instruments, materials;</li> <li>3.0 Apply engineering drawing standards, conventions, and line types;</li> <li>4.0 Develop orthographic projections of machine components;</li> <li>5.0 Develop isometric projections of machine components;</li> <li>6.0 Apply dimensioning, tolerances, fits, and surface finish symbols;</li> <li>7.0 Interpret engineering symbols, diagrams, and machine drawings relevant to marine machinery;</li> <li>8.0 Develop sectional views and assembly drawings of marine components;</li> <li>9.0 Use Computer-Aided Designs (CAD) and Computer-Aided Manufacturing (CAM), software (e.g., AutoCAD, SolidWorks) to produce engineering graphics;</li> <li>10.0 Relate engineering drawings to shipboard machinery, piping systems, and maintenance tasks; communicate technical information effectively.</li> </ol>		
<p><b>COMPETENCES:</b></p> <ul style="list-style-type: none"> <li>• Interpret Engineering Drawings and Graphics</li> <li>• Produce Engineering Drawings for Fabrication of Components for Maintenance and Repairs.</li> </ul>		

PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY						
COURSE TITLE: ENGINEERING DRAWING AND GRAPHICS			Course Code: MAR 122		Contact Hours: 4 Hours/Week	
			Credit Unit: 4		Theoretical: 1 Hour/Week	
Year: I Semester: II			PRE-REQUISITE		Practical: 3 Hour/Week	
COURSE SPECIFICATION:						
General Objective 1.0: Understand the Purpose of Engineering Drawing						
THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	Specific Learning Outcome	Teacher's Activities	Resources	Specific Learning Outcome	Teacher's Activities	Resources
1	1.1 Explain purpose of engineering drawing in marine practice. 1.2 Explain the importance of graphical communication. 1.3 Discuss the applications of engineering drawings and graphics to shipboard operations and maintenance.	<ul style="list-style-type: none"> <li>Lecture on role of drawings in ship maintenance; show sample drawings.</li> <li>Ask Students to explain why drawings are essential.</li> <li>Supervise discussion and short presentations.</li> </ul>	<ul style="list-style-type: none"> <li>Standards guides, sample marine machinery drawings, projector.</li> </ul>			
General Objective 2.0: Identify correct use of drawing instruments, and Materials.						
2	2.1 Identify drawing instruments and materials. 2.2 Outline the uses of the various instruments, equipment and materials. 2.3 State the precautions to be taken when using drawing Instruments	<ul style="list-style-type: none"> <li>Demonstrate the use of instruments (compass, dividers, French curves, etc.).</li> </ul>	<ul style="list-style-type: none"> <li>Physical drawing instruments, instructional charts.</li> </ul>	2.1 Set up drawing equipment and materials correctly.	<ul style="list-style-type: none"> <li>Supervise line work exercises.</li> </ul>	<ul style="list-style-type: none"> <li>Drawing boards, T-squares, pencils, erasers</li> </ul>

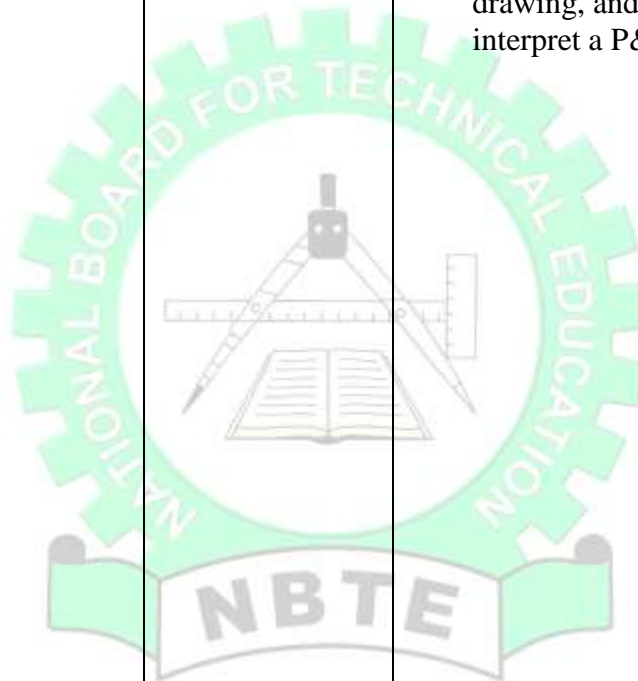
	and equipment. 2.4 Explain care and maintenance of drawing instruments and equipment.					
<b>General Objective 3.0: Apply engineering drawing standards, conventions, and line types.</b>						
<b>3-4</b>	3.1 Apply drawing standards and conventions. 3.2 Explain line types and meanings. 3.3 List different types of graphical presentations for ships drawings. 3.4 Illustrate the various conventional representation lines, in graphical productions of construction lines, hidden and overhead finished lines, projections, centre lines, break lines, dimensioning of plane, elevations and sections of objects.	<ul style="list-style-type: none"> <li>Teach Internal Standards; show line type charts.</li> </ul>	<ul style="list-style-type: none"> <li>Standards manuals, charts.</li> <li>Worksheets, sample drawings.</li> </ul>	3.1 Draw different types of graphical presentations for ships drawings. 3.2 Draw various conventional representation lines, in graphical productions of construction lines, hidden and overhead finished lines, projections, centre lines, break lines, dimensioning of plane, elevations and sections of objects.	<ul style="list-style-type: none"> <li>Assign exercises on line types.</li> </ul>	<ul style="list-style-type: none"> <li>Standards manuals, charts.</li> <li>Worksheets, sample drawings.</li> </ul>
<b>General Objective 4.0: Develop Orthographic Projections of Machine Components.</b>						
<b>5-6</b>	4.1 Explain principles of orthographic projection. 4.2 Draw first-angle views. 4.3 Discuss applications of orthographic projections.	<ul style="list-style-type: none"> <li>Step-by-step examples; multimedia animations.</li> </ul>	<ul style="list-style-type: none"> <li>Projection diagrams, slides.</li> </ul>	4.1 Draw orthographic views of marine components.	<ul style="list-style-type: none"> <li>Supervise scaled drawing exercises.</li> </ul>	<ul style="list-style-type: none"> <li>Marine component samples, worksheets.</li> </ul>
<b>General Objective 5.0: Develop Isometric Projections of Machine Components.</b>						

7-8	5.1 Explain principles of isometric projection. 5.2 Explain oblique projections. 5.3 Show how to draw isometric views. 5.4 Explain how to draw a sphere in isometric and oblique projections. 5.5 Discuss how to use appropriate conventional symbols and abbreviations.	<ul style="list-style-type: none"> <li>Lecture on isometric principles; show related marine examples.</li> </ul>	<ul style="list-style-type: none"> <li>Isometric charts, sample drawings.</li> </ul>	5.1 Draw isometric views. 5.2 Draw a sphere in isometric and oblique. 5.3 Use appropriate conventional symbols and abbreviations.	<ul style="list-style-type: none"> <li>Supervise drawing of pumps, piping layouts.</li> </ul>	<ul style="list-style-type: none"> <li>Marine component models, Sample Engine Component Drawing, CAD templates.</li> </ul>
<b>General Objective 6.0: Apply Dimensioning, Tolerances, Fits, and Surface Finish Symbols.</b>						
9	6.1 Apply dimensioning techniques. 6.2 Interpret tolerances and fits. 6.3 Discuss surface finishing symbols and their uses.	<ul style="list-style-type: none"> <li>Lecture on dimensioning rules; explain using standard tolerance tables.</li> </ul>	<ul style="list-style-type: none"> <li>Dimensioning charts, standards manuals.</li> </ul>	6.1 Apply dimensioning techniques. 6.2 Interpret tolerances and fits. 6.3 Interpret surface finishing drawings.	<ul style="list-style-type: none"> <li>Assign exercises on shafts, bearings.</li> </ul>	<ul style="list-style-type: none"> <li>Worksheets, marine component drawings.</li> </ul>
<b>General Objective 7.0: Interpret Engineering Symbols, Diagrams, and Machine Drawings Relevant to Marine Machinery.</b>						
10	7.1 Explain the need for engineering symbols 7.2 Identify engineering symbols. 7.3 Explain different shipboard machinery drawings	<ul style="list-style-type: none"> <li>Teach welding, piping, electrical symbols; relate to shipboard diagrams.</li> </ul>	<ul style="list-style-type: none"> <li>Symbol charts, marine piping diagrams.</li> </ul>	7.1 Identify engineering symbols. 7.2 Interpret marine machinery diagrams.	<ul style="list-style-type: none"> <li>Supervise exercises identifying components.</li> </ul>	<ul style="list-style-type: none"> <li>Marine system drawings, worksheets.</li> </ul>
<b>General Objective 8.0: Develop Sectional views and assembly drawings of marine components.</b>						
11	8.1 Explain sectional views. 8.2 Produce sectional views.	<ul style="list-style-type: none"> <li>Lecture on sectional</li> </ul>	<ul style="list-style-type: none"> <li>Assembly drawings,</li> </ul>	8.1 Produce sectional views.	<ul style="list-style-type: none"> <li>Guide drawing</li> </ul>	<ul style="list-style-type: none"> <li>Assembly drawings, sectional charts.</li> </ul>

	<p>8.3 Discuss the importance of assembly drawing.</p> <p>8.4 Explain methods of producing assembly drawings of marine components.</p>	<p>views; show marine assemblies.</p>	<p>sectional charts.</p> <ul style="list-style-type: none"> <li>• Marine component samples, CAD sectional templates.</li> </ul>	<p>8.2 Produce assembly drawings.</p>	<p>of pumps, valves, etc.</p>	<ul style="list-style-type: none"> <li>• Marine component samples, CAD sectional templates.</li> </ul>
<p><b>General Objective 9.0: Use Computer-Aided Design (CAD)/Computer-Aided Manufacturing (CAM), software (e.g., AutoCAD, SolidWorks) to produce engineering graphics.</b></p>						
<p><b>12-13</b></p>	<p>9.1 State the functions of CAD/CAM Software</p> <p>9.2 Explain how to install CAD/CAM software on computers.</p> <p>9.3 Explain how to start, create, save and close a new project or open existing projects using CAD/CAM software.</p> <p>9.4 Highlight the features of workspace layout of the CAD/CAM software</p> <p>9.5 Discuss how to choose and change measurement settings in CAD/CAM software.</p> <p>9.6 Identify the tools for drawing and making modification on the CAD/CAM software</p> <p>9.7 Explain how to draw using CAD software (AutoCAD, SolidWorks)</p>	<ul style="list-style-type: none"> <li>• Introduce CAD commands; demonstrate workflows.</li> </ul>	<ul style="list-style-type: none"> <li>• CAD manuals, tutorials.</li> <li>• Computers, CAD software, projector.</li> </ul>	<p>9.1 Use CAD software (AutoCAD, SolidWorks) to produce digital drawings.</p>	<ul style="list-style-type: none"> <li>• Supervise CAD labs, assign projects.</li> </ul>	<ul style="list-style-type: none"> <li>• CAD manuals, tutorials.</li> <li>• Computers, CAD software, projector.</li> </ul>

**General Objective 10.0: Relate engineering drawings to shipboard machinery, piping systems, and maintenance tasks; communicate technical information effectively.**

14-15	<p>10.1 Discuss how to relate drawings to shipboard machinery.</p> <p>10.2 Explain how to communicate technical information using drawings.</p> <p>10.3 Explain how to produce ship piping diagrams (e.g. fuel line, freshwater lines, etc.).</p> <p>10.4 Interpret engineering drawings and Piping and Instrumentation Diagrams (P&amp;IDs) used in engine rooms.</p> <p>10.5 Produce basic 2-D assembly drawings to specified tolerances using CAD.</p> <p>10.6 Apply drawing information to plan a simple maintenance task.</p>	<ul style="list-style-type: none"> <li>• Case-based lectures; show maintenance tasks supported by drawings.</li> </ul>	<ul style="list-style-type: none"> <li>• Marine system drawings, case studies.</li> </ul>	<p>10.1 Present drawings/sketches during technical discussions.</p> <p>10.2 Produce an assembly drawing, and interpret a P&amp;ID.</p>	<ul style="list-style-type: none"> <li>• Organize group presentations.</li> </ul>	<ul style="list-style-type: none"> <li>• CAD projector, marine diagrams.</li> </ul>
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**Course Assessment:**

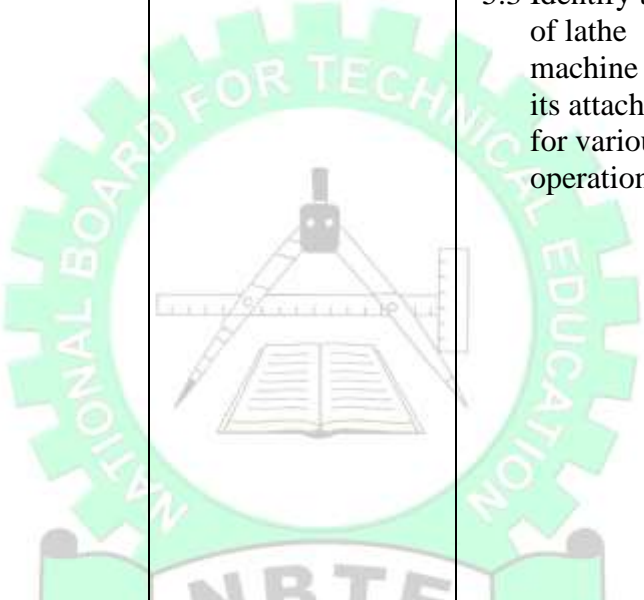
Course work: 10%  
 Test/Assignments: 10%  
 Practical: 40%  
 Examination: 40%  
**Total: 100%**

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: MARINE WORKSHOP PRACTICE II</b>	<b>Course Code: MAR 123</b>	<b>Contact Hours: 4HOURS/WEEK</b>
<b>Year: I Semester: II</b>	<b>Credit Unit: 4</b>	<b>Theoretical: 1HOUR/WEEK</b>
	<b>PRE-REQUISITE: MARINE WORKSHOP PRACTICE I</b>	<b>Practical: 3HOURS/WEEK</b>
<p><b>GOAL: This course is designed to equip the students with operational competence in engineering measurement and workshop practice, including accurate use of measuring instruments, interpretation of tolerances and fits, alignment techniques, and application of workshop skills for maintenance and repairs, enabling them to carry out shipboard fabrication, inspection, and maintenance tasks safely and accurately, in accordance with STCW Code, Section A-III/1.</b></p>		
<p><b>GENERAL OBJECTIVES:</b> On completion of this Course the Students should be able to:</p> <ol style="list-style-type: none"> <li>1.0 Understand Safety Precautions, Engineering Measurement, and Measuring Instruments;</li> <li>2.0 Know Tolerances, Fits and Dimensional Control;</li> <li>3.0 Know Alignment, Inspection and Workshop Maintenance Techniques;</li> <li>4.0 Understand Application to Shipboard Maintenance and Repairs;</li> <li>5.0 Understand the Importance of Cutting Fluid Machining Operation;</li> <li>6.0 Understand the Features, Functions and uses of Shaping Machines;</li> <li>7.0 Understand the Features, Functions and uses of Milling Machines.</li> </ol>		
<p><b>COMPETENCES:</b></p> <ul style="list-style-type: none"> <li>• Appropriate use of hand tools, machine tools and measuring instruments for fabrication and repairs on board</li> </ul>		

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>						
<b>COURSE TITLE: MARINE WORKSHOP PRACTICE II</b>			<b>Course Code: MAR 123</b>		<b>Contact Hours: 4hours/Week</b>	
<b>Year: I Semester: II</b>		<b>Credit Unit: 4</b>			<b>Theoretical: 1 Hour/Week</b>	
<b>PRE-REQUISITE: MARINE WORKSHOP PRACTICE I</b>					<b>Practical: 3 Hours/Week</b>	
<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>General Objective 1.0: Understand Safety Precautions, Engineering Measurement and Measuring Instruments.</b>						
<b>Week</b>	<b>Specific Learning Outcomes</b>	<b>Teacher's Activities</b>	<b>Resources</b>	<b>Specific Learning Outcomes</b>	<b>Teacher's Activities</b>	<b>Resources</b>
<b>1</b>	1.1 State safety precautions 1.2 Explain protective wears 1.3 List all safety rules and regulations. 1.4 Explain the importance of accurate measurement in Marine Engineering. 1.5 Identify common engineering measuring instruments. 1.6 Explain principles of linear and angular measurement. 1.7 Select appropriate instruments for given engineering tasks.	<ul style="list-style-type: none"> <li>• Lecture 1.1-1.7</li> <li>• Explain all safety precautions in the workshop.</li> <li>• List all protective wears in the workshop.</li> <li>• Discuss safety rules in the workshop</li> <li>• Instrument demonstrations</li> </ul>	<ul style="list-style-type: none"> <li>• Vernier calipers, micrometers, steel rules, white board, markers, multimedia, PowerPoint slides, textbooks, Boiler suits, overalls, aprons safety goggles, safety boots/shoes, safety hand gloves, fire extinguishers, nose masks, ear muffs, hard hats, non-slip mats, safety posters, Water hose Sand buckets, Recommended textbooks, Makers, Dusters, White and magnetic board, Projectors</li> </ul>	1.1 Observe all safety precautions rules and regulation. 1.2 Operate safety equipment e.g. fire extinguishers, safety water hose etc. 1.3 Identify all personal protective equipment 1.4 Use basic measuring instruments correctly. 1.5 Record measurements accurately.	<ul style="list-style-type: none"> <li>• Supervise measurement practice</li> <li>• Demonstrate awareness of measurement errors and precautions.</li> </ul>	<ul style="list-style-type: none"> <li>• Vernier calipers, micrometers, steel rules, calibration instruments, etc.</li> </ul>

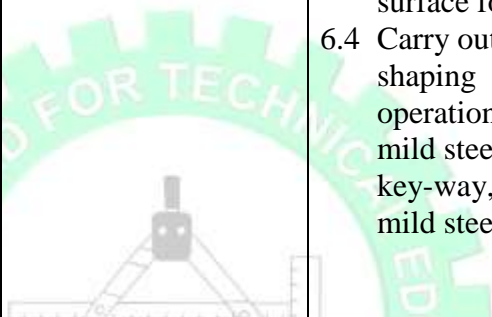
<b>General Objective 2.0: Know Tolerances, Fits and Dimensional Control</b>						
<b>2-3</b>	2.1 Explain the concept of tolerances and limits. 2.2 Distinguish between different types of fits. 2.3 Interpret tolerances on engineering drawings. 2.4 Apply tolerance concepts to marine components.	<ul style="list-style-type: none"> <li>Lecture 2.1-2.4</li> <li>Solve some examples</li> </ul>	<ul style="list-style-type: none"> <li>Drawing samples, fit charts, white board, markers, multimedia, PowerPoint slides, textbooks, etc.</li> </ul>	2.1 Measure components and check tolerances. 2.2 Identify correct fits for applications.	<ul style="list-style-type: none"> <li>Measurement and fitting exercises</li> <li>Demonstrate awareness of dimensional control importance.</li> </ul>	<ul style="list-style-type: none"> <li>Practical Manuals, Students' logbooks, Engineering Drawings, etc.</li> </ul>
<b>General Objective 3.0: Know Alignment, Inspection and Workshop Maintenance Techniques</b>						
<b>4-5</b>	3.1 Explain principles of shaft and machinery alignment. 3.2 Identify common misalignment conditions. 3.3 Apply basic inspection techniques to machinery components. 3.4 Explain consequences of poor alignment and measurement errors.	<ul style="list-style-type: none"> <li>Lecture 3.1-3.4</li> <li>Case discussions</li> </ul>	<ul style="list-style-type: none"> <li>Alignment diagrams, inspection tools, white board, markers, multimedia, PowerPoint slides, textbooks, etc.</li> </ul>	3.1 Perform basic alignment checks. 3.2 Identify misalignment from given scenarios. 3.3 Perform shaft alignment and coupling installation to specified tolerances. 3.4 Fit bearings and seals and inspect installations for correct clearance. 3.5 Use precision measuring tools	<ul style="list-style-type: none"> <li>Supervise alignment practice</li> <li>Demonstrate awareness of safety during maintenance tasks.</li> </ul>	<ul style="list-style-type: none"> <li>Dial gauge, spirit level, etc.</li> </ul>

				to verify component dimensions.		
<b>General Objective 4.0: Understand Shipboard Maintenance and Repairs</b>						
6-7	<p>4.1 Explain the importance of measurement and workshop skills to shipboard maintenance tasks.</p> <p>4.2 Discuss how to carryout simple fabrication and repair tasks.</p> <p>4.3 Discuss measuring instruments during inspection and reassembly.</p> <p>4.4 Discus preparation towards readiness for shipboard maintenance duties.</p>	<ul style="list-style-type: none"> <li>• Case-based lectures on 4.1-4.4</li> <li>• Revision sessions</li> </ul>	<ul style="list-style-type: none"> <li>• Workshop job cards, white board, markers, multimedia, PowerPoint slides, textbooks</li> </ul> 	<p>4.1 Complete maintenance tasks to specifications.</p> <p>4.2 Carryout simple fabrication tasks.</p> <p>4.3 Use measuring instruments during maintenance and inspection activities.</p>	<ul style="list-style-type: none"> <li>• Practical workshop tasks</li> <li>• Demonstrate correct workshop discipline and safety.</li> </ul>	<ul style="list-style-type: none"> <li>• Measuring tools, fabrication workshop, etc.</li> </ul>
<b>General Objective 5.0: Understand the Importance of Cutting Fluid Machining Operations.</b>						
8-9	<p>5.1 Describe main types of lathes (such as capstan, turret, centre and bench lathes) and their accessories.</p> <p>5.2 Describe the different operations that could be carried out on the lathe.</p> <p>5.3 List the safety</p>	<ul style="list-style-type: none"> <li>• Ask students to sketch any type of lathe.</li> <li>• Explain activities 5.1 to 5.4 and assess the students •</li> <li>• Explain activities 5.1 to 5.4 and assesses the students.</li> <li>• Explain the processes in 5.5</li> </ul>	<ul style="list-style-type: none"> <li>• White and magnetic board, Projectors, Lecture note, Chalkboard, recommended textbooks, etc.</li> </ul>	<p>5.1 Perform the following operations using centre lathe:</p> <ol style="list-style-type: none"> <li>Facing</li> <li>Cylindrical</li> <li>Turning</li> <li>Step turning</li> <li>Tapper turning</li> <li>Drilling</li> </ol>	<ul style="list-style-type: none"> <li>• Illustrate and ask the students to identify the main lather types, and turn tapers on mild steel bars using attachments and taking safety precautions during</li> </ul>	

	<p>precautions necessary while working on the lathe.</p> <p>5.4 List methods of carrying out various operations e.g. taper turning, set screw cutting.</p> <p>5.5 Describe the use of centre lathe for the following operations:</p> <ol style="list-style-type: none"> <li>i. Facing operation;</li> <li>ii. Cylindrical turning;</li> <li>iii. Step turning;</li> <li>iv. Taper turning;</li> <li>v. Drilling;</li> <li>vi. Boring;</li> <li>vii. Parting;</li> <li>viii. Knurling;</li> <li>ix. Reaming;</li> <li>x. Thread cutting.</li> </ol>	<p>make notes and assesses the students</p> <ul style="list-style-type: none"> <li>• Mild steel bars, lather machine, assorted cutting tools and fluids</li> </ul>		<ol style="list-style-type: none"> <li>vii. Boring</li> <li>iii. Parting</li> <li>ix. Knurling</li> <li>x. Reaming</li> </ol> <p>5.2 Carry out thread cutting operations on the lathe.</p> <p>5.3 Identify types of lathe machine and its attachment for various operations</p>	<p>machining operations</p>	
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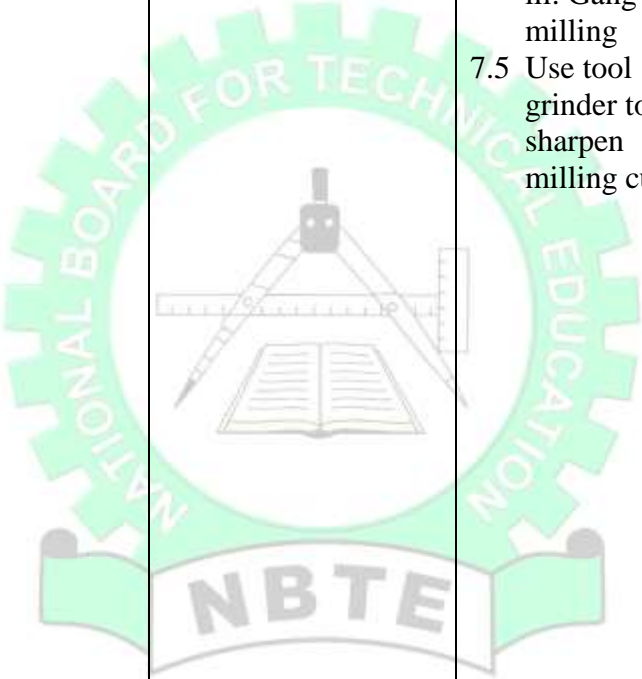
**General Objective 6.0: Understand the Features, Functions and uses of Shaping Machines.**

<p><b>10-11</b></p>	<p>6.1 Describe the main features of shaping machines</p> <p>6.2 Describe how to adjust the length and position of the stroke of the shaping machine.</p> <p>6.3 Explain how to set</p>	<ul style="list-style-type: none"> <li>• Ask students to list the features of shaping machines.</li> <li>• Ask students to carry out the adjustment of length and position of the stroke of a</li> </ul>	<ul style="list-style-type: none"> <li>• White and magnetic board, Projectors, Lecture note, Chalkboard, recommended textbooks, etc.</li> </ul>	<p>6.1 Carry out the adjustment of length and position of the stroke of a shaping machine.</p> <p>6.2 Set up workpiece on</p>	<ul style="list-style-type: none"> <li>• Illustrate and ask the cadet/students to demonstrate activities 6.1 to 6.4.</li> </ul>	
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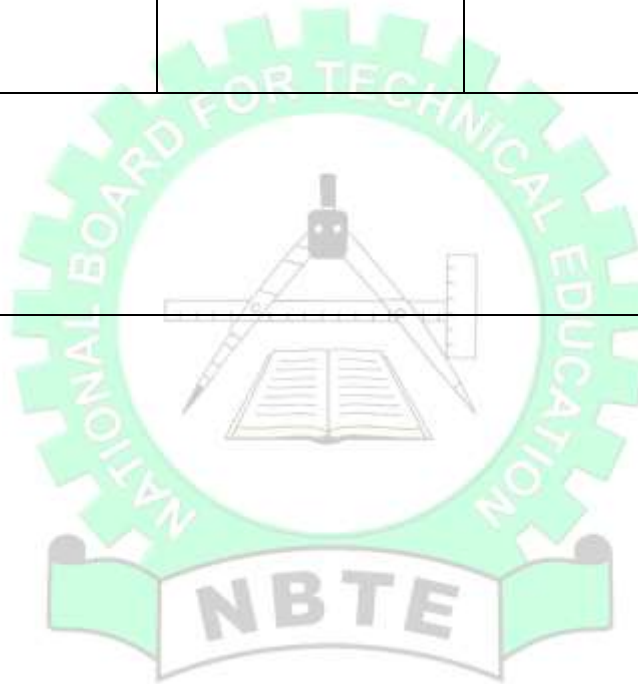
	<p>the clapper box for a given operation.</p> <p>6.4 List the advantages of a swan-necked tool on a shaping machines.</p> <p>6.5 Describe the methods of setting up workpiece on shaping machine.</p> <p>6.6 List the precautions to be observed while using shaping machines.</p>	<p>shaping machine</p> <ul style="list-style-type: none"> <li>• Explain activities 6.1 to 6.6, make notes and assesses the students</li> <li>• Assess the students/students Shaping machine, assorted tools, and accessories</li> <li>• Identify the features functions and uses of shaping machines.</li> </ul>		<p>shaping machine.</p> <p>6.3 Use appropriate shaping tools and holding devices for different surface forms.</p> <p>6.4 Carry out shaping operations on mild steel e.g. key-way, slots mild steel.</p>		
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**General Objective 7.0: Understand the Features, Functions and uses of Milling Machines**

12-15	<p>7.1 Describe the main features of milling machines.</p> <p>7.2 Describe how to mount cutters on the milling machine.</p> <p>7.3 Describe the various work pieces, cutter holding devices, and attachments used on the milling machine</p> <p>7.4 State the uses of different types of milling cutters,</p>	<ul style="list-style-type: none"> <li>• Explain the activities in 7.1 to 7.13, make notes and assess the students/students</li> <li>• Identify features and types of milling machines</li> <li>• Ask students/students to explain feed and cutting speed.</li> <li>• Ask students to explain relationship between feed and cutting speed.</li> </ul>	<ul style="list-style-type: none"> <li>• White and magnetic board, Projectors, Lecture note, Chalkboard, recommended textbooks</li> </ul>	<p>7.1 Mount different types of cutters for appropriate jobs.</p> <p>7.2 Use various types of work and cutter holding devices for different types of jobs.</p> <p>7.3 Perform milling exercises using the dividing head and index</p>	<ul style="list-style-type: none"> <li>• Illustrate the activities from 7.1 to 7.6 and ask the students to perform the activities. Assess the students</li> </ul>	
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	<p>e.g. arbor cutters - plain cutters, shank cutters - and mills, T-slot side and mill cutters etc.</p> <p>7.5 Describe the features and working principle of the dividing head.</p> <p>7.6 Explain various methods of indexing e.g. direct, simple, differential, angular indexing.</p> <p>7.7 Explain feed and cutting speed as applied to milling operations.</p> <p>7.8 State factors which influence cutting speed determination for milling work, e.g. material to be cut, use of coolant, type of finish etc.</p> <p>7.9 Determine cutting speeds and feeds for a given milling work.</p> <p>7.10 Outline the safety and operational</p>	<ul style="list-style-type: none"> <li>• Milling machine, Assorted cutters including arbor, Plain shank, etc. Dividing Head, Brass, and Mild steel, High carbon steel.</li> </ul>		<p>plate.</p> <p>7.4 Carry out milling using the following methods:</p> <ol style="list-style-type: none"> <li>Up milling</li> <li>Down milling</li> <li>Gang milling</li> </ol> <p>7.5 Use tool grinder to sharpen milling cutters.</p>		
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	precautions to be observed when milling. 7.11 Describe up and down milling. 7.12 Describe straddle and gang milling. 7.13 Describe the various features of the tool and cutter grinder.					
<b>Course Assessment:</b> Course work: 10% Test/Assignments: 10% Practical: 40% Examination: 40% <b>Total: 100%</b>						



<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: MARINE POLLUTION PREVENTION AND ENVIRONMENTAL PROTECTION</b>	<b>Course Code: MAR 124</b>	<b>Contact Hours: 2hours/week</b>
<b>Year: I Semester: II</b>	<b>Credit Unit: 2</b>	<b>Theoretical: 2hours/week</b>
	<b>Pre-requisite:</b>	<b>Practical: 0</b>
<b>GOAL: This course is designed to equip the students with knowledge of pollution prevention measures relevant to engine-room operations for the protection of the environment in compliance with international environmental regulations, in line with STCW Code, Section A-III/1.</b>		
<b>GENERAL OBJECTIVES:</b>		
On completion of this course, the student will be able to:		
<ol style="list-style-type: none"> <li>1.0 Understand Marine Pollution and Regulatory Framework;</li> <li>2.0 Know Engine-Room Pollution Sources and Prevention Systems;</li> <li>3.0 Know Environmental Compliance and Operational Responsibilities;</li> <li>4.0 Know Pollution Response, Best Practices and Operational Readiness;</li> <li>5.0 Know other sources of Marine Pollution, their Effects and prevention;</li> <li>6.0 Know the regulations relating to Marine Pollution Prevention;</li> <li>7.0 Understand basic Knowledge of Air Pollution Menace and Mitigating Methods.</li> </ol>		
<b>COMPETENCES:</b>		
<ul style="list-style-type: none"> <li>• Comply with pollution prevention requirements and international environmental regulations.</li> </ul>		

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>						
<b>Course Title : MARINE POLLUTION PREVENTION AND ENVIRONMENTAL PROTECTION</b>			<b>Course Code: MAR 124</b>	<b>Contact Hours: 2hours/week</b>		
			<b>Credit Unit: 2</b>	<b>Theoretical: 2hours/week</b>		
<b>Year: I Semester: II</b>			<b>Pre-requisite: -</b>	<b>Practical: 0</b>		
<b>COURSE SPECIFICATION:</b>						
<b>General Objective 1.0: Understand Marine Pollution and Regulatory Framework</b>						
<b>THEORETICAL CONTENT</b>			<b>PRACTICAL CONTENT</b>			
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher’s Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher’s Activities</b>	<b>Resources</b>
<b>1-2</b>	1.1 Explain the concept and importance of marine environmental protection. 1.2 Identify major sources of marine pollution from engine-room operations. 1.3 Describe the impact of pollution on the marine environment. 1.4 Identify key international regulations governing marine pollution. 1.5 Explain marine engineers’ environmental responsibilities on-board.	<ul style="list-style-type: none"> <li>• Discuss different definitions of marine pollution</li> <li>• List various pollutants and their sources</li> <li>• Differentiate between pollutant and pollution.</li> <li>• Enumerate impact of pollution on marine environment.</li> <li>• Discuss key international regulations governing marine environment.</li> <li>• Discuss engineers’ environmental responsibilities onboard</li> <li>• Discuss different marine pollution definitions.</li> <li>• List various pollutants and their sources.</li> </ul>	<ul style="list-style-type: none"> <li>• White board, markers, projectors, films video, internet, sources, textbooks, etc.</li> </ul>			

		<ul style="list-style-type: none"> <li>• Differentiate between pollutant and pollution.</li> <li>• Show videos of pollution incidents at sea and offshore.</li> </ul>				
<b>General Objective 2.0: Know Engine-Room Pollution Sources and Prevention Systems.</b>						
3-4	<p>2.1 Identify oil, sewage, garbage, and air-emission pollution sources in the engine room.</p> <p>2.2 Explain operation of basic pollution-prevention equipment.</p> <p>2.3 Describe correct handling of oily residues and wastes.</p> <p>2.4 Apply pollution-prevention procedures during routine operations.</p> <p>2.5 Explain the consequences of non-compliance.</p>	<ul style="list-style-type: none"> <li>• Give an overview of types, sources and effects of marine pollutants</li> <li>• Discuss briefly the pollution caused by burning fossil fuels, ships accidents, ships discharges and emission of cargo vapours.</li> <li>• Discuss oil-water separator, incinerator, ODMCS, oil filtering equipment in handling of oil pollution.</li> <li>• Explain the consequences of non-compliance.</li> </ul>	<ul style="list-style-type: none"> <li>• Textbooks, marine habitants and environmental issues.</li> <li>• IMO Regulations: MARPOL 73/78, SOLAS 1974, ISM Code and UNCLOS 82.</li> </ul>			
<b>General Objective 3.0: Know Environmental Compliance and Operational Responsibilities.</b>						
5-6	<p>3.1 Explain engineers' responsibilities for environmental compliance.</p> <p>3.2 Discuss basic environmental records and documentation.</p> <p>3.3 Describe correct procedures used during</p>	<ul style="list-style-type: none"> <li>• Discuss engineers' responsibilities for environmental compliance.</li> <li>• Explain correct procedures during inspections and audits.</li> <li>• Apply ethical and professional</li> </ul>	<ul style="list-style-type: none"> <li>• Whiteboard, flip charts, projectors and slides</li> </ul>			

	<p>inspections and audits.</p> <p>3.4 Discuss compliance during normal and emergency operations.</p> <p>3.5 Describe ethical and professional environmental conduct.</p>	<p>environmental conduct.</p> <ul style="list-style-type: none"> <li>• Explain the various devastating effects of marine pollution.</li> </ul>				
<b>General Objective 4.0: Know Pollution Response, Best Practices and Operational Readiness</b>						
<b>7-9</b>	<p>4.1 Discuss appropriate responses to pollution incidents.</p> <p>4.2 Discuss shipboard pollution-prevention best practices.</p> <p>4.3 Describe corrective actions related to pollution events.</p> <p>4.4 Explain the procedures for intervention in cases of environmental pollution.</p> <p>4.5 Explain the importance of engine-room readiness to perform environmental protection duties.</p> <p>4.6 Discuss the need to promote a culture of environmental responsibility onboard.</p> <p>4.7 Explain how industrial revolution contributed</p>	<p>environmental conduct.</p> <ul style="list-style-type: none"> <li>• Discuss pollution sources by oil tankers accidents, groundings etc.</li> <li>• Explain how oil pollution at sea affects economic activities at shorelines, aquaculture, human health and recreational activities.</li> <li>• Explain how oil spills can be controlled by international and Nation regulations, contingency planning</li> <li>• Explain the clean-up methods of oil spills or major oil pollution, by burning, separations dispersant, mop-ups etc.</li> <li>• Discuss the use of oil water monitoring and control equipment to discharge large water contaminated with small oil.</li> <li>• List tankers that are involved in major oil</li> </ul>	<ul style="list-style-type: none"> <li>• Whiteboard, flip charts, projectors and slides, etc.</li> </ul>	<p>4.1 Perform alarm response identification and immediate actions by simulating the following scenarios:</p> <ol style="list-style-type: none"> <li>Bilge high-level alarm;</li> <li>Oil Monitoring Discharge and control system (ODME);</li> <li>Oil Tank High-High Level alarm;</li> <li>Cargo Tank High-Level alarm;</li> <li>Cargo Pump Room Leakage alarm;</li> <li>Seawage Holding Tank High-Level alarm;</li> <li>Sewage</li> </ol>		

	<p>to environmental pollution.</p> <p>4.8 State the effects of marine pollution on marine and shore habitats or ecosystem</p> <p>4.9 Discuss the problems of oil spills from ships</p> <p>4.10 Describe the various oil pollution control methods.</p> <p>4.11 List the precautions to be observed before, during and after bunkering.</p> <p>4.12 Explain the use of oil-water separator, monitoring, and control equipment to prevent oil pollution by overboard discharges.</p>	<p>spills in the World</p> <ul style="list-style-type: none"> <li>• Explain the devastating effect of oil pollution in the Niger Delta shores</li> </ul>		<p>Treatment Plant Failure Alarm.</p>		
<b>General Objective 5.0: Know other sources of Marine Pollution, their effects and prevention</b>						
10-12	<p>5.1 Explain the sources, effects and prevention methods of pollution by garbage at sea.</p> <p>5.2 Discuss the sources, effects and prevention methods, of pollution by chemical waste and chemical/liquefied gases in bulk at sea.</p> <p>5.3 State the sources, effects and prevention</p>	<ul style="list-style-type: none"> <li>• Explain the devastating effect of plastic dumping at sea.</li> <li>• Explain the control measures and the use of record books, reception facilities, placards, garbage management planning and incinerators.</li> <li>• Discuss the problems of coliform and the</li> </ul>	<ul style="list-style-type: none"> <li>• Whiteboard, flip charts, projectors and slides.</li> <li>• MARPOL Annexes overview, oil record book entries, oily water separator operation records,</li> </ul>	<p>5.1 Simulate oil spill response and correct completion of an Oil Record Book entry.</p>	<ul style="list-style-type: none"> <li>• Perform simulation drills with different oil spillage scenarios.</li> </ul>	<ul style="list-style-type: none"> <li>• MARPOL Annexes overview, oil record book entries, oily water separator operation records, garbage manageme</li> </ul>

	<p>methods of pollution by untreated sewage at sea.</p> <p>5.4 Discuss the causes, effects and control methods of noise pollution.</p> <p>5.5 Explain Ballast water</p> <p>5.6 Discuss problems associated with, and control measures of ballast water carried by ships to foreign countries.</p> <p>5.7 Discuss other sources of pollution such as beach crapping of ships, dredging operations and dumping of wrecks.</p> <p>5.8 Explain MARPOL Annexes and apply shipboard procedures to prevent pollution.</p> <p>5.9 Operate basic oily water separator controls and complete an Oil Record Book entry.</p> <p>5.10 Demonstrate an emergency pollution response drill.</p>	<p>Biological Oxygen demand associated with discharge of untreated sewage at sea</p> <ul style="list-style-type: none"> <li>• Explain the control methods of sewage menace by use of retention tanks, chemical treatment tank, and biological treatment tank and sludge incinerators.</li> <li>• Explain the menace caused by dumping of chemical waste at sea or shorelines.</li> <li>• Discuss the control measures of chemical waste dumping.</li> <li>• Explain the meaning of noise.</li> <li>• State various health hazards of exposure to noise and discuss methods of control.</li> <li>• Define ballast water</li> <li>• State the problems of invasive species</li> <li>• Discuss ballast water management models.</li> <li>• Explain the problem associated with beach scrapping of ships, dredging operation and dumping of wrecks.</li> </ul>	<p>garbage management records, pollution incident reports, etc.</p>			<p>nt records, pollution incident reports.</p>
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**GENERAL OBJECTIVE 6.0: Know the regulations relating to Marine Pollution Prevention**

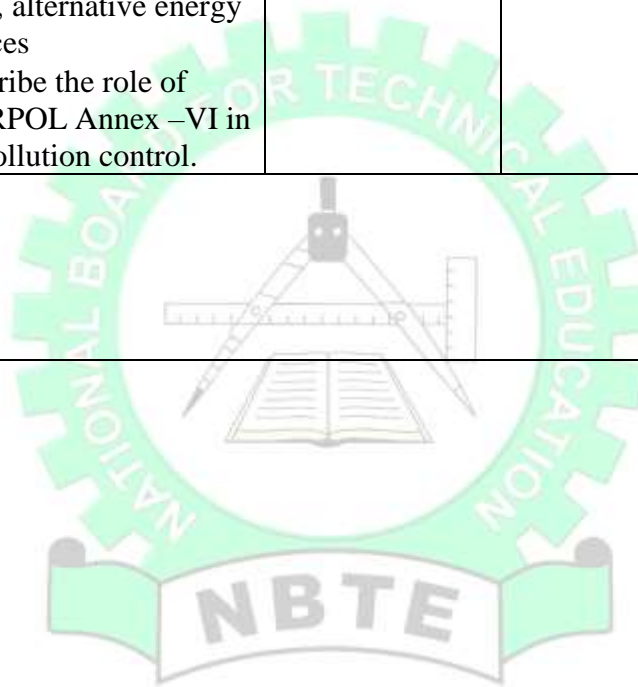
13	<p>6.1 List the international conventions on marine pollution prevention</p> <p>6.2 Discuss the national regulations relating to marine pollution prevention.</p> <p>6.3 Explain the importance of applying local, national and international conventions to protect the marine environment.</p>	<ul style="list-style-type: none"> <li>• Explain the purpose of the national and international regulations as they relate to pollution control such as MARPOL 73/78, SOLAS 74, ISM code, UNCLOS82, MARPOL Annexes I-IV, oil in Navigable water Act, OPRC and others.</li> <li>• Discuss Nigerian Regulations such as Merchant Shipping (Marine Environment) Regulations 2012</li> </ul>	<ul style="list-style-type: none"> <li>• Whiteboard, flip charts, projectors and slides, etc.</li> </ul>			
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**GENERAL OBJECTIVE 7.0: Understand basic Knowledge of Air Pollution Menace and Mitigating Methods.**

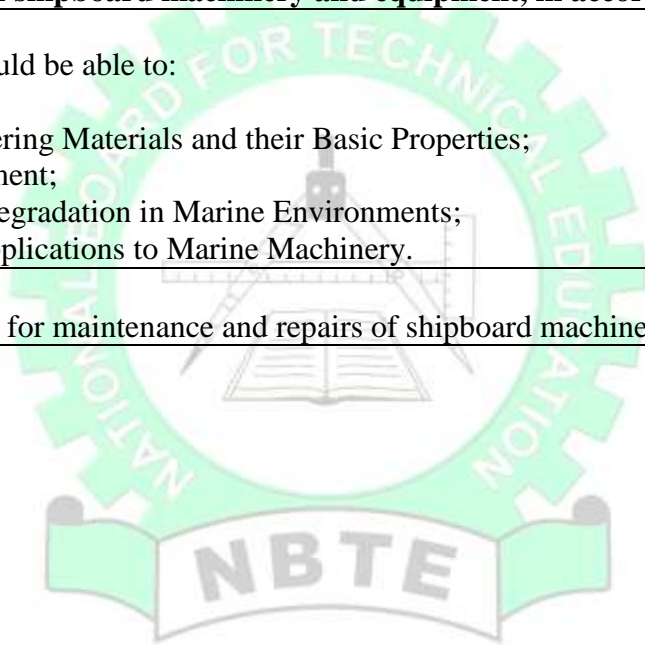
14-15	<p>7.1 List various air pollutants and their sources to the atmosphere.</p> <p>7.2 Identify main pollutants by engine combustion and their effects</p> <p>7.3 Describe methods of controlling engine exhaust emission gases, cargo oil gasses and ozone depleting emissions.</p> <p>7.4 State how International</p>	<ul style="list-style-type: none"> <li>• Identify the atmospheric pollutants and their source such as exhaust gas emission, cargo gasses, ozone depleting emissions from equipment etc.</li> <li>• Explain the devastating effects of these pollutants to the atmosphere such as greenhouse gas effects, global warning, acid rain smog, ozone formation</li> </ul>	<ul style="list-style-type: none"> <li>• Whiteboard, flip charts, projectors and slides</li> </ul>			
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	<p>Maritime Organization (IMO) regulations helped in controlling the atmospheric emissions (MARPOL Annex VI).</p>	<p>and depleting.</p> <ul style="list-style-type: none"><li>• Explain the control measure for these air pollutant including capture methods, energy savings, engine combustion systems innovation, alternative fuels, alternative energy sources</li><li>• Describe the role of MARPOL Annex –VI in air pollution control.</li></ul>				
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**Course Assessment:**  
Course work: 20%  
Test/Assignments: 20%  
Examination: 60%  
**Total: 100%**



<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: PROPERTIES OF ENGINEERING MATERIALS</b>	<b>Course Code: MAR 125</b>	<b>Contact Hours: 3hours/week</b>
<b>Year: I Semester: II</b>	<b>Credit Unit: 3</b>	<b>Theoretical: 1hour/week</b>
	<b>Pre-requisite:</b>	<b>Practical: 2hours/week</b>
<b>GOAL: This course is designed to equip students with foundational knowledge of engineering materials used in marine environments, including metals, alloys, polymers, corrosion mechanisms, heat treatment, and material selection, enabling them to support maintenance, repairs, and safe operation of shipboard machinery and equipment, in accordance with STCW Code, Section A-III/1.</b>		
<b>GENERAL OBJECTIVES:</b>		
On completion of this course, the student should be able to:		
<ul style="list-style-type: none"> <li>1.0 Understand Classifications of Engineering Materials and their Basic Properties;</li> <li>2.0 Know Metals, Alloys and Heat Treatment;</li> <li>3.0 Understand Corrosion and Material Degradation in Marine Environments;</li> <li>4.0 Know Material Selection and their Applications to Marine Machinery.</li> </ul>		
<b>COMPETENCES:</b>		
<ul style="list-style-type: none"> <li>• Use appropriate engineering materials for maintenance and repairs of shipboard machinery and equipment.</li> </ul>		



<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>						
<b>Course Title: PROPERTIES OF ENGINEERING MATERIALS</b>			<b>Course Code: MAR 125</b>		<b>Contact Hours: 3hours/week</b>	
			<b>Credit Unit: 3</b>		<b>Theoretical: 1hour/week</b>	
<b>Year: I Semester: II</b>			<b>Pre-requisite:</b>		<b>Practical: 2hours/week</b>	
<b>COURSE SPECIFICATION:</b>						
<b>General Objective 1.0: Understand Classifications of Engineering Materials and their Basic Properties</b>						
<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher’s Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher’s Activities</b>	<b>Resources</b>
<b>1-3</b>	1.1 Enumerate engineering materials used in marine applications. 1.2 Identify common metals, alloys, and polymers. 1.3 Explain basic material properties (strength, hardness, ductility, etc.). 1.4 Differentiate material properties to engineering performance. 1.5 Describe common engineering materials and select appropriate materials for marine applications. 1.6 Explain basic material tests (hardness, simple tensile) and applications of their results.	<ul style="list-style-type: none"> <li>• Lectures 1.1-1.4</li> <li>• Guided discussions</li> </ul>	<ul style="list-style-type: none"> <li>• Material samples</li> <li>• Properties of material charts</li> <li>• PowerPoint slides, White board, smart board, multimedia.</li> </ul>	1.1 Identify common materials from samples. 1.2 Perform experiments to determine properties of materials for suitable engineering applications.	<ul style="list-style-type: none"> <li>• Material identification exercises</li> <li>• Demonstrate awareness of material limitations in marine service.</li> </ul>	<ul style="list-style-type: none"> <li>• Material samples, properties of material, charts, PowerPoint slides, White board, smart board, multimedia, Practical manual, etc.</li> </ul>
<b>General Objective 2.0: Know Metals, Alloys and Heat Treatment</b>						

<p><b>4-6</b></p>	<p>2.1 Describe ferrous and non-ferrous metals used on-board ships.</p> <p>2.2 Describe the production of iron through:</p> <ol style="list-style-type: none"> <li>i. the blast furnace</li> <li>ii. direct method</li> </ol> <p>2.3 Describe the following steel making processes:</p> <ol style="list-style-type: none"> <li>i. the Bessemer convert;</li> <li>ii. the open hearth furnace;</li> <li>iii. Basic Oxygen Furnace (Linz-Donawitz, LD) processes;</li> <li>iv. Kaldo converter;</li> <li>v. Spray steel making.</li> </ol> <p>2.4 Describe the various types of plain carbon steels, their properties, and limitations.</p> <p>2.5 Explain the basic properties and uses of common non-ferrous metals, tin, lead, nickel, titanium, magnesium, zinc, aluminium, and their alloys.</p> <p>2.6 State examples of application of metals</p> <p>2.7 Explain alloying and its effects on material</p>	<ul style="list-style-type: none"> <li>• Lectures 2.1 to 2.9</li> <li>• Diagram explanations</li> </ul>	<ul style="list-style-type: none"> <li>• Alloy charts</li> <li>• Heat treatment diagrams</li> <li>• PowerPoint slides, Smart boards, white board.</li> </ul>	<p>2.1 Identify heat-treated components.</p> <p>2.2 Demonstrate heat treatment process.</p> <p>2.3 Perform tests to produce composite materials.</p> <p>2.4 Perform melting and moulding of ferrous metals.</p> <p>2.5 Perform pattern casting of non-ferrous metals.</p>	<ul style="list-style-type: none"> <li>• Sample analysis discussions</li> <li>• Demonstrate awareness of heat-treated components in marine machinery.</li> </ul>	<ul style="list-style-type: none"> <li>• Heat treatment furnace, sample of alloy materials, Foundry workshop, etc.</li> </ul>
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	<p>properties.</p> <p>2.8 Explain basic heat treatment processes.</p> <p>2.9 Differentiate between heat treatment from strength and durability.</p>					
<b>General Objective 3.0: Understand Corrosion and Material Degradation in Marine Environment.</b>						
<b>7-9</b>	<p>3.1 Explain corrosion mechanisms affecting marine materials.</p> <p>3.2 Identify types of corrosion common on ships.</p> <p>3.3 Explain effects of corrosion on shipboard machinery, and marine structures – both static and rotating parts.</p> <p>3.4 Describe basic corrosion prevention methods.</p> <p>3.5 Explain corrosion mechanisms and its mitigation measures.</p>	<ul style="list-style-type: none"> <li>Lecture 3.1-3.4</li> <li>Case studies</li> <li>Recommend basic preventive measures.</li> </ul>	<ul style="list-style-type: none"> <li>Corrosion images</li> <li>Protective coating samples</li> <li>PowerPoint slides, Smart boards, white board.</li> </ul>	<p>3.1 Identify corrosion damage from examples.</p> <p>3.2 Measure corrosion rates of metals in different environmental conditions.</p> <p>3.3 Determine the effects of corrosion on balancing and vibration of machinery.</p>	<ul style="list-style-type: none"> <li>Scenario-based discussions</li> <li>Demonstrate awareness of inspection and maintenance needs</li> </ul>	<ul style="list-style-type: none"> <li>Corrosion images, protective coating samples, practical manual, etc.</li> </ul>
<b>General Objective 4.0: Know Material Selection and their Applications to Marine Machinery.</b>						
<b>10-12</b>	<p>4.1 List materials used for marine structures and shipboard machinery.</p> <p>4.2 Explain material properties, their applications to shipboard structures and marine machinery.</p> <p>4.3 Distinguish material choices based on</p>	<ul style="list-style-type: none"> <li>Case-based lectures 4.1-4.6</li> <li>Guided discussions</li> </ul>	<ul style="list-style-type: none"> <li>Machinery component examples</li> <li>Selection charts.</li> <li>White board/ smart board, textbooks,</li> </ul>	<p>4.1 Justify material selection for given applications.</p> <p>4.2 Identify unsuitable material choices.</p>	<ul style="list-style-type: none"> <li>Material selection exercises</li> <li>Demonstrate readiness for advanced maintenance and repair courses.</li> </ul>	

	operational conditions. 4.4 Describe maintenance decisions using knowledge of material properties. 4.5 Explain fatigue, creep, cracking, and deformations of engineering materials. 4.6 Identify material-related failure risks.		multimedia systems, PowerPoint slides, overhead projectors.			
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**General Objective 5.0: Comprehend the Properties and Application of Composite and Emerging Materials.**

<b>13-15</b>	5.1 Explain common plastic materials and their applications in shipboard structures and marine machinery. 5.2 State the properties of plastic materials. 5.3 Mention types of composite materials. 5.4 Describe composite materials and their applications to engineering tasks. 5.5 State emerging engineering materials and their applications onboard.	<ul style="list-style-type: none"> <li>• Case-based lectures 5.1-5.5</li> <li>• Guided discussions</li> </ul>	<ul style="list-style-type: none"> <li>• White board/ smart board, textbooks, multimedia systems, PowerPoint slides, overhead projectors.</li> </ul>	5.1 Identify composite materials used in shipboard structures and marine machinery. 5.2 Determine the mechanical properties of composite materials.		
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**Course Assessment:**

Course work: 10%  
 Test/Assignments: 10%  
 Practical: 40%  
 Examination: 40%  
**Total: 100%**

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: MARINE ELECTRO-TECHNOLOGY I</b>	<b>Course Code: MAR 126</b>	<b>Contact Hours: 4 Hours/Week</b>
<b>Year: I Semester: II</b>	<b>Credit Unit: 4</b>	<b>Theoretical: 2 Hours/Week</b>
	<b>PRE-REQUISITE: ELECTRICAL ENGINEERING SCIENCE (EEC 114)</b>	<b>Practical: 2 Hours/Week</b>
<b>GOAL: This course is designed to equip students with applied electrical competence for marine engineering, including DC and AC systems, generators, motors, shipboard distribution systems, and electrical safety, enabling them to operate, monitor, and support maintenance of marine electrical, electronic, and control systems in accordance with STCW, Code, Section A-III/1.</b>		
<p><b>GENERAL OBJECTIVES:</b>                      On completion of this course, the student will be able to:</p> <ol style="list-style-type: none"> <li>1.0 Understand the principles of DC electrical systems and their marine applications;</li> <li>2.0 Analyze AC electrical systems, generators, and motors used onboard ships;</li> <li>3.0 Apply Electrical Calculations to DC and AC Systems;</li> <li>4.0 Comprehend shipboard electrical distribution systems and protective devices;</li> <li>5.0 Apply electrical safety procedures in the marine environment;</li> <li>6.0 Demonstrate competence in basic faultfinding and maintenance awareness;</li> <li>7.0 Apply Electrical Calculations to DC and AC Systems;</li> <li>8.0 Relate electrical systems to shipboard machinery operation and STCW requirements.</li> </ol>		
<p><b>COMPETENCES:</b></p> <ul style="list-style-type: none"> <li>• Perform Operation and Maintenance of electrical, electronic and control systems</li> </ul>		

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>						
<b>COURSE TITLE: MARINE ELECTRO-TECHNOLOGY I</b>		<b>Course Code: MAR 126</b>		<b>Contact Hours: 2 Hours/Week</b>		
<b>Year: I Semester: II</b>		<b>Credit Unit: 4</b>		<b>Theoretical: 2 Hours/Week</b>		
		<b>PRE-REQUISITE:</b>		<b>Practical: 2 Hours/Week</b>		
		<b>Electrical Engineering Scien</b>				
<b>COURSE SPECIFICATION: Theoretical and Practical</b>						
<b>General Objective 1.0: Understand the principles of DC electrical systems and their marine applications.</b>						
<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>
<b>1 – 2</b>	1.1 Explain principles of DC electricity. 1.2 Enumerate DC power sources onboard ships. 1.3 Analyze simple DC circuits. 1.4 Explain DC applications in ship machinery.	<ul style="list-style-type: none"> <li>Lectures, worked examples, case studies of shipboard DC systems.</li> </ul>	<ul style="list-style-type: none"> <li>Circuit diagrams, training boards, IMO manuals.</li> <li>PowerPoint slides, Smart boards, white board,</li> </ul>	1.1 Identify DC power sources onboard ships. 1.2 Perform experiment to connect DC circuits. 1.3 Carryout safe measurements of DC voltage and current.	<ul style="list-style-type: none"> <li>Supervise laboratory exercises on DC circuits.</li> <li>Demonstrate awareness of DC hazards.</li> </ul>	<ul style="list-style-type: none"> <li>Multimeter, DC training kits, DC motors, practical manual, practical logbook, etc.</li> </ul>
<b>General Objective: 2.0: Analyse AC electrical systems, generators, and motors used onboard ships.</b>						
<b>3 – 4</b>	2.1 Explain AC principles. 2.2 Distinguish between single-phase and three-phase power system. 2.3 Explain operation of AC generators and motors. 2.4 Relate AC machines to marine applications.	<ul style="list-style-type: none"> <li>Lecture 2.1-2.4, diagram explanations, multimedia animations.</li> </ul>	<ul style="list-style-type: none"> <li>Generator, motor diagrams, ship electrical layouts, PowerPoint slides, Smart boards, white board, etc.</li> </ul>	2.1 Identify shipboard AC machines, and their basic operations. 2.2 Carryout safe measurements of AC voltage and current.	<ul style="list-style-type: none"> <li>Equipment identification, demonstration exercises.</li> <li>Demonstrate awareness of operational limits.</li> </ul>	<ul style="list-style-type: none"> <li>Shipboard generator, AC motor samples, lab kits/trainers, practical manual, practical logbook</li> </ul>
<b>General Objective 3.0: Apply Electrical Calculations to DC and AC Systems.</b>						

<p>5 – 6</p>	<p>3.1 Calculate current, voltage, and resistance in DC circuits using Ohm’s Law. 3.2 State the Kichoff’s Law. 3.3 Calculate unknown voltage, current in DC circuits using Kichoff’s Law. 3.4 State Thevenin’s and Norton’s theorems. 3.5 Apply Thevenin’s and Norton’s theorems to DC circuits. 3.6 Solve simple AC circuit problems (impedance, RMS values, power factor). 3.7 Perform efficiency calculations for DC/AC machines.</p>	<ul style="list-style-type: none"> <li>• Lectures with worked examples, derive equations, assign calculation tasks.</li> </ul>	<ul style="list-style-type: none"> <li>• Circuit diagrams, textbooks, projector, whiteboard, shipboard layouts/ schematics.</li> </ul>	<p>3.1 Perform DC circuit experiments to verify Ohm’s Law. 3.2 Measure AC voltage and current. 3.3 Compute impedance of AC circuits. 3.4 Determine efficiency of a small motor experimentally.</p>	<ul style="list-style-type: none"> <li>• Supervise laboratory exercises, demonstrate calculations, guide efficiency test.</li> </ul>	<ul style="list-style-type: none"> <li>• Multimeter, AC/DC training kits, lab motors, CRO, practical manuals.</li> </ul>
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**General Objective 4.0: Comprehend shipboard electrical distribution systems and protective devices**

<p>7 – 8</p>	<p>4.1 Explain shipboard distribution systems. 4.2 Enumerate types of shipboard switchboards, circuit breakers, and other protective devices. 4.3 Explain overload/ short-circuit protection. 4.4 Discuss fault-finding</p>	<ul style="list-style-type: none"> <li>• Lectures, case discussions, fault scenarios.</li> </ul>	<ul style="list-style-type: none"> <li>• Distribution diagrams/ schematics, protection device samples. Shipboard electrical panels, PowerPoint slides, Smart boards, white</li> </ul>	<p>4.1 Identify shipboard switchgears, circuit breakers, and other protective devices. 4.2 Demonstrate their response in different fault scenarios. 4.3 Perform switchboard wiring.</p>	<ul style="list-style-type: none"> <li>• Supervise diagram interpretation, scenario analysis.</li> <li>• Demonstrate understanding of power continuity.</li> </ul>	<ul style="list-style-type: none"> <li>• Switchboard layouts, transformers, protective relays, Distribution diagrams, protection device samples. Shipboard</li> </ul>
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	techniques in Electrical distribution systems.		board,			electrical panels, etc.
<b>General Objective 5.0: Apply electrical safety procedures in the marine environment</b>						
9 – 10	5.1 Identify electrical hazards onboard. 5.2 Outline correct safety procedures. 5.3 Explain the appropriate use of electrical PPEs. 5.4 Discuss appropriate response to electrical emergencies.	<ul style="list-style-type: none"> <li>• Safety lectures, incident case studies, role-play scenarios.</li> </ul>	<ul style="list-style-type: none"> <li>• Safety manuals, PPE samples, ISM Code references.</li> <li>• PowerPoint slides, Smart boards, white board, etc.</li> </ul>	5.1 Identify unsafe practices. 5.2 Demonstrate the correct use of electrical PPEs.	<ul style="list-style-type: none"> <li>• Safety-focused lab sessions, emergency drills.</li> <li>• Demonstrate safety-conscious behaviour.</li> </ul>	<ul style="list-style-type: none"> <li>• Electrical PPE kits, lock-out/tag-out devices.</li> </ul>
<b>General Objective 6.0: Demonstrate competence in basic fault-finding and maintenance awareness</b>						
11–12	6.1 Explain basic fault-finding principles. 6.2 Identify common faults in shipboard systems. 6.3 Explain reading and interpretation of more electrical diagrams 6.4 Discuss routine inspection, maintenance and reporting of electrical systems.	<ul style="list-style-type: none"> <li>• Lectures, case-based discussions.</li> </ul>	<ul style="list-style-type: none"> <li>• Fault scenarios, inspection checklists.</li> <li>• PowerPoint slides, Smart boards, white board,</li> </ul>	6.1 Identify faults and suggest corrective actions. 6.2 Perform circuit fault-finding. 6.3 Troubleshoot faulty safety devices.	<ul style="list-style-type: none"> <li>• Supervise fault-finding exercises.</li> </ul>	<ul style="list-style-type: none"> <li>• Fault simulation kits/trainers, shipboard diagrams.</li> </ul>
<b>General Objective 7.0: Perform Power and Fault Current Calculations in Shipboard Systems.</b>						
13-14	7.1 Explain ‘real’, ‘reactive’ and ‘apparent’ power. 7.2 Calculate apparent, real, and reactive	<ul style="list-style-type: none"> <li>• Lecture with diagrams, derive power triangle equations, assign numerical</li> </ul>	<ul style="list-style-type: none"> <li>• Shipboard power diagrams, textbooks, projector.</li> </ul>	7.1 Measure voltage and current. 7.2 Compute real, reactive and apparent power.	<ul style="list-style-type: none"> <li>• Demonstrate CRO readings, supervise fault simulation, guide alternator</li> </ul>	<ul style="list-style-type: none"> <li>• CRO, relay test kits, alternator trainer, shipboard simulator, lab</li> </ul>

	<p>power in shipboard AC systems (power triangle).</p> <p>7.3 Determine fault current using <math>I_{sc} = \frac{V}{Z}</math></p> <p>7.4 Apply load sharing calculations for alternators operating in parallel.</p>	<p>problems.</p>		<p>7.3 Simulate fault conditions and calculate fault current.</p> <p>7.4 Perform alternator load sharing calculations using trainer kits.</p>	<p>sharing exercise.</p>	<p>manuals, etc.</p>
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**General Objective 8.0: Relate electrical systems to shipboard machinery operation and STCW requirements.**

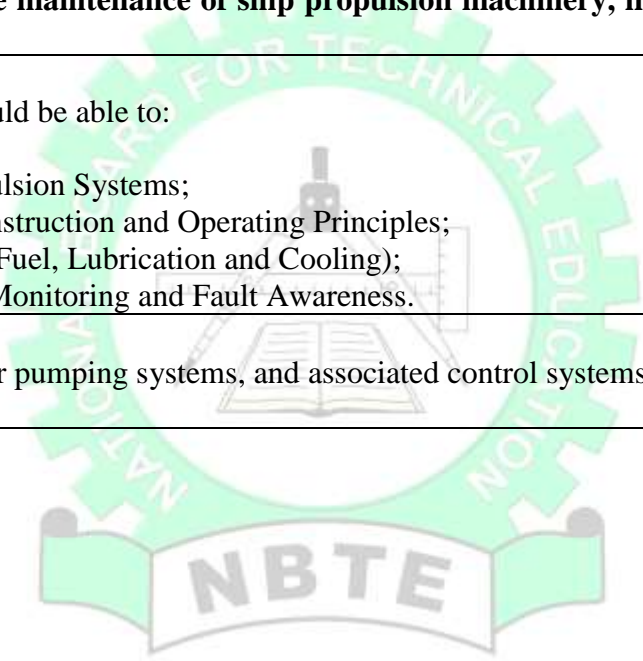
15	<p>8.1 Relate electrical systems to shipboard machinery operation.</p> <p>8.2 Discuss STCW compliance in electrical operations.</p> <p>8.3 Explain the applications of battery systems in shipboard machinery operations.</p>	<ul style="list-style-type: none"> <li>• Case-based lectures, STCW references.</li> </ul>	<ul style="list-style-type: none"> <li>• IMO/STCW manuals, marine system drawings.</li> <li>• PowerPoint slides, Smart boards, white board,</li> </ul>	<p>8.1 Demonstrate shipboard electrical systems operations.</p> <p>8.2 Perform practical wiring or rewiring tasks.</p>	<ul style="list-style-type: none"> <li>• Guide group discussions.</li> </ul>	<ul style="list-style-type: none"> <li>• CAD projector, shipboard diagrams.</li> </ul>
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**Course Assessment:**  
 Course work: 10%  
 Test/Assignments: 10%  
 Practical: 40%  
 Examination: 40%  
**Total: 100%**



**YEAR II SEMESTER I**

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: MARINE ENGINES AND PROPULSION SYSTEMS I</b>	<b>Course Code: MAR 211</b>	<b>Contact Hours: 4 hours/week</b>
<b>Year: II Semester: 1</b>	<b>Credit Unit: 4</b>	<b>Theoretical: 2hours/week</b>
	<b>Pre-requisite:</b>	<b>Practical: 2 hours/week</b>
<b>GOAL: This course is to equip students with operational-level competence in marine engines and propulsion systems, including construction, operating principles, auxiliary systems, propulsion arrangements, and basic fault awareness, enabling them to support the safe operation, monitoring, and routine maintenance of ship propulsion machinery, in accordance with STCW Code, Section A-III/1.</b>		
<b>GENERAL OBJECTIVES:</b> On completion of this course, the student should be able to:		
<ol style="list-style-type: none"> <li>1.0 Understand Marine Engines and Propulsion Systems;</li> <li>2.0 Understand Marine Diesel Engine Construction and Operating Principles;</li> <li>3.0 Understand Engine Support Systems (Fuel, Lubrication and Cooling);</li> <li>4.0 Know Propulsion System Operation, Monitoring and Fault Awareness.</li> </ol>		
<b>COMPETENCES:</b>		
<ul style="list-style-type: none"> <li>• Operate fuel, lubrication, ballast, and other pumping systems, and associated control systems.</li> </ul>		



<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>						
<b>Course Title: MARINE ENGINES AND PROPULSION SYSTEMS I</b>			<b>Course Code: MAR 211</b>	<b>Contact Hours: 4hours/week</b>		
			<b>Credit Unit: 4</b>	<b>Theoretical: 2hours/week</b>		
<b>Year: II Semester: I</b>			<b>Pre-requisite:</b>	<b>Practical: 2hours/week</b>		
<b>COURSE SPECIFICATION:</b>						
<b>General Objective 1.0: Understand Marine Engines and Propulsion Systems</b>						
<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>
<b>1-3</b>	1.1 Explain the role of propulsion systems in ship operations. 1.2 Discuss main types of marine engines used for propulsion. 1.3 Describe basic propulsion arrangements (direct drive, reduction gearing, etc.). 1.4 Explain the relationship between engine output and propeller action. 1.5 Explain propulsion flow paths.	<ul style="list-style-type: none"> <li>Lecture 1.1-1.4</li> <li>System overviews</li> </ul>	<ul style="list-style-type: none"> <li>Engine diagrams</li> <li>Propulsion layouts</li> <li>PowerPoint slides, Smart boards, white board</li> </ul>	1.1 Identify propulsion components from diagrams. 1.2 Identify main types of marine engines used for propulsion.	<ul style="list-style-type: none"> <li>Diagram-based discussions</li> <li>Demonstrate awareness of propulsion safety considerations.</li> </ul>	<ul style="list-style-type: none"> <li>Engine diagrams</li> <li>Propulsion layouts</li> </ul>
<b>General Objectives 2.0: Understand Marine Diesel Engine Construction and Operating Principles</b>						
<b>4-7</b>	2.1 Distinguish between four and two stroke cycles. 2.2 Discuss principles of operations of 2-stroke and 4-stroke engines. 2.3 Discuss scavenging and turbocharging. 2.4 Distinguish between a	<ul style="list-style-type: none"> <li>Students practice timing</li> <li>Calculations, ship visit, show video tapes</li> <li>Explain four and two stroke cycles.</li> </ul>	<ul style="list-style-type: none"> <li>Fully equipped fuel pump and injector maintenance room, video tapes.</li> <li>Visit engine</li> </ul>	2.1. Carry out coupling and decoupling of marine engines. 2.2. Carry out the timing of an Injection pump from first	<ul style="list-style-type: none"> <li>Demonstrate, explain and have Students practice timing and calculations, ship visit, show video</li> </ul>	<ul style="list-style-type: none"> <li>Turbocharger</li> </ul>

	<p>turbocharger and a scavenge blower.</p> <p>2.5 State the types and functions of turbochargers.</p> <p>2.6 Explain the constructional details and design considerations of Internal Combustion Engine (ICE).</p> <p>2.7 Identify the components and the operation of the following fuel Injection systems: fuel pump (jerk, common rail, electronic injection), fuel injectors.</p> <p>2.8 Describe the procedure of phasing and calibrating of an injector pump.</p> <p>2.9 Explain timing of an Injection pump from first principles.</p> <p>2.10 Explain engine starting and manoeuvring systems i.e. Engine starting manually, by battery, air or hydraulic manoeuvring systems.</p> <p>2.11 State safety devices in starting systems.</p> <p>2.12 Interpret indicator diagrams.</p> <p>2.13 Explain fault detection,</p>	<p>bay and show sample of various engine components e.g., camshaft value of a piston.</p> <ul style="list-style-type: none"> <li>• Visit dockyard and Autotronics laboratory.</li> <li>• Using multi point injection demonstrator system</li> <li>• Indicator chart required</li> </ul>	<p>principles.</p>	<p>tapes.</p>		
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	<p>power balancing and heat balance.</p> <p>2.14 Explain ignition delay period, after burning, turbulence, atomization and penetration.</p> <p>2.15 Describe the main components of marine diesel engines.</p> <p>2.16 Explain combustion process in diesel engines.</p> <p>2.17 Identify engine sub-systems supporting propulsion.</p>					
<b>General Objective 3.0: Understand Engine Support Systems (Fuel, Lubrication and Cooling)</b>						
<b>8-12</b>	<p>3.1 Explain fuel oil supply and treatment systems.</p> <p>3.2 List types of fuels approved for marine applications.</p> <p>3.3 Describe the influence of additives on fuel oil.</p> <p>3.4 Explain fuel oil purification methods.</p> <p>3.5 Calculate fuel consumption.</p> <p>3.6 Describe engine lubrication systems.</p> <p>3.7 State the measures directed at ensuring efficient lubrication.</p> <p>3.8 Discuss the modes of engine lubrication</p>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• System walkthroughs</li> </ul>	<ul style="list-style-type: none"> <li>• Piping diagrams</li> <li>• System schematics</li> <li>• PowerPoint slides, Smart boards, white board,</li> </ul>	<p>3.1 Trace system flow paths.</p> <p>3.2 Identify monitoring points.</p> <p>3.3 Sketch a line diagram of the fuel oil system</p>	<ul style="list-style-type: none"> <li>• Demonstrate awareness of routine monitoring parameters.</li> <li>• System tracing exercises</li> </ul>	<ul style="list-style-type: none"> <li>• Marine Engines repairs workshop.</li> <li>• Full mission engine simulator.</li> <li>• Piping diagrams.</li> <li>• System schematics.</li> </ul>

	<p>systems.</p> <p>3.9 Explain cooling system arrangements and purposes.</p> <p>3.10 Explain the cooling of pistons, cylinder heads and liners.</p> <p>3.11 Identify risks associated with system failures.</p>					
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**General Objective 4.0: Know Propulsion System Operation, Monitoring and Fault Awareness.**

<b>13-15</b>	<p>4.1 Explain safe operation of propulsion machinery.</p> <p>4.2 List the various components of transmission system</p> <p>4.3 Identify the functions of the components of the transmission system.</p> <p>4.4 Explain the air starting system</p> <p>4.5 Discuss the use of hydraulic in propulsion system.</p> <p>4.6 Describe Monitoring engine parameters during operation.</p> <p>4.7 Identify common engine faults and abnormalities.</p> <p>4.8 Explain basic corrective and reporting actions.</p>	<ul style="list-style-type: none"> <li>• Case-based lectures 4.1-4.7</li> <li>• Fault scenario discussions.</li> <li>• Explain appropriate response actions to faults.</li> </ul>	<ul style="list-style-type: none"> <li>• Fault charts</li> <li>• Monitoring logs</li> <li>• PowerPoint slides, Smart boards, white board,</li> </ul>	<p>4.1 Diagnose abnormal operating conditions.</p> <p>4.2 Sketch the air, and hydraulic starting system.</p>	<ul style="list-style-type: none"> <li>• Scenario-based discussions</li> <li>• Demonstrate readiness for advanced propulsion studies.</li> </ul>	<ul style="list-style-type: none"> <li>• Fault charts</li> <li>• Monitoring logs</li> </ul>
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**Course Assessment:**

Course work: 10%

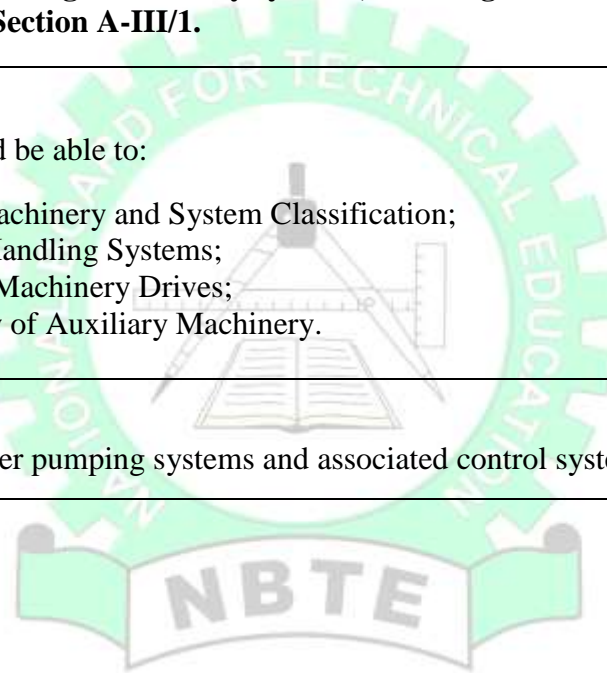
Test/Assignments: 10%

Practical: 40%

Examination: 40%

**Total: 100%**

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: MARINE AUXILIARY MACHINERY I</b>	<b>Course Code: MAR 212</b>	<b>Contact Hours: 4 hours/week</b>
<b>Year: II Semester: I</b>	<b>Credit Unit: 4</b>	<b>Theoretical: 2 hours/week</b>
	<b>Pre-requisite:</b>	<b>Practical: 2 hours/week</b>
<b>GOAL: This course is designed to equip students with competence in marine auxiliary machinery, including identification, operating principles, safety features, and routine monitoring of auxiliary systems, enabling them to support safe, efficient, and continuous ship operation, in accordance with STCW Code, Section A-III/1.</b>		
<b>GENERAL OBJECTIVES:</b>		
On completion of this course, the student should be able to:		
<ol style="list-style-type: none"> <li>1.0 Know the basics of Marine Auxiliary Machinery and System Classification;</li> <li>2.0 Know Compressors, Pumps and Fluid-Handling Systems;</li> <li>3.0 Know Boilers, Steering Gear and Deck Machinery Drives;</li> <li>4.0 Know Operation, Monitoring and Safety of Auxiliary Machinery.</li> </ol>		
<b>COMPETENCES:</b>		
<ul style="list-style-type: none"> <li>• Operate fuel, lubrication, ballast and other pumping systems and associated control systems</li> </ul>		



<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>						
<b>Course Title: MARINE AUXILIARY MACHINERY I</b>			<b>Course Code: MAR 212</b>		<b>Contact Hours: 4hours/week</b>	
			<b>Credit Unit: 4</b>		<b>Theoretical: 2hours/week</b>	
<b>Year: II Semester: I</b>			<b>Pre-requisite:</b>		<b>Practical: 2hours/week</b>	
<b>COURSE SPECIFICATION:</b>						
<b>General Objective 1.0: Know the basics of Marine Auxiliary Machinery and System Classification</b>						
<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>
<b>1-3</b>	1.1 Explain the role of auxiliary machinery in ship operations. 1.2 Itemize auxiliary machinery systems used on-board ships. 1.3 Identify major auxiliary systems supporting propulsion and hotel services. 1.4 Explain inter-relationship between auxiliary and main machinery. 1.5 Describe safety considerations associated with auxiliary systems.	<ul style="list-style-type: none"> <li>Lectures 1.1-1.5</li> <li>System overview discussions</li> </ul>	<ul style="list-style-type: none"> <li>PowerPoint slides, Smart boards, white board, etc.</li> </ul>	1.1 Identify auxiliary machinery from diagrams. 1.2 Relate auxiliary systems to ship functions.	<ul style="list-style-type: none"> <li>Diagram-based identification exercises</li> </ul>	<ul style="list-style-type: none"> <li>Machinery system charts</li> <li>Ship layout diagrams, practical manual, etc.</li> </ul>
<b>General Objective 2.0: Know Compressors, Pumps and Fluid-Handling Systems</b>						
<b>4-7</b>	2.1 Explain operating principles of air compressors. 2.2 State the applications of air compressors. 2.3 Explain safety measures	<ul style="list-style-type: none"> <li>Lectures</li> <li>Worked system explanations</li> </ul>	<ul style="list-style-type: none"> <li>PowerPoint slides, Smart boards, white board,</li> </ul>	2.1 Identify compressor and pump components. 2.2 Demonstrate basic operating sequences air	<ul style="list-style-type: none"> <li>Supervised system-tracing exercises</li> </ul>	<ul style="list-style-type: none"> <li>Pump and compressor diagrams</li> <li>Safety device illustration</li> </ul>

	<p>and fittings for air compressors and air starting system.</p> <p>2.4 Explain the construction and operational principles of pumps.</p> <p>2.5 Identify types of pumps used in marine applications.</p> <p>2.6 Describe auxiliary pumping systems (fuel, lubrication, ballast, etc.).</p> <p>2.7 Explain safety devices associated with compressors and pumps.</p> <p>2.8 Describe operating limits and common faults of auxiliary systems.</p>			<p>compressors, pumps, etc.</p>		
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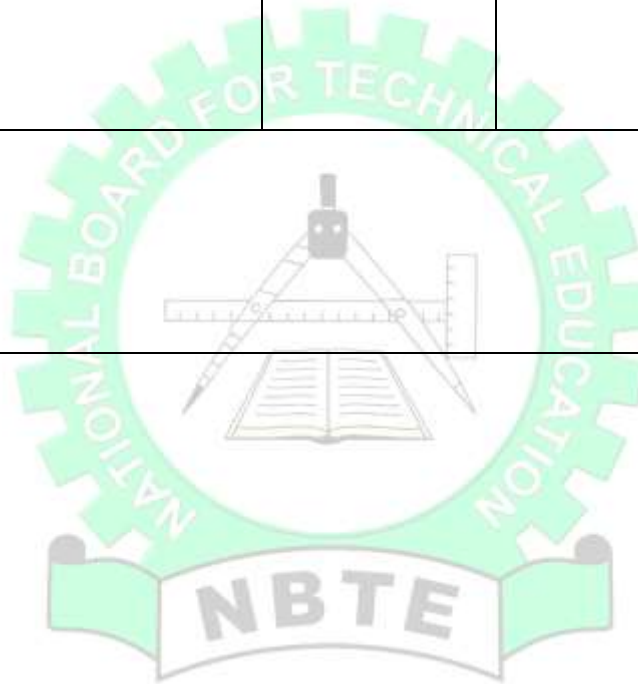
**General Objective 3.0: Know Boilers, Steering Gear and Deck Machinery**

<p><b>8-11</b></p>	<p>3.1 Explain the purpose of auxiliary boilers on ships.</p> <p>3.2 Identify basic boiler components and safety fittings.</p> <p>3.3 Describe steering gear systems and their importance.</p> <p>3.4 Explain basic deck machinery drives (winches, windlass, etc.).</p> <p>3.5 Explain safety features and emergency arrangements for deck machinery drives.</p>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Diagram explanations</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board,</li> </ul>	<p>3.1 Identify major components of auxiliary boilers and steering gear.</p> <p>3.2 Demonstrate safety precautions associated with basic deck machinery drivers.</p>	<ul style="list-style-type: none"> <li>• Equipment identification discussions</li> </ul>	<ul style="list-style-type: none"> <li>• Boiler schematics, steering gear layouts, etc.</li> </ul>
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**General Objective 4.0: Know Operation, Monitoring and Safety of Auxiliary Machinery**

<p><b>12-15</b></p>	<p>4.1 Explain routine operation of auxiliary machinery.                  4.2 Describe monitoring operating parameters and recognize abnormalities.                  4.3 Explain common auxiliary machinery faults.                  4.4 Explain basic corrective and reporting actions.                  4.5 List emerging trends in auxiliary machinery of ships</p>	<ul style="list-style-type: none"> <li>• Case-based discussions</li> <li>• Revision lectures</li> </ul>	<ul style="list-style-type: none"> <li>• Fault charts</li> <li>• Monitoring log examples</li> </ul>	<p>4.1 Identify common auxiliary machinery faults.                  4.2 Perform corrective actions on faulty auxiliary machinery.</p>	<ul style="list-style-type: none"> <li>• Scenario-based discussions</li> </ul>	<ul style="list-style-type: none"> <li>• Pumps, air compressors , boilers, practical manuals, toolboxes, spare parts, practical manual, etc.</li> </ul>
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**Course Assessment:**  
 Course work: 10%  
 Test/Assignments: 10%  
 Practical: 40%  
 Examination: 40%  
**Total: 100%**



<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: REFRIGERATION, AIR-CONDITIONING AND VENTILATION</b>	<b>Course code: MAR 213</b>	<b>Contact Hours: 3hours/week</b>
<b>Year: II Semester: I</b>	<b>Credit Units: 3</b>	<b>Theoretical: 1 hour/week</b>
	<b>Pre-requisite:</b>	<b>Practical: 2hours/week</b>
<p><b>GOAL: This course is designed to equip students with competence in marine refrigeration, air-conditioning, and ventilation systems, including operating principles, components, refrigerants, safety, and basic maintenance, enabling them to support safe operation of HVAC systems essential to machinery performance, cargo preservation, and shipboard habitability, in accordance with STCW Code, Section A-III/1.</b></p>		
<p><b>GENERAL OBJECTIVES:</b></p> <p>On completion of this course, the student should be able to:</p> <ol style="list-style-type: none"> <li>1.0 Know Principles of Refrigeration in Marine Applications;</li> <li>2.0 Know Refrigeration and Air-Conditioning System Components;</li> <li>3.0 Understand the properties of refrigerants;</li> <li>4.0 Comprehend methods of lubrication in refrigeration;</li> <li>5.0 Know the procedures for recharging refrigeration circuit On-board Ships;</li> <li>6.0 Know various applications of refrigeration;</li> <li>7.0 Understand functions of an air-conditioning system on-board a Ship;</li> <li>8.0 Know Ventilation Systems, Safety and Environmental Considerations;</li> <li>9.0 Understand Operation, Monitoring and Basic Maintenance of Heating, Ventilation, and Air Conditioning (HVAC) Systems.</li> </ol>		
<p><b>COMPETENCES:</b></p> <ul style="list-style-type: none"> <li>• Operate main and auxiliary machinery and associated control systems</li> </ul>		

**PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY**

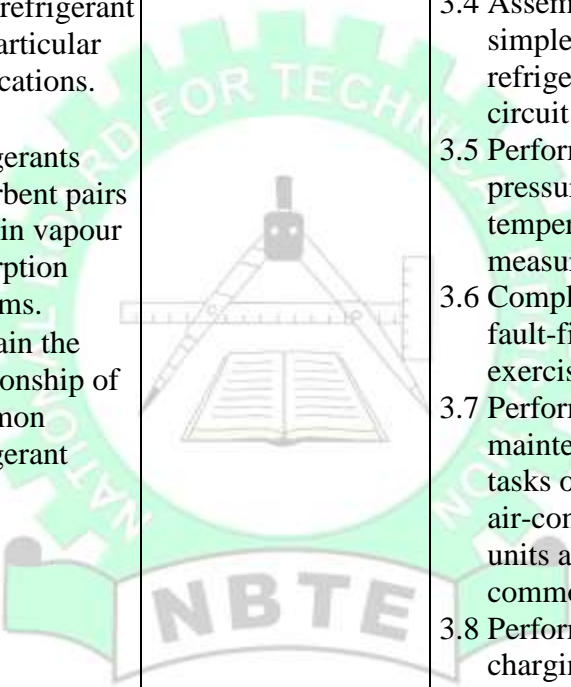
<b>Course Title: REFRIGERATION, AIR-CONDITIONING AND VENTILATION</b>	<b>Course Code: MAR 213</b>	<b>Contact Hours: 3hours/week</b>
	<b>Credit Unit: 3</b>	<b>Theoretical: 1hour/week</b>
<b>Year: II Semester: I</b>	<b>Pre-requisite:</b>	<b>Practical: 2 hours/week</b>

**COURSE SPECIFICATION:**

**General Objective 1.0: Know Principles of Refrigeration in Marine Applications**

THEORETICAL CONTENT			PRACTICAL CONTENT			
Week	Specific Learning Outcome	Teacher's Activities	Resources	Specific Learning Outcome	Teacher's Activities	Resources
1	1.1 Explain the purpose of refrigeration on board ships. 1.2 Describe basic refrigeration principles and terminology. 1.3 Explain the vapour-compression refrigeration cycle. 1.4 State general applications of refrigeration in marine operations. 1.5 Identify the equipment used in refrigeration workshop 1.6 Explain operational and safety considerations in marine refrigeration applications.	<ul style="list-style-type: none"> <li>Lectures</li> <li>Cycle diagram explanations</li> <li>Explain basic operation of refrigeration.</li> </ul>	<ul style="list-style-type: none"> <li>PowerPoint slides, Smart boards, white board, etc.</li> </ul>	1.1 Identify stages of the refrigeration cycle.	<ul style="list-style-type: none"> <li>Diagram interpretation exercises</li> </ul>	<ul style="list-style-type: none"> <li>Refrigeration cycle diagrams, Marine system schematics etc.</li> </ul>

<b>General Objective 2.0: Know Refrigeration and Air-Conditioning System Components</b>						
<b>2-3</b>	2.1 Identify major refrigeration and air-conditioning components. 2.2 Explain functions of compressors, condensers, evaporators, and expansion devices. 2.3 Identify common marine refrigerants. 2.4 Explain basic system controls and safety devices. 2.5 Describe component operating limits.	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Component walkthroughs</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board,</li> </ul>	2.1. Identify components from diagrams. 2.2. Explain component functions correctly.	<ul style="list-style-type: none"> <li>• System identification exercises</li> </ul>	<ul style="list-style-type: none"> <li>• Component diagrams, Refrigerant charts etc</li> </ul>
<b>General Objective 3.0: Understand the properties of refrigerants</b>						
<b>4-5</b>	3.1 Define refrigerant. 3.2 List common refrigerants. 3.3 Discuss different refrigerants: <ol style="list-style-type: none"> <li>i. Traditional/Older – mostly phased out (R12, R-22, R-502)</li> <li>ii. Common Refrigerants on most Ships (R-134a, R-407C, R-140, R-404A, R-507A, R-407F)</li> <li>iii. Natural Refrigerants (R717, R-744, R-290)</li> <li>iv. Modern Low-GWP/</li> </ol>	<ul style="list-style-type: none"> <li>• Define refrigerants</li> <li>• List common refrigerants</li> <li>• State the application of listed refrigerants especially for ships</li> <li>• State properties of refrigerant</li> <li>• Explain the differences between primary and</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbook, Whiteboard, Marker, Lecture notes, etc Drawing</li> <li>• Refrigerants, Refrigeration/Air conditioning demonstration unit, charging hose</li> </ul>	3.1 Identify various refrigerants and their applications. 3.2 Use refrigeration and air condition demonstration unit to illustrate the effect of: (i) pressure on temperature (ii) cooling water rate on condenser and	<ul style="list-style-type: none"> <li>• Demonstrate the activities in 3.1 to 3.3 for the students to learn and ask the students to practice.</li> </ul>	<ul style="list-style-type: none"> <li>• Component diagrams, Refrigerant charts etc</li> </ul>

	<p>Next-Generation Refrigerants (R-1234yf, R-1234ze, R-513A).</p> <p>3.4 State the properties of refrigerants.</p> <p>3.5 Explain the differences between primary and secondary refrigerants</p> <p>3.6 Describe the pressure-temperature relationships of common refrigerants.</p> <p>3.7 Describe the effects of refrigerants on piping materials.</p> <p>3.8 Explain refrigeration cycle components and operate a basic refrigeration system under supervision.</p> <p>3.9 State the safety precautions in the storage and handling of refrigerants.</p> <p>3.10 Explain the suitability of each refrigerant for application in:  i. Domestic refrigerator;  ii. Different rooms for food preservation on ships;  iii. Air conditioning unit;  iv. Refrigerant or absorbent combinations in the vapour</p>	<p>secondary refrigerants</p> <ul style="list-style-type: none"> <li>• Describe the effects of refrigerants on piping materials</li> <li>• The merits of each refrigerant for particular applications.</li> <li>• List refrigerant absorbent pairs used in vapour absorption systems.</li> <li>• Explain the relationship of common refrigerant</li> </ul>		<p>evaporator temperatures.</p> <p>3.3 Observe safety precaution in the workshop and in the storage of refrigerants.</p> <p>3.4 Assemble a simple refrigeration circuit</p> <p>3.5 Perform pressure and temperature measurements.</p> <p>3.6 Complete a fault-finding exercise.</p> <p>3.7 Perform routine maintenance tasks on air-conditioning units and detect common leaks.</p> <p>3.8 Perform charging and evacuation procedures, leak detection, basic compressor servicing, and ventilation calculations for engine rooms</p>		
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	absorption system. 3.11 Explain the effects of Chlorofluorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs) on global warming and ozone depletion.			and accommodation.		
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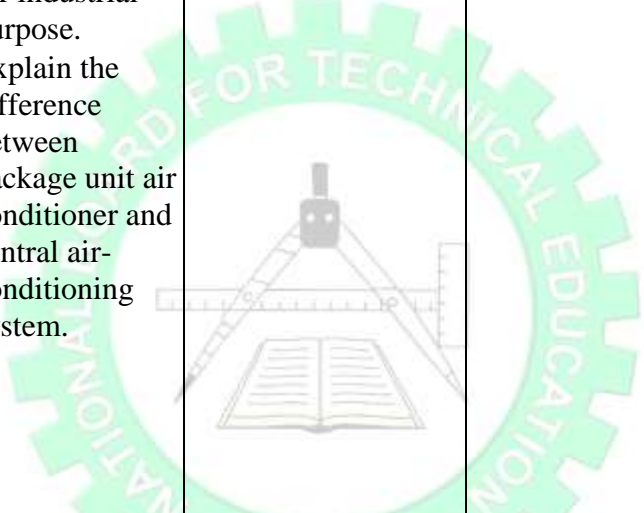
**General Objective 4.0: Comprehend methods of lubrication in refrigeration**

<b>6</b>	4.1 List the required properties of compressor oil. 4.2 Explain the term pour point, and dielectric strength for lubricants. 4.3 Describe methods of lubrication and the mechanism of oil pumps.	<ul style="list-style-type: none"> <li>List required properties of compressor oils</li> <li>Explain the terms as applied to lubrication</li> <li>Describe lubrication methods in refrigeration systems, especially onboard ships</li> </ul>	<ul style="list-style-type: none"> <li>Recommended textbooks, Whiteboard, markers, Lecture notes, Lubricants, Oil pumps, etc</li> </ul>	4.1 Identify the lubrication points in a refrigeration system. 4.2 Carry out lubrication operation in a refrigerator using appropriate equipment e.g. oil pumps.	<ul style="list-style-type: none"> <li>Demonstrate the activities in 4.1 and 4.2 for the students to learn and allow the students to practice</li> </ul>	Practical Manual, Writing materials, Refrigerator models etc
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**General Objective 5.0: Know the procedures for recharging refrigeration circuit On-board Ships**

<b>7-8</b>	5.1 Describe safe methods of transferring refrigerants to service cylinders. 5.2 Describe correct storage conditions 5.3 Describe correct charging methods, identifying when liquid charging is permissible and when vapour charging is advisable	<ul style="list-style-type: none"> <li>Explain safe methods of handling refrigerants</li> <li>Explain when liquid charging is required</li> <li>Explain when vapour charging is required</li> </ul>	<ul style="list-style-type: none"> <li>Recommended textbook, Whiteboard, Marker, Lecture notes, Halide torch, Manifold gauge, Hoses, connector, vacuum pump, Hand tools etc.</li> </ul>	5.1 Conduct leakage detection tests. 5.2 Purge, charge and re-charge domestic refrigeration and window air-conditioning units. 5.3 Dismantle,	<ul style="list-style-type: none"> <li>Ask students to: Explain when liquid charging is required and explain when vapour charging is required.</li> <li>Explain the service</li> </ul>	Practical Manual, Writing materials, Refrigerator models, toolboxes etc
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	5.4 State the circumstances when: i. toxic products may be produced ii. There is the risk of an explosion.	<ul style="list-style-type: none"> <li>• Explain the service cylinder positions in both charging techniques</li> </ul>		<p>service and assemble a typical shipboard refrigeration unit.</p> <p>5.4 Perform brazing activities on the leaking points.</p>	cylinder positions in both charging techniques	
<b>General Objective 6.0: Know various applications of refrigeration</b>						
9	<p>6.1 Explain the use of a refrigerating unit in an air-conditioning system.</p> <p>6.2 List examples of other common refrigeration systems for industrial applications.</p> <p>6.3 Describe a typical layout for cold room.</p> <p>6.4 List the safety requirements for the various refrigeration rooms in a ship.</p>	<ul style="list-style-type: none"> <li>• Explain the use of refrigeration in Air-conditioning</li> <li>• Explain common refrigeration rooms in a ship.</li> <li>• Sketch a layout for cold room, cool room and dairy room in a ship</li> <li>• Explain safety needs for cold rooms, cool rooms and dairy rooms.</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbook, videos, projectors, etc.</li> </ul>	6.1 Identify the different refrigeration rooms: cold room, cool room, dairy room by their temperature ranges	<ul style="list-style-type: none"> <li>• Take the students to the various rooms onboard a ship.</li> <li>• Read various room temperature</li> </ul>	Simulators, practical manuals etc
<b>General Objective 7.0: Understand functions of an air-conditioning system in a Ship</b>						
10-11	<p>7.1 Explain the reasons for air-conditioning in a ship.</p> <p>7.2 Differentiate between comfort and industrial air-conditioning system</p> <p>7.3 State the differences</p>	<ul style="list-style-type: none"> <li>• Define air-conditioning</li> <li>• Explain reasons for providing air-conditioning in</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbook, Whiteboard, Marker, Lecture notes</li> </ul>	<p>7.1 Dismantle, service and reassemble a window type air-conditioner.</p> <p>7.2 Dismantle,</p>	<ul style="list-style-type: none"> <li>• Determine the effect of cooling water rate on condenser</li> </ul>	<ul style="list-style-type: none"> <li>• Practical Manual, Writing materials, Refrigerator models,</li> </ul>

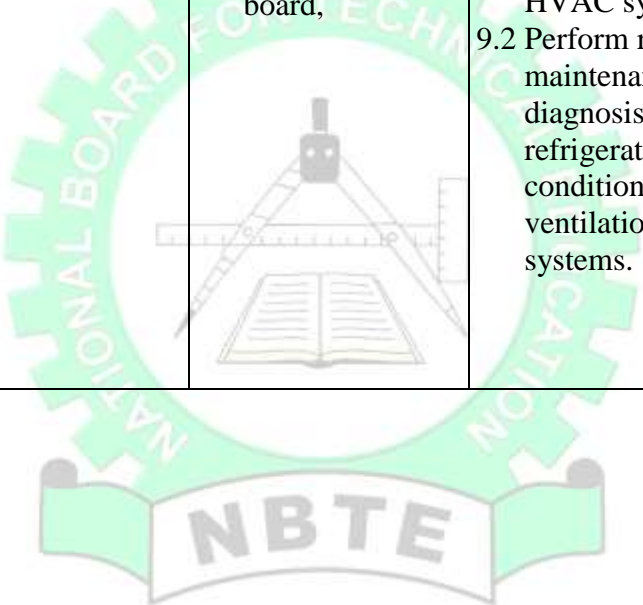
	<p>between package-unit and central air- conditioning systems.</p> <p>7.4 List the main components of a unit air-conditioning system.</p> <p>7.5 Explain the various components used in an air-conditioning system.</p> <p>7.6 State the functions of the components explained in 7.5.</p> <p>7.7 Describe typical layouts of central air- conditioning system</p> <p>7.8 Explain the sources of various load imposed on the air-conditioning syste</p> <p>7.9 List the techniques by which some of the loads imposed on air-conditioning system may be reduced.</p>	<p>ships.</p> <ul style="list-style-type: none"> <li>• Explain the difference between air-conditioning for comfort and air - conditioning for industrial purpose.</li> <li>• Explain the difference between package unit air conditioner and central air-conditioning system.</li> </ul>		<p>service, reassemble and test a heat exchanger unit of an air-conditioner.</p>	<p>and evaporator temperature.</p> <ul style="list-style-type: none"> <li>• Carry out: Cutting, flaring, bending, and joining, of pipes for central air-conditioning unit, using the appropriate tools.</li> </ul>	<p>toolboxes etc</p>
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**General Objective 8.0: Know Ventilation Systems, Safety and Environmental Considerations**

<p>12-13</p>	<p>8.1 Explain the purpose of ventilation systems on-board ships.</p> <p>8.2 Identify natural and mechanical ventilation arrangements.</p> <p>8.3 Explain the relationship between ventilation and machinery safety.</p> <p>8.4 Identify hazards associated with</p>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Safety discussions</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board,</li> </ul>	<p>8.1 Identify ventilation systems onboard.</p>	<ul style="list-style-type: none"> <li>• Scenario-based discussions</li> </ul>	<ul style="list-style-type: none"> <li>• Ventilation layouts</li> <li>• Safety manuals</li> </ul>
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	refrigerants and HVAC systems and safe operating practices. 8.5 Explain relevant environmental and safety regulations.					
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**Objectives 9.0: Understand Operation, Monitoring and Basic Maintenance of HVAC Systems**

<b>14-15</b>	<p>9.1 Discuss routine operation of refrigeration and air conditioning systems.</p> <p>9.2 Explain how to monitor basic operating parameters.</p> <p>9.3 Identify common faults and abnormalities.</p> <p>9.4 Explain basic maintenance and reporting procedures.</p> <p>9.5 State new and emerging technologies in HVAC systems</p>	<ul style="list-style-type: none"> <li>• Case-based lectures</li> <li>• Revision sessions</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board,</li> </ul> 	<p>9.1 Identify unsafe operating conditions for HVAC systems.</p> <p>9.2 Perform routine maintenance and diagnosis on refrigeration, air-conditioning and ventilation systems.</p>	<ul style="list-style-type: none"> <li>• Scenario-based exercises</li> </ul>	<ul style="list-style-type: none"> <li>• Fault charts</li> <li>• Maintenance logs</li> </ul>
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**Course Assessment:**  
 Course work: 10%  
 Test/Assignments: 10%  
 Practical: 40%  
 Examination: 40%  
**Total: 100%**

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: NAVAL ARCHITECTURE AND SHIP CONSTRUCTION I</b>	<b>Course Code: MAR 214</b>	<b>Contact Hours: 4hours/week</b>
<b>Year: II Semester: I</b>	<b>Credit Units: 4</b>	<b>Theoretical: 2hours/week</b>
	<b>Pre-requisite:</b>	<b>Practical: 2hours/week</b>
<b>GOAL: This course is designed to equip students with foundational knowledge of naval architecture and ship construction, including ship types, structural members, hull construction methods, and the interaction between ship structure and machinery installation, enabling them to support seaworthiness, machinery alignment, and safe operation of the ship, in accordance with STCW Code, Section A-III/1.</b>		
<b>GENERAL OBJECTIVES:</b>		
<p>On completion of this course, the student should be able to:</p> <ol style="list-style-type: none"> <li>1.0 Comprehend the fundamentals of Naval Architecture and types of Ships;</li> <li>2.0 Understand Elements of Ship Motion;</li> <li>3.0 Know Ship Structural Members and Hull Components;</li> <li>4.0 Appreciate Elements of Ship Resistance;</li> <li>5.0 Know the Functions of a Propeller and Rudder;</li> <li>6.0 Understand Hull Construction Methods and Materials;</li> <li>7.0 Comprehend Engineering–Structure Interface and Seaworthiness.</li> </ol>		
<b>COMPETENCES:</b>		
<ul style="list-style-type: none"> <li>• Support safe construction and seaworthiness of the ship</li> </ul>		

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>						
<b>Course Title: NAVAL ARCHITECTURE AND SHIP CONSTRUCTION I</b>			<b>Course Code: MAR 214</b>		<b>Contact Hours: 4hours/week</b>	
			<b>Credit Unit: 4</b>		<b>Theoretical: 2hours/week</b>	
<b>Year: II Semester: I</b>			<b>Pre-requisite:</b>		<b>Practical: 2 hours/week</b>	
<b>COURSE SPECIFICATION: Theoretical and Practical</b>						
<b>General Objective 1.0: Comprehend the fundamentals of Naval Architecture and types of Ships</b>						
<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>
<b>1-3</b>	1.1 Explain the scope of naval architecture in ship design and operation. 1.2 Identify major types of ships and their functions. 1.3 Explain basic ship dimensions and terminologies. 1.4 State the various terms used in shipbuilding calculation. 1.5 Distinguish ship type from machinery and operational requirements. 1.6 Calculate the areas of Ship section and wetted surface areas using Trapezoidal and Simpson's rules. 1.7 Calculate moments of Area and centroid by Simpson's rules. 1.8 Calculate form coefficient for ship sections. 1.9 Describe structural considerations affecting machinery installation.	<ul style="list-style-type: none"> <li>Lectures</li> <li>Guided discussions</li> </ul>	<ul style="list-style-type: none"> <li>PowerPoint slides, Smart boards, white board,</li> </ul>	1.1 Identify ship types from diagrams. 1.2 Use design software to draw structural layout of a ship. 1.3 Interpret basic ship construction drawings 1.4 Identify structural members relevant to machinery installation.	<ul style="list-style-type: none"> <li>Diagram interpretation exercises</li> </ul>	<ul style="list-style-type: none"> <li>Ship type diagrams</li> <li>Classification sketches</li> </ul>

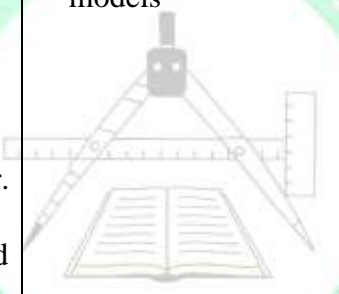
**General Objective 2.0: Understand Elements of Ship Motion.**

<p><b>4-5</b></p>	<p>2.1 Outline types of ship structures 2.2 Determine load acting on a ship structure 2.3 Explain the function of ship structural components. 2.4 Determine wave loading, weight distribution, loading, shearing force and bending moment</p>	<ul style="list-style-type: none"> <li>• Set up numerical problems for the determination of loads acting on ship structure and describe 2.1-2.4</li> <li>• Discuss the function of ship structural components.</li> </ul>	<ul style="list-style-type: none"> <li>• Writing materials, photographs/sketches.</li> <li>• Excursion, visiting workshop with writing materials, photographs/ sketches.</li> <li>• Visit ship repair yard</li> </ul>	<p>2.1 Identify types of ship structure. 2.2 Determine wave loading weight distribution, loading shearing force and bending moments. 2.3 Compute simple hydrostatic properties and assess basic stability for given loading conditions.</p>	<ul style="list-style-type: none"> <li>• Set up the numerical problems for the determination of loads acting on ship structure and describe 2.1-2.2</li> </ul>	
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**General Objective 3.0: Know Ship Structural Members and Hull Components**

<p><b>6-8</b></p>	<p>3.1 Identify principal structural members of a ship. 3.2 Outline types of ship structures 3.3 Explain the functions of ship structural components 3.4 Explain functions of keel, frames, decks,</p>	<ul style="list-style-type: none"> <li>• Lectures 3.1-3.12</li> <li>• Structural walkthroughs</li> <li>• Ask students to explain functions of ship structures.</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board,</li> </ul>	<p>3.1 Identify structural members correctly. 3.2 Explain engine foundation requirements and evaluate alignment</p>	<ul style="list-style-type: none"> <li>• Structural identification exercises.</li> </ul>	<ul style="list-style-type: none"> <li>• Hull structure diagrams</li> <li>• Sectional drawings</li> </ul>
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	<p>bulkheads, and shell plating.</p> <p>3.5 Describe load paths within the ship structure.</p> <p>3.6 Distinguish between structural strength from machinery support.</p> <p>3.7 Describe implications of structural damage.</p> <p>3.8 Determine load acting on a ship structure.</p> <p>3.9 Determine wave loading, weight distribution, loading, shearing force and bending moments.</p> <p>3.10 State the method of Construction of the bow and stern of a ship</p> <p>3.11 Describe the framing system.</p> <p>3.12 Describe the construction of the bow and stern of a ship.</p>			<p>implications for propulsion machinery.</p>		
<b>General Objective 4: Appreciate Elements of Ship Resistance</b>						
<p><b>9-10</b></p>	<p>4.1 State types of resistance.</p> <p>4.2 Explain various methods of resistance calculation.</p> <p>4.3 Discuss the procedures to determine the total resistance of ships.</p>	<ul style="list-style-type: none"> <li>• Explain ship resistance</li> </ul>	<ul style="list-style-type: none"> <li>• Writing materials, lecture notes, online resources, internet, whiteboard, marker, etc.</li> </ul>	<p>4.1 Identify the types of resistance.</p> <p>4.2 Carry out various methods of resistance calculations.</p> <p>4.3 Determine</p>	<ul style="list-style-type: none"> <li>• Perform experiments on ship resistance using ship models with the students.</li> </ul>	<ul style="list-style-type: none"> <li>• Tow tank, ship models, practical manuals, etc.</li> </ul>

				by experiments the resistance of ships using models.		
<b>General Objective 5: Know the Functions of a Propeller and Rudder</b>						
<b>11-12</b>	<p>5.1 Explain the various dimensions of a propeller.</p> <p>5.2 Explain the functions of a marine propeller.</p> <p>5.3 Differentiate between fixed pitch propeller and controllable pitch propeller.</p> <p>5.4 State the uses of rudder.</p> <p>5.5 State the types of rudders in use.</p> <p>5.6 Calculate the force on a rudder.</p>	<ul style="list-style-type: none"> <li>Show models of propellers and explain requirements of 5.1–5.6.</li> <li>Explain the functions of a marine propeller and controllable pitch propeller.</li> <li>State the uses of a rudder and types of rudders in use.</li> </ul>	<ul style="list-style-type: none"> <li>Propeller and rudder models.</li> <li>Demonstrate.</li> <li>Visit workshop to see propeller and rudder models</li> </ul> 	<p>5.1 Identify the various dimensions of a propeller.</p> <p>5.2 Use CAD/CAM software to draw propellers and rudders.</p> <p>5.3 Calculate the force in a rudder</p>	<p>Guide students to use CAD/CAM software to draw propellers and rudders.</p>	<p>CAD/CAM software, computers etc</p>
<b>General Objective 6.0: Understand Hull Construction Methods and Materials</b>						
<b>13-14</b>	<p>6.1 Explain common hull construction methods.</p> <p>6.2 Identify materials used in ship construction.</p> <p>6.3 Explain welding and joining methods at awareness level.</p> <p>6.4 Relate construction methods to structural strength and durability.</p> <p>6.5 Discuss corrosion and structural protection.</p>	<ul style="list-style-type: none"> <li>Lectures</li> <li>Case discussions</li> <li>Explain material selection rationale.</li> </ul>	<ul style="list-style-type: none"> <li>PowerPoint slides, Smart boards, white board etc.</li> </ul>	<p>6.1 Identify construction methods from diagrams.</p> <p>6.2 Perform mechanical strength test on materials used in ship construction.</p>	<ul style="list-style-type: none"> <li>Diagram interpretation discussions</li> </ul>	<ul style="list-style-type: none"> <li>Construction method diagrams</li> <li>Material samples/images</li> </ul>

	6.6 Discuss cathodic protection. 6.7 State the advantages and disadvantages of welding over riveting.					
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**General Objective 7.0: Comprehend Engineering–Structure Interface and Seaworthiness.**

<b>15</b>	<p>7.1 Explain how ship structure supports machinery installation.</p> <p>7.2 Differentiate between foundation design from vibration and alignment.</p> <p>7.3 Explain effects of structural deformation on machinery operation.</p> <p>7.4 Explain seaworthiness through engineering awareness.</p> <p>7.5 List new and emerging technologies in ship construction and stability studies.</p> <p>7.6 Explain structure-machinery interaction scenarios.</p> <p>7.7 Explain Load-Line Convention, and its application to seaworthiness.</p>	<ul style="list-style-type: none"> <li>• Case-based lectures</li> <li>• Revision sessions</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board, etc.</li> </ul>	<p>7.1 Identify risks from poor structural integration.</p>	<ul style="list-style-type: none"> <li>• Scenario-based discussions</li> </ul>	<ul style="list-style-type: none"> <li>• Machinery foundation diagrams</li> <li>• Structural case studies</li> </ul>
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**Course Assessment:**  
 Course work: 10%  
 Test/Assignments: 10%  
 Practical: 40%  
 Examination: 40%  
**Total: 100%**

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: MARINE SAFETY TRAINING</b>	<b>Course code: MAR 215</b>	<b>Contact Hours: 3hours/week</b>
<b>Year: II Semester: I</b>	<b>Credit Unit: 3</b>	<b>Theoretical: 1hour/week</b>
	<b>Pre-requisite:-</b>	<b>Practical: 2hours/week</b>
<p><b>GOAL: This course is designed to equip the students with safety competence for marine engineering duties, including engine-room hazard awareness, fire prevention and firefighting, oil system safety, personal survival technique, personal safety and social responsibility, elementary first aid and security awareness training, enabling them to contribute effectively to shipboard emergency response and the safety and care of personnel onboard, in accordance with STCW Code, Section A-III/1.</b></p>		
<p><b>GENERAL OBJECTIVES:</b></p> <p>On completion of this course, the student should be able to:</p> <ol style="list-style-type: none"> <li>1.0 Know Elementary First Aid;</li> <li>2.0 Know Personal Safety and Social Responsibility (PSSR);</li> <li>3.0 Know Personal Survival Techniques (PST);</li> <li>4.0 Understand Fire Prevention and Fire Fighting (FPFF);</li> <li>5.0 Know Security Awareness Training for all Seafarers;</li> <li>6.0 Understand Seafarers with Designated Security Duties;</li> <li>7.0 Understand Basic Oil and Chemical Tanker Cargo Operations;</li> <li>8.0 Understand Basic Liquefied Gas Tanker Cargo Operations;</li> <li>9.0 Understand Tanker Firefighting;</li> <li>10.0 Know Enclosed Space Entry Procedures;</li> <li>11.0 Comprehend Human Element and Leadership Management at Operational Level;</li> <li>12.0 Know Engine Room Resource Management at Operational Level;</li> <li>13.0 Know High Voltage Training at Operational Level;</li> <li>14.0 Know Environmental Awareness for all Seafarers.</li> </ol>		
<p><b>COMPETENCES:</b></p> <ul style="list-style-type: none"> <li>• Prevent, control and fight fires onboard.</li> <li>• Operate lifesaving appliances,</li> <li>• Apply medical first aid onboard ships.</li> <li>• Contribute to safety and care of personnel onboard.</li> </ul>		

**PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY**

<b>Course Title: MARINE SAFETY TRAINING</b>	<b>Course Code: MAR 215</b>	<b>Contact Hours: 3hours/week</b>
	<b>Credit Unit: 3</b>	<b>Theoretical: 1hour/week</b>
<b>Year: II Semester: I</b>	<b>Pre-requisite: -</b>	<b>Practical: 2hours/week</b>

**COURSE SPECIFICATION:**

**General Objective 1.0: Know Elementary First Aid**

<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher’s Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher’s Activities</b>	<b>Resources</b>
<b>1</b>	1.1 Explain principles of first aid and casualty care. 1.2 Explain priorities of first aid at sea. 1.3 Identify common injuries and illnesses on board. 1.4 Describe procedures for handling shock, bleeding, burns, and fractures. 1.5 Describe Cardio-Pulmonary-Resuscitation (CPR) principles and casualty handling.	<ul style="list-style-type: none"> <li>Lectures</li> <li>Video demonstrations</li> <li>Case studies and guided discussions.</li> </ul>	<ul style="list-style-type: none"> <li>PowerPoint slides, Smart boards, White board, Charts, IMO medical guide Multimedia presentations, First aid manuals, STCW II/1/II/2 guidelines, etc.</li> </ul>	1.1 Demonstrate CPR, bandaging, and casualty handling. 1.2 Apply first aid procedures for minor injuries 1.3 Control bleeding, dress wounds, splint fractures, etc. 1.4 Transport casualty safely onboard	<ul style="list-style-type: none"> <li>Demonstration and supervised drills.</li> </ul>	<ul style="list-style-type: none"> <li>CPR mannequin, First aid box, Stretcher, Bandages, PPE, etc.</li> </ul>

**General Objective 2.0: Know Personal Safety and Social Responsibility (PSSR)**

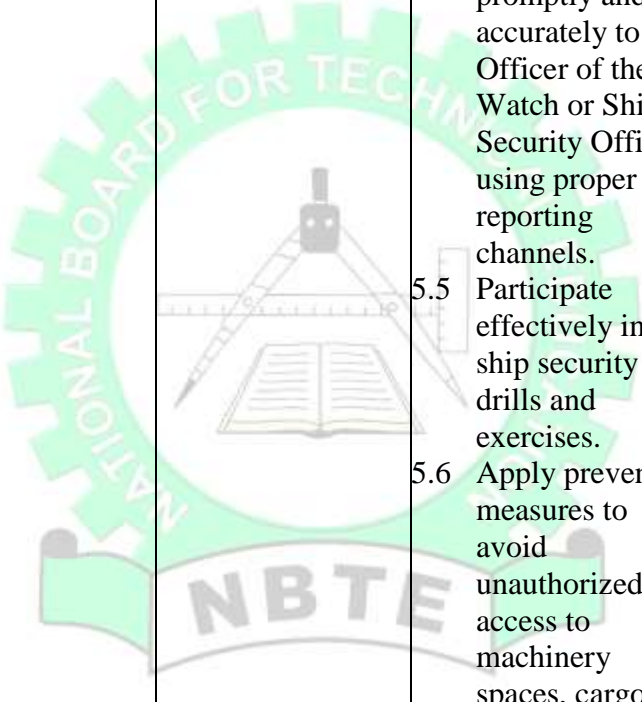
<b>2</b>	2.1 Explain personal safety procedures and use of PPE. 2.2 Discuss social responsibility and team conduct onboard. 2.3 Identify common	<ul style="list-style-type: none"> <li>Interactive lectures.</li> <li>Hazard identification exercises.</li> <li>Group discussion.</li> <li>Discussion of case laws Review of</li> </ul>	<ul style="list-style-type: none"> <li>PowerPoint slides,</li> <li>Smart boards, White board,</li> <li>Safety manuals,</li> </ul>	2.1 Demonstrate proper use of PPE and safety equipment. 2.2 Conduct hazard identification drills. 2.3 Demonstrate safe	<ul style="list-style-type: none"> <li>Safety walkthroughs.</li> <li>Supervised drills.</li> </ul>	<ul style="list-style-type: none"> <li>PPE kits</li> <li>Hazard signage</li> <li>Mock hazards.</li> </ul>
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	<p>hazards on deck and in engine room.</p> <p>2.4 Explain safe working practices, accident prevention, effects of fatigue, stress and mental health, policies, and crew rights onboard.</p> <p>2.5 Explain prevention of Violence and Harassment including Sexual Harassment, Bullying and Sexual Assault Onboard Ship.</p>	<p>STCW and MLC provisions.</p>	<p>Videos on social conduct.</p> <ul style="list-style-type: none"> <li>STCW code, MLC extracts, Company safety policies, etc.</li> </ul>	<p>behaviour onboard</p> <p>2.4 Apply reporting procedures for hazards, Violence and Harassment</p> <p>2.5 Practice teamwork and stress coping techniques.</p>		
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**General Objective 3.0: Know Personal Survival Techniques (PST)**

<p>3</p>	<p>3.1 Explain principles of survival at sea.</p> <p>3.2 Identify survival crafts and equipment onboard ships.</p> <p>3.3 Identify life-saving appliances onboard ships.</p> <p>3.4 Outline survival crafts launching procedures onboard ships.</p> <p>3.5 Identify survival signals and emergency communication</p>	<ul style="list-style-type: none"> <li>Lectures</li> <li>Demonstration of survival craft equipment</li> <li>Discussion of case studies.</li> <li>Review of SOLAS life-saving appliances.</li> </ul>	<ul style="list-style-type: none"> <li>PowerPoint slides</li> <li>Smart boards, White board</li> <li>STCW II/1 manuals</li> <li>Life raft and life jacket guides</li> <li>Simulation</li> <li>Videos.</li> </ul>	<p>3.1 Perform Personal Survival drills with the aid of life jackets.</p> <p>3.2 Demonstrate launching and boarding of survival crafts.</p> <p>3.3 Demonstrate use of pyrotech</p>	<ul style="list-style-type: none"> <li>Supervised lifeboat and life jacket drills, swimming pool exercises.</li> <li>Abandon ship simulation.</li> </ul>	<ul style="list-style-type: none"> <li>Life jackets, Lifeboats, Life rafts, Survival kits, Swimming pool, etc.</li> </ul>
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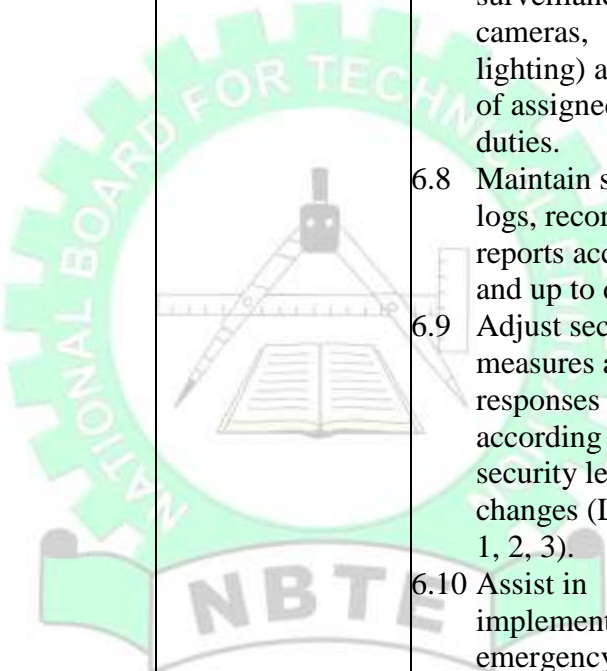
www.nbte.gov.ng						
	methods.					
<b>General Objectives 4.0: Understand Fire Prevention and Fire Fighting (FPFF)</b>						
<b>4</b>	4.1 Explain fire triangle. 4.2 Explain classes of fire 4.3 Discuss causes of fire. 4.4 Describe fire-fighting equipment and their uses onboard. 4.5 Describe fire prevention measures onboard. 4.6 Discuss fire detection, alarms, and extinguishing methods.	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Videos</li> <li>• Group discussion</li> <li>• Analysis of fire incidents.</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards</li> <li>• White board,</li> <li>• FPFF manuals, STCW II/2 guidelines</li> <li>• Fire equipment catalogs.</li> </ul>	4.1 Use firefighting equipment correctly (extinguishers, hoses, fixed systems). 4.2 Demonstrate response to fire alarms and emergency situations. 4.3 Enter smoke-filled space with Breathing Apparatus (BA) set.	<ul style="list-style-type: none"> <li>• Hands-on firefighting drills</li> <li>• Simulated fire exercises.</li> </ul>	<ul style="list-style-type: none"> <li>• Fire extinguisher s, Hoses, Hydrants, PPE, Mock fire setups, Breathing Apparatus (BA) set, etc.</li> </ul>
<b>General Objective 5.0: Understand Security Awareness Training Requirement for Seafarers.</b>						
<b>5</b>	5.1 Explain the purpose and requirement of International Ship and Port facility Security (ISPS) Code. 5.2 Identify different types of maritime security threats (piracy, terrorism, stowaways, smuggling, cyber risk, etc 5.3 Identify shipboard security	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• ISPS code review</li> <li>• Case studies</li> <li>• Scenario discussions.</li> </ul>	<ul style="list-style-type: none"> <li>• ISPS Code manuals, Security awareness Videos, STCW II/2 guidelines.</li> <li>• Whiteboard</li> <li>• Multimedia</li> </ul>	5.1 Identify suspicious persons, objects, and activities during routine shipboard duties 5.2 Carry out access control procedures at gangways, accommodation entrances, and restricted areas under supervision 5.3 Demonstrate	<ul style="list-style-type: none"> <li>• Simulated security drills</li> <li>• Checkpoint exercises.</li> </ul>	<ul style="list-style-type: none"> <li>• Mock ship areas, Security equipment, Security logbook, Reporting forms.</li> </ul>

	<p>responsibilities and procedures.</p> <p>5.4 Describe Security Levels (1,2,3) and their implications on shipboard operations.</p> <p>5.5 Recognise the roles and responsibilities of crew members in ship security.</p> <p>5.6 Explain procedures for access control, monitoring, and inspection of personnel and cargo.</p> <p>5.7 Explain procedure for reporting and handling of suspicious activities.</p> <p>5.8 Describe methods used to maintain vigilance and prevent unauthorised access.</p> <p>5.9 Explain the importance of security equipment and restricted areas onboard.</p>			<p>correct procedures for escorting visitors and verifying identity documents.</p> <p>5.4 Report security concerns promptly and accurately to the Officer of the Watch or Ship Security Officer using proper reporting channels.</p> <p>5.5 Participate effectively in ship security drills and exercises.</p> <p>5.6 Apply preventive measures to avoid unauthorized access to machinery spaces, cargo areas, and control rooms</p> <p>5.7 Maintain vigilance while performing assigned duties without</p>		
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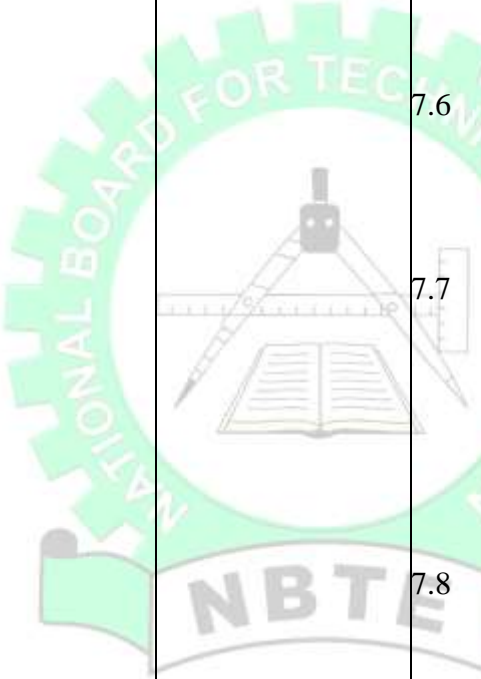
				<p>compromising ship operations.</p> <p>5.8 Respond appropriately to changes in security levels (Level 1, 2, and 3) as directed by shipboard procedures.</p> <p>5.9 Assist in basic searches of personal effects, baggage, and ship spaces when required and under supervision</p> <p>5.10 Demonstrate awareness of security equipment such as lighting, alarms, surveillance devices, and access logs.</p> <p>5.11 Demonstrate correct use of personal life-saving appliances.</p> <p>5.12 Perform basic survival craft launching procedures.</p>		
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**General Objective 6.0: Understand the Role of Seafarers with Designated Security Duties.**

<p><b>6</b></p>	<p>6.1 Explain the roles and responsibilities of seafarers with designated security duties.</p> <p>6.2 Explain the ship security plan (SSP), including its procedures and operational requirements</p> <p>6.3 Describe the different security levels (1, 2, 3) and their implications for shipboard operations</p> <p>6.4 Identify potential security threats to the ship, crew, cargo, and facilities</p> <p>6.5 Explain procedures for access control, monitoring, and inspection of personnel and cargo</p> <p>6.6 Explain how to report, record, and respond to security incidents.</p> <p>6.7 Explain emergency procedures in case of a security breach or threat.</p>	<ul style="list-style-type: none"> <li>• Interactive lectures</li> <li>• Scenario-based learning: Group discussions</li> </ul>	<ul style="list-style-type: none"> <li>• ISPS Code manuals, STCW II/2 guidelines,</li> <li>• Case studies.</li> <li>• Ship security plan</li> <li>• Whiteboard</li> <li>• Multimedia</li> </ul>	<p>6.1 Implement the ship security plan (SSP) effectively during daily operations.</p> <p>6.2 Conduct access control at gangways, restricted areas, and machinery spaces according to assigned duties</p> <p>6.3 Verify identity and inspect personnel, luggage, and cargo under supervision.</p> <p>6.4 Patrol and monitor assigned shipboard areas to detect and deter unauthorized access.</p> <p>6.5 Respond appropriately to security incidents following SSP procedures and report them accurately.</p> <p>6.6 Coordinate with other crew and</p>	<ul style="list-style-type: none"> <li>• Supervised drills,</li> <li>• Access control exercises,</li> <li>• Emergency scenarios.</li> <li>• Simulation exercises.</li> </ul>	<ul style="list-style-type: none"> <li>• Mock security equipment, Access logs, Ship plan diagrams, etc.</li> </ul>
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<p>6.8 Describe the use of security equipment, surveillance systems, and communication tools for monitoring.</p> <p>6.9 Discuss coordination with port facility security personnel and other ships.</p>			<p>security officers during drills and real security situations.</p> <p>6.7 Operate basic security equipment (alarms, surveillance cameras, lighting) as part of assigned duties.</p> <p>6.8 Maintain security logs, records, and reports accurately and up to date.</p> <p>6.9 Adjust security measures and responses according to security level changes (Levels 1, 2, 3).</p> <p>6.10 Assist in implementing emergency measures, including lockdowns or controlled access to areas</p> <p>6.11 Participate in security drills and exercises,</p>		
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				<p>demonstrating competence in performing designated duties.</p> <p>6.12 Perform identification and reporting of potential threats or suspicious activities promptly.</p>		
<b>General Objective 7.0: Understand Basic Oil and Chemical Tanker Cargo Operations.</b>						
7-8	<p>7.1 Explain the properties and hazards of oil and chemical cargoes.</p> <p>7.2 Describe the operation, monitoring, and maintenance of cargo pumps, pipelines, valves, and associated instrumentation.</p> <p>7.3 Explain the segregation, compatibility, and contamination prevention requirements for oil and chemical cargoes</p> <p>7.4 Explain MARPOL and IBC Code regulations</p>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Demonstration</li> <li>• Case studies</li> <li>• Simulation exercises.</li> </ul>	<ul style="list-style-type: none"> <li>• STCW II/2 guidelines, IMO Model Courses, Cargo handling manuals, Tanker diagrams.</li> </ul>	<p>7.1 Operate cargo pumping systems, valves, and pipelines safely under supervision.</p> <p>7.2 Monitor cargo tanks for level, pressure, and temperature using instrumentations.</p> <p>7.3 Take corrective action in case of abnormal readings or operational issues.</p> <p>7.4 Carry out safe loading, discharging, and transfer of oil and chemical</p>	<ul style="list-style-type: none"> <li>• Hands-on drills</li> <li>• Supervised exercises</li> <li>• Simulation of operations and emergencies.</li> </ul>	<ul style="list-style-type: none"> <li>• Training deck, Valves, Pumps, Piping systems, Checklists, Gauges, Alarms, Pipelines, PPE, Logbooks, Simulators.</li> </ul>

	<p>relevant to cargo handling and environmental protection.</p> <p>7.5 Describe cargo documentation, record keeping, and reporting requirements.</p> <p>7.6 Explain emergency procedures, including alarms, shutdowns, and containment in case of spills, leaks, or fire.</p> <p>7.7 Describe safe cargo transfer procedures, including loading, discharging, and tank cleaning.</p> <p>7.8 Identify potential risks to personnel, ship, and environment during cargo operations.</p> <p>7.9 Discuss the importance of personal protective equipment (PPE) and safe work practices.</p>			<p>cargoes according to operational limits.</p> <p>7.5 Apply segregation and contamination prevention procedures during cargo handling.</p> <p>7.6 Use PPE appropriately while handling hazardous cargoes.</p> <p>7.7 Respond to alarms, leaks, spills, and emergencies according to the ship's emergency procedures.</p> <p>7.8 Maintain accurate cargo documentation and logs during operations.</p> <p>7.9 Perform tank cleaning and gas freeing operations safely (if applicable to operational</p>		
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	7.10 Explain the principles of monitoring tank levels, pressures, and temperatures to prevent overfilling or hazardous conditions.			level). 7.10 Demonstrate team coordination and communication during cargo operations.		
<b>General Objective 8.0: Understand Basic Liquefied Gas Tanker Cargo Operations.</b>						
9	8.1 Explain the properties and hazards of liquefied gases cargo containment systems. 8.2 Describe safe procedures for loading, discharging, and transfer. 8.3 Discuss segregation, contamination prevention, and emergency response.	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Demonstration videos</li> <li>• Case study discussions.</li> </ul>	IMO Model Course 3.21 manuals, LNG/LPG operation guides, STCW II/2 guidelines.	8.1 Demonstrate safe operation of cargo pumps, valves, and pipelines and emergency response. 8.2 Conduct monitoring of pressure, temperature, and tank levels. 8.3 Respond to simulated gas leaks or spills.	<ul style="list-style-type: none"> <li>• Hands-on drills</li> <li>• Simulator exercises,</li> <li>• Emergency scenarios.</li> </ul>	<ul style="list-style-type: none"> <li>• LNG/LPG mock tanks, Simulators, PPE, Gas detector, Monitoring instruments, Practical manuals, etc.</li> </ul>
<b>General Objective 9.0: Understand Tanker Firefighting.</b>						
10	9.1 Explain fire hazards specific to oil, chemical, and gas cargoes. 9.2 Describe methods for controlling and extinguishing	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Videos</li> <li>• Incident analysis</li> <li>• Case discussions.</li> </ul>	FPPF manuals STCW II/2 guidelines, etc. IMO training guides. Foam system charts.	9.1 Operate foam systems, hoses, and portable extinguishers. 9.2 Perform fire-fighting drills in cargo areas.	Simulated fire drills Teamwork exercises.	<ul style="list-style-type: none"> <li>• Firefighting equipment, Mock foam systems, PPE, etc.</li> </ul>

	<p>tanker fires.</p> <p>9.3 Explain foam systems and tanker fire risks.</p> <p>9.4 Discuss emergency plans and communication procedures.</p>			<p>9.3 Apply firefighting techniques using appropriate equipment and operate breathing apparatus under supervision.</p> <p>9.4 Execute emergency response procedures and coordinate with team members during drills.</p>		
<b>General Objective 10.0: Know Enclosed Space Entry.</b>						
<b>11</b>	<p>10.1 Identify hazards in enclosed spaces.</p> <p>10.2 Explain hazards of enclosed spaces and permit-to-work system.</p> <p>10.3 Explain entry procedures, atmospheric testing, and ventilation requirements.</p> <p>10.4 Discuss emergency rescue methods and use of breathing</p>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Videos</li> <li>• Risk assessment exercises.</li> </ul>	<p>Enclosed space entry manuals</p> <p>STCW II/2 Breathing apparatus.</p>	<p>10.1 Demonstrate safe entry and exit procedures under supervision.</p> <p>10.2 Use gas detection and rescue equipment correctly</p>	<p>Mock enclosed space exercises</p> <p>Use of PPE and monitoring devices.</p>	<ul style="list-style-type: none"> <li>• Confined space mock-up</li> <li>• Gas detectors</li> <li>• Rescue equipment.</li> </ul>

	apparatus.					
<b>General Objective 11.0: Know Human Element and Leadership (Operational Level)</b>						
<b>12</b>	<p>11.1 Explain teamwork, communication, and human element factors onboard.</p> <p>11.2 Explain human element factors affecting performance on board.</p> <p>11.3 Discuss leadership principles, communication, and teamwork.</p> <p>11.4 Identify causes of human error and methods to mitigate risks.</p>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Group discussion</li> <li>• Role-play</li> <li>• Case studies.</li> </ul>	<p>IMO Model Course 7.01, Leadership manuals, Videos.</p>	<p>11.1 Demonstrate teamwork in simulated shipboard operations.</p> <p>11.2 Apply leadership and decision-making under supervision.</p> <p>11.3 Demonstrate effective communication during watchkeeping.</p>	<p>Group exercises Bridge/Engine Room Simulator Scenario drills.</p>	<ul style="list-style-type: none"> <li>• Simulator, Role-play scripts, Evaluation checklists, etc.</li> </ul>
<b>General Objective 12.0: Know Engine Room Resource Management (Operational Level)</b>						
<b>13</b>	<p>12.1 Explain principles of resource management and workload sharing in engine room.</p> <p>12.2 Discuss effective communication, planning, and decision-making.</p> <p>12.3 Identify risks and strategies to</p>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Simulations</li> <li>• Case study discussions.</li> </ul>	<p>STCW II/2 guidelines ERM manuals Simulators.</p>	<p>12.1 Apply ERM principles in supervised engine room scenarios.</p> <p>12.2 Demonstrate coordination, monitoring, and troubleshooting as a team.</p>	<p>Simulator exercises Teamwork drills Problem-solving tasks.</p>	<ul style="list-style-type: none"> <li>• Engine Room Simulator, Monitoring instruments, Checklists.</li> </ul>

	optimize safety and performance.					
<b>General Objective 13.0: Know High Voltage Training at Operational Level</b>						
<b>14</b>	<p>13.1 Explain principles of high-voltage systems and associated hazards.</p> <p>13.2 Describe the Isolation procedures high voltage.</p> <p>13.3 Describe safety precautions and emergency procedures.</p> <p>13.4 Identify testing, monitoring, and maintenance requirements.</p>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Demonstration</li> <li>• Interactive discussions.</li> <li>• HV diagrams.</li> </ul>	<p>High-voltage manuals</p> <p>STCW II/2 guidelines</p> <p>Videos.</p> <p>Whiteboard</p> <p>Multimedia</p>	<p>13.1 Demonstrate safe handling of high-voltage equipment under supervision.</p> <p>13.2 Conduct basic tests, monitoring, and fault identification.</p> <p>13.3 Apply lock-out and isolation procedures safely.</p>	<p>Supervised exercises on training boards</p> <p>Mock circuits</p> <p>Safety drills.</p>	<ul style="list-style-type: none"> <li>• HV training panels, PPE, Testing instruments, Practical manuals, etc.</li> </ul>
<b>General Objective 14.0: Know Environmental Awareness for all Seafarers</b>						
<b>15</b>	<p>14.1 Explain the impact of shipping on the marine environment.</p> <p>14.2 Describe MARPOL regulations and shipboard pollution prevention.</p> <p>14.3 Identify waste management and emergency</p>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Case studies</li> <li>• Discussions</li> </ul>	<p>MARPOL manuals</p> <p>IMO Model Course 1.38</p> <p>Videos.</p> <p>Whiteboard</p> <p>Multimedia</p>	<p>14.1 Demonstrate proper handling of oily waste, sewage, and garbage.</p> <p>14.2 Demonstrate use of SOPEP equipment during drills.</p> <p>14.3 Conduct emergency drills for</p>	<p>Mock waste management exercises</p> <p>Oil spill containment drills.</p>	<ul style="list-style-type: none"> <li>• Waste handling equipment, Spill kits, PPE, etc.</li> </ul>

	response procedures.			pollution incidents		
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**Course Assessment:**

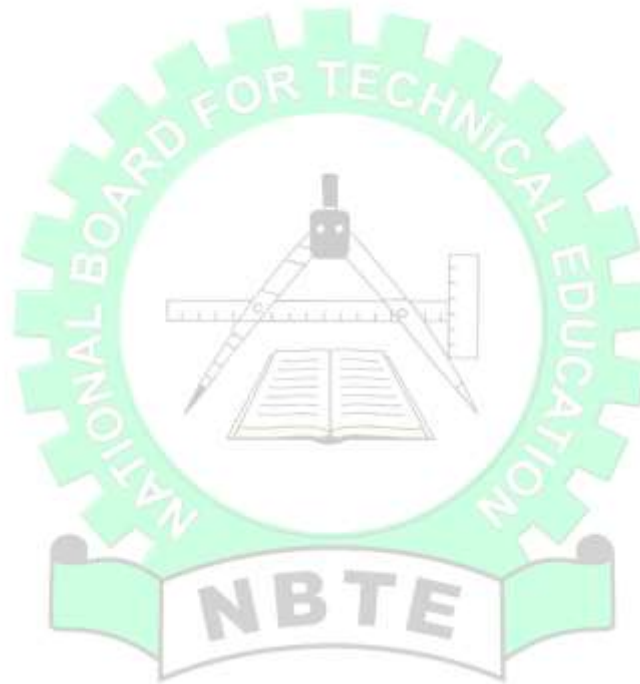
Course work: 10%

Test/Assignments: 10%

Practical: 40%

Examination: 40%

**Total: 100%**



<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>			
<b>COURSE TITLE: MARITIME COMMUNICATION IN ENGLISH I</b>	<b>COURSE CODE: MAR 216</b>	<b>CREDIT UNIT: 4</b>	<b>CONTACT HOURS: 2HOURS/ WEEK</b>
			<b>THEORETICAL: 2HOURS/ WEEK</b>
<b>GOAL: This course is designed to enables students know, understand, and use English for marine engineering duties and general communication. It builds competence in technical vocabulary, oral and written communication, comprehension of manuals and instructions, and preparation of engineering reports. Students will communicate clearly and accurately in the engine-room environment and in academic/professional contexts, in accordance with STCW Code, Section A-III/1, and NBTE Communication in English I and II requirements.</b>			
<b>YEAR: II SEMESTER: I</b>	<b>PRE-REQUISITE:</b>		<b>PRACTICAL/TUTORIAL: 2HOURS / WEEK</b>
<b>GENERAL OBJECTIVE:</b>			
On completion of this course, the student will be able to:			
<ol style="list-style-type: none"> <li>1.0 Know the Importance of English in Marine Engineering Practice;</li> <li>2.0 Understand Basic English Structures for Workplace Communication;</li> <li>3.0 Use Technical Vocabulary and Interpret Engineering Instructions;</li> <li>4.0 Understand Written Communication in Engineering Reports and Logbooks;</li> <li>5.0 Use Oral Communication in Engine-Room Operations;</li> <li>6.0 Understand Communication Skills in Routine and Emergency Situations;</li> <li>7.0 Develop Confidence through Proper Professional Communication Etiquette Onboard;</li> <li>8.0 Understand Reading, Listening, and Presentation Skills for Academic and Professional Contexts.</li> </ol>			
<b>COMPETENCE</b>			
<ul style="list-style-type: none"> <li>• Use English for Effective Communication during Operation, surveillance assessment and maintaining safety of propulsion plant and auxiliary machinery</li> </ul>			

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>						
<b>COURSE TITLE: MARITIME COMMUNICATION IN ENGLISH I</b>		<b>COURSE CODE: MAR 216</b>	<b>CREDIT UNIT: 4</b>	<b>CONTACT HOURS: 2 HOURS/WEEK</b>		
				<b>THEORETICAL: 2 HOURS/WEEK</b>		
<b>YEAR: II SEMESTER: I</b>		<b>PRE-REQUISITE: -</b>		<b>PRACTICAL/TUTORIAL: 2 HOURS/WEEK</b>		
<b>THEORETICAL CONTENTS</b>			<b>PRACTICAL CONTENTS</b>			
<b>WEEK</b>	<b>SPECIFIC LEARNING OUTCOMES</b>	<b>TEACHER'S ACTIVITIES</b>	<b>RESOURCES</b>	<b>SPECIFIC LEARNING OUTCOMES</b>	<b>TEACHER'S ACTIVITIES</b>	<b>RESOURCES</b>
1	1.1 Explain the role of English in marine engineering. 1.2 Identify areas where English is essential (manuals, reports, safety). 1.3 Explain shipboard communication barriers.	<ul style="list-style-type: none"> <li>Lectures, guided discussions.</li> </ul>	<ul style="list-style-type: none"> <li>Whiteboard, Smartboard, Multimedia projector, Communication texts.</li> </ul>	1.1 Communicate simple engineering messages verbally. 1.2 Participate in basic workplace conversations.	<ul style="list-style-type: none"> <li>Speaking drills, role-play exercises.</li> </ul>	<ul style="list-style-type: none"> <li>Audio samples, workplace scenarios.</li> </ul>
<b>GENERAL OBJECTIVE: 2.0: Understand Basic English Structures for Workplace Communication.</b>						
2-3	2.1 Use basic sentence structures for workplace communication. 2.2 Apply grammar rules in technical contexts. 2.3 Demonstrate	<ul style="list-style-type: none"> <li>Vocabulary drills, pronunciation practice.</li> </ul>	<ul style="list-style-type: none"> <li>Technical manuals, Smartboard, Whiteboard.</li> </ul>	2.1 Interpret basic engineering instructions correctly. 2.2 Respond appropriately to written directions.	<ul style="list-style-type: none"> <li>Reading comprehension exercises.</li> </ul>	<ul style="list-style-type: none"> <li>Instruction sheets, logbook samples.</li> </ul>

	correct pronunciation of engineering terms.					
<b>GENERAL OBJECTIVE 3.0: Use Technical Vocabulary and Interpret Engineering Instructions.</b>						
<b>4-5</b>	<p>3.1 Identify common marine engineering technical terms.</p> <p>3.2 Explain operating and safety instructions.</p> <p>3.3 Discuss how step-by-step technical procedures are followed.</p>	<ul style="list-style-type: none"> <li>Lectures, guided vocabulary practice.</li> </ul>	<ul style="list-style-type: none"> <li>Technical manuals, Smartboard, Multimedia projector.</li> </ul>	<p>3.1 Demonstrate comprehension of engineering manuals.</p> <p>3.2 Apply vocabulary in simulated tasks.</p>	<ul style="list-style-type: none"> <li>Supervised reading tasks.</li> </ul>	<ul style="list-style-type: none"> <li>Instruction sheets, safety notices.</li> </ul>
<b>GENERAL OBJECTIVE 4.0: Understand Written Communication in Engineering Reports and Logbooks.</b>						
<b>6-7</b>	<p>4.1 Explain purpose of engineering reports and records.</p> <p>4.2 Write simple engineering reports and log entries.</p> <p>4.3 Use correct grammar and structure in technical writing.</p>	<ul style="list-style-type: none"> <li>Lectures, sample report analysis.</li> </ul>	<ul style="list-style-type: none"> <li>Report templates, Whiteboard, Smartboard.</li> </ul>	<p>4.1 Prepare basic engineering reports.</p> <p>4.2 Complete logbook entries correctly.</p>	<ul style="list-style-type: none"> <li>Supervised writing tasks.</li> </ul>	<ul style="list-style-type: none"> <li>Logbook samples, report templates.</li> </ul>
<b>GENERAL OBJECTIVE 5.0: Use Oral Communication in Engine-Room Operations.</b>						
<b>8-9</b>	5.1 Discuss the importance of	<ul style="list-style-type: none"> <li>Role-play scenarios,</li> </ul>	<ul style="list-style-type: none"> <li>Engine-room scenarios,</li> </ul>	5.1 Perform oral communication	<ul style="list-style-type: none"> <li>Role-play and simulations.</li> </ul>	<ul style="list-style-type: none"> <li>Communication scripts, audio</li> </ul>

	<p>effective communication with supervisors and colleagues.</p> <p>5.2 Express technical questions and provide clear, accurate responses.</p> <p>5.3 Apply communication etiquette in the engine room.</p>	<p>communication drills.</p>	<p>Smartboard, Multimedia projector.</p>	<p>tasks confidently.</p> <p>5.2 Demonstrate clarity and accuracy in spoken English.</p> <p>5.3 Use Standard Marine Communication Phrases to conduct routine engine-bridge exchanges.</p> <p>5.4 Compose clear engine-room log entries and watch handover reports.</p> <p>5.5 Interpret bridge orders and respond using correct maritime English.</p>		<p>recordings.</p>
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**General Objective 6.0: Understand Communication Skills in Routine and Emergency Situations.**

<b>10-11</b>	<p>6.1 Use appropriate language during routine operations.</p> <p>6.2 Communicate clearly during emergency situations.</p> <p>6.3 Recognize readiness for</p>	<ul style="list-style-type: none"> <li>Lectures, emergency communication drills.</li> </ul>	<ul style="list-style-type: none"> <li>Safety manuals, Smartboard, Multimedia projector.</li> </ul>	<p>6.1 Simulate communication during emergency drills.</p>	<ul style="list-style-type: none"> <li>Supervise role-play exercises.</li> </ul>	<ul style="list-style-type: none"> <li>Emergency communication scripts.</li> </ul>
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	professional duties.					
<b>General Objective 7.0: Know Professional Communication Etiquette and Confidence Onboard.</b>						
<b>12-13</b>	<p>7.1 Apply politeness strategies in communication.</p> <p>7.2 Demonstrate confidence in technical communication.</p> <p>7.3 Explain the importance of professional communication in ensuring safety.</p>	<ul style="list-style-type: none"> <li>Lectures, group discussions, case reviews.</li> </ul>	<ul style="list-style-type: none"> <li>Communication texts, Smartboard, Whiteboard.</li> </ul>	<p>7.1 Demonstrate professional etiquette in role-play.</p> <p>7.2 Evaluate communication scenarios.</p>	<ul style="list-style-type: none"> <li>Case review workshops.</li> </ul>	<ul style="list-style-type: none"> <li>Workplace scenarios, evaluation rubrics.</li> </ul>
<b>General Objective 8.0: Understand Reading, Listening, and Presentation Skills for Academic and Professional Contexts.</b>						
<b>14-15</b>	<p>8.1 Read and interpret marine engineering texts.</p> <p>8.2 Demonstrate listening comprehension of spoken instructions.</p> <p>8.3 Summarize information from oral and written sources.</p> <p>8.4 Deliver short oral</p>	<ul style="list-style-type: none"> <li>Guided reading, listening drills, comprehension exercises, presentation practice.</li> </ul>	<ul style="list-style-type: none"> <li>Audio recordings, technical texts, Smartboard, Whiteboard.</li> </ul>	<p>8.1 Respond to oral instructions accurately.</p> <p>8.2 Summarize written passages correctly.</p> <p>8.3 Deliver short presentations with clarity.</p>	<ul style="list-style-type: none"> <li>Supervised comprehension tasks, presentation practice.</li> </ul>	<ul style="list-style-type: none"> <li>Audio samples, comprehension worksheets, presentation rubrics, language laboratory.</li> </ul>

presentations.

**Course Assessment:**

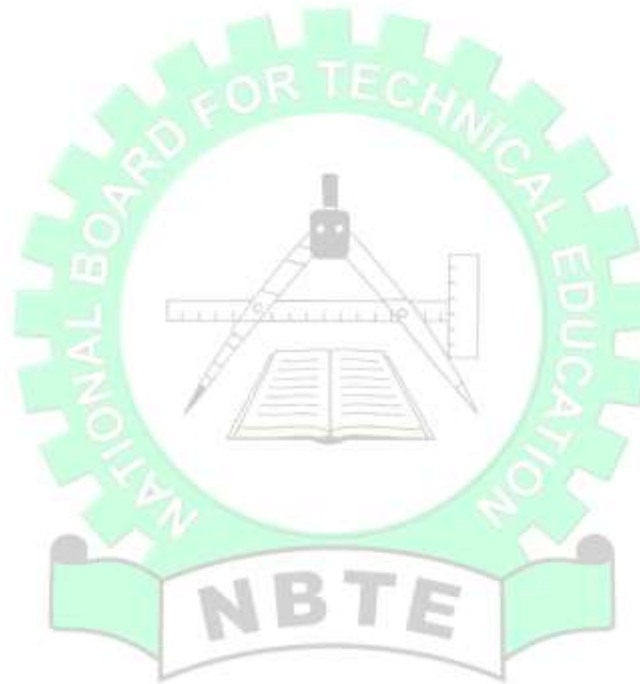
Course work: 10%

Test/Assignments: 10%

Practicals: 40%

Examination: 40%

**Total: 100%**



<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: RESEARCH METHODOLOGY</b>	<b>COURSE CODE: MAR 217</b>	<b>Contact Hours: 3 Hours/Week</b>
<b>Year: II Semester: I</b>	<b>Credit Unit: 3</b>	<b>Theoretical: 2 Hours/Week</b>
	<b>Pre-requisite:</b>	<b>Practical: 1 Hour/Week</b>
<b>GOAL: This course is to equip students with essential research skills and methodologies for identifying and investigating shipboard and navigation-related problems. It enables the students to collect and interpret data, review relevant literatures, and prepare structured research proposals and reports.</b>		
<b>GENERAL OBJECTIVES:</b>		
At the end of this course, the students should be able to:		
1.0 Understand the scientific approach to research and the nature of research problems; 2.0 Understand how to identify and formulate research problems; 3.0 Know how to design a research study, including hypothesis formulation, validation, and variables; 4.0 Understand Literature Review and apply appropriate sampling techniques; 5.0 Know how to collect, analyze, and interpret research data using suitable tools and techniques, including data analytic software; 6.0 Know how to prepare structured research proposals and report findings effectively.		
<b>COMPETENCES:</b>		
<ul style="list-style-type: none"> <li>• Perform scientific enquiry in Marine Engineering field</li> </ul>		

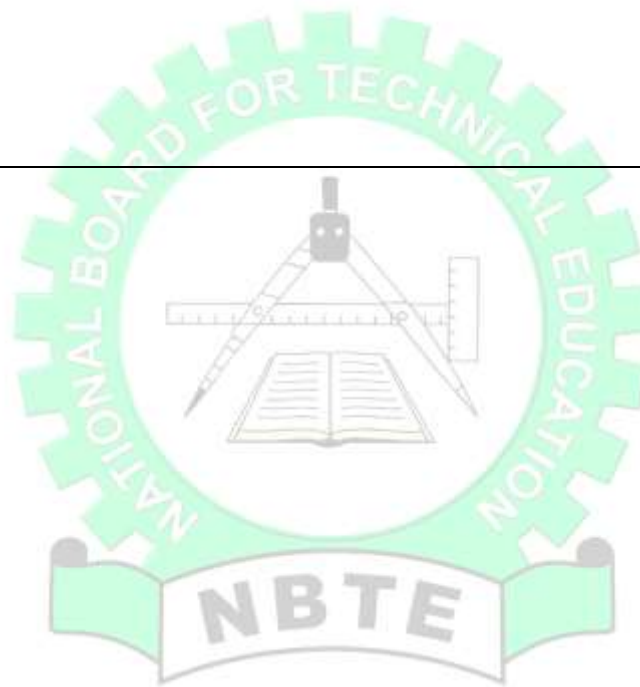
<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>						
<b>Course Title: RESEARCH METHODOLOGY</b>			<b>Course Code: NSC 217</b>		<b>Contact Hours: 3 Hours/Week</b>	
			<b>Credit Unit: 3</b>		<b>Theoretical: 2 Hours/Week</b>	
<b>Year: II Semester: I</b>			<b>Pre-requisite:</b>		<b>Practical: 1 Hour/Week</b>	
<b>COURSE SPECIFICATION: Theoretical and Practical</b>						
<b>GOAL: This course is to equip students with essential research skills and methodologies for identifying and investigating shipboard and navigation-related problems. It enables the students to collect and interpret data, review relevant literatures, and prepare structured research proposals and reports.</b>						
<b>General Objectives 1.0: Understand the scientific approach to research and the nature of research problems</b>						
<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>
1-2	1.1 Explain the meaning and importance of research. 1.2 Describe the characteristics of scientific research. 1.3 Differentiate research from routine operational inquiry. 1.4 Discuss research ecosystem.	<ul style="list-style-type: none"> <li>Lecture, class discussion with examples from navigation and ship operations.</li> <li>Use real-life situations aboard ships where research can improve operations.</li> <li>Case study discussion, group activity.</li> </ul>	Nautical journals, ship operation reports etc.			
<b>General Objective 2.0: Understand how to identify and formulate research problems.</b>						

3-5	<p>2.1 Define a research problem.</p> <p>2.2 Identify research problems related to maritime and related fields.</p> <p>2.3 Explain how to identify research gap in maritime and related fields.</p> <p>2.4 Prioritize problems based on relevance and feasibility.</p>	<ul style="list-style-type: none"> <li>• Brainstorming, guided discussion, examples from ship incidents.</li> <li>• Select research problems for mini-study Group exercises, peer discussion.</li> </ul>	<p>Laptop Computers, Smart Board, Projector, Writing Materials, White Board, Markers, Multi- Media Resources, Incident Reports, Ship Logs Etc</p>			
<p><b>General Objective 3.0: Understand research design, including hypothesis formulation, validation, and variables</b></p>						
6-8	<p>3.1 Explain the meaning and types of hypotheses in research.</p> <p>3.2 Formulate testable hypotheses (e.g., effect of fatigue on bridge watchkeeping).</p> <p>3.3 Identify independent, dependent, and control variables in nautical studies.</p>	<ul style="list-style-type: none"> <li>• Lecture, real-life examples from shipboard operations.</li> <li>• Formulate hypotheses and identify variables for a chosen shipboard problem.</li> <li>• Group exercises, guided practice.</li> </ul>	<p>Textbooks, slides, ship operation data Worksheets, ship logs, navigation scenarios etc.</p>			
<p><b>GENERAL OBJECTIVE 4.0: Understand literature review and apply appropriate sampling techniques.</b></p>						

9-11	<p>4.1 Explain the importance of reviewing research literature.</p> <p>4.2 Conduct literature search on maritime and related field..</p> <p>4.3 Explain sample and sampling techniques suitable for maritime and related field.</p> <p>4.4 Select sampling method for a small-scale study.</p>	<ul style="list-style-type: none"> <li>• Lecture, demonstration, library/online search.</li> <li>• Conduct a mini literature review and select sampling method maritime and related field.</li> <li>• Practical library/online search, group work study.</li> </ul>	Library, online databases, journals, IMO reports, ship operation manuals etc.	<ul style="list-style-type: none"> <li>• Conduct literature search on multi-media resources.</li> </ul>	<ul style="list-style-type: none"> <li>• Guide students to use to download papers.</li> </ul>	Computers, Multi-media resources. Practical manuals etc.
<b>General Objective 5.0: Know how to collect, analyze, and interpret research data using suitable tools and techniques.</b>						
12-13	<p>5.1 Explain data collection methods for research (Questionnaires, interviews, logs, surveys, and instruments).</p> <p>5.2 Explain data analysis techniques applicable to maritime and related field.</p> <p>5.3 Interpret results from data analysis.</p>	<ul style="list-style-type: none"> <li>• Lecture with examples from bridge or deck operations.</li> <li>• Demonstration, guided practice.</li> <li>• Explain data collection from bridge simulators or ship logs and perform basic analysis.</li> </ul>	SPSS, Excel, navigation data Bridge simulator, Excel, SPSS, ship logs	<ul style="list-style-type: none"> <li>• Use software package to collect, process and analyse data.</li> </ul>	<ul style="list-style-type: none"> <li>• Guide students to collect data.</li> <li>• Assist student to use software package.</li> </ul>	Computer, Data, Practical manual etc.
<b>General Objective 6.0: Understand application of basic research methods to prepare structured research proposals and report findings.</b>						
14-15	<p>6.1 Outline components of research proposal.</p> <p>6.2 Prepare a structured research proposal on maritime and related</p>	<ul style="list-style-type: none"> <li>• Lecture, review of sample nautical research reports.</li> <li>• Prepare a mini</li> </ul>	Sample proposals, evaluation rubric, bridge	<ul style="list-style-type: none"> <li>• Write a research proposal.</li> </ul>	<ul style="list-style-type: none"> <li>• Guide students to research</li> </ul>	Computer, Data, Practical

	field problems. 6.3 Present research findings in written and oral form relevant to maritime and related field.	research proposal and present findings to class. • Guide project work, peer review.	simulator data etc.		proposal.	manual etc.
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<b>Course Assessment:</b>						
Course work: 10%						
Test/Assignments: 10%						
Practical: 40%						
Examination: 40%						
<b>Total: 100%</b>						





**YEAR II SEMESTER II**

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: MARINE ENGINES AND PROPULSION SYSTEMS II</b>	<b>Course code: MAR 221</b>	<b>Contact Hours: 4hours/week</b>
<b>Year: II Semester: II</b>	<b>Credit Unit: 4</b>	<b>Theoretical: 2hours/week</b>
	<b>Pre-requisite: MAR 121</b>	<b>Practical: 2hours/week</b>
<p><b>GOAL: This course is designed to equip the students with competence in marine engines and propulsion systems, including engine performance monitoring, fuel injection systems, control and safety devices, troubleshooting, and routine maintenance, enabling them to operate, monitor, and support corrective actions on propulsion machinery safely and effectively, in accordance with STCW Code, Section A-III/1.</b></p>		
<p><b>GENERAL OBJECTIVES:</b> On completion of this course, the student should be able to:</p> <ol style="list-style-type: none"> <li>1.0 Understand Advanced Marine Diesel Engine Operation and Performance;</li> <li>2.0 Know Fuel Injection, Control and Monitoring Systems;</li> <li>3.0 Know Engine Faults, Troubleshooting and Corrective Actions;</li> <li>4.0 Know Maintenance, Safe Operation and Propulsion Readiness.</li> </ol>		
<p><b>COMPETENCES:</b></p> <ul style="list-style-type: none"> <li>• Operate main and auxiliary machinery and associated control systems</li> </ul>		

**PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY**

<b>Course Title: MARINE ENGINES AND PROPULSION SYSTEMS II</b>	<b>Course Code: MAR 221</b>	<b>Contact Hours: 4hours/week</b>
	<b>Credit Unit: 4</b>	<b>Theoretical: 2hours/week</b>
<b>Year: II Semester: II</b>	<b>Pre-requisite: MAR 121</b>	<b>Practical: 2 hours/week</b>

**COURSE SPECIFICATION:**

**General Objective1.0: Understand Advanced Marine Diesel Engine Operation and Performance.**

<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher’s Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher’s Activities</b>	<b>Resources</b>
<b>1-3</b>	1.1 Explain advanced operating principles of marine diesel engines. 1.2 Describe engine performance characteristics at different loads. 1.3 Explain engine efficiency. 1.4 Discuss engine power output 1.5 Explain factors affecting engine efficiency and power output. 1.6 Describe basic engine performance curves. 1.7 Explain safe operating limits.	<ul style="list-style-type: none"> <li>Lectures 1.1-1.7</li> <li>Performance curve analysis</li> <li>Relate performance trends to operating conditions.</li> </ul>	<ul style="list-style-type: none"> <li>PowerPoint slides, Smart boards, white board,</li> </ul>	1.1 Interpret basic performance data. 1.2 Use simulator or software packages to determine engine performance characteristics under different load scenarios. 1.3 Compute engine performance parameters (indicated power, brake power, thermal efficiency) from given test data.	<ul style="list-style-type: none"> <li>Guided data interpretation exercises</li> </ul>	<ul style="list-style-type: none"> <li>Engine performance charts, System diagrams, Simulator etc.</li> </ul>

<b>General Objective 2.0: Know Fuel Injection, Control and Monitoring Systems.</b>						
<b>4-7</b>	2.1 Explain principles of fuel injection systems. 2.2 Identify the components and the operation of the following Fuel Injection systems: i. fuel pump (Jerk, common rail, electronic injection) ii. Fuel injectors. 2.3 Describe the procedure of phasing and calibrating of an injector pump. 2.4 Explain the timing of an Injection pump 2.5 List the advantages and disadvantages of electronic fuel injection systems. 2.6 Explain engine control and protection systems. 2.7 Explain key engine parameters during operation. 2.8 Discuss the working principles of alarms and safety shutdowns.	<ul style="list-style-type: none"> <li>• Lectures 2.1-2.8</li> <li>• System walkthroughs</li> <li>• Explain control and alarm functions.</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board,</li> </ul>	2.1 Identify major components of marine propulsion systems and locate their control and monitoring points. 2.2 Identify fuel system components. 2.3 Carry out the timing of an Injection pump from first principles. 2.4 Use simulator to demonstrate the operation of shipboard fuel supply systems.	<ul style="list-style-type: none"> <li>• System identification exercises</li> </ul>	<ul style="list-style-type: none"> <li>• Fuel system schematics.</li> <li>• Control system diagrams.</li> <li>• Simulator</li> </ul>
<b>General Objective 3.0 Know Engine Faults, Troubleshooting and Corrective Actions.</b>						
<b>8-11</b>	3.1 Identify common marine diesel engine	<ul style="list-style-type: none"> <li>• Case-based lectures</li> <li>• Fault analysis</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides,</li> </ul>	3.1 Perform basic lubrication and	<ul style="list-style-type: none"> <li>• Fault-diagnosis</li> </ul>	<ul style="list-style-type: none"> <li>• Fault charts</li> <li>• Case studies</li> </ul>

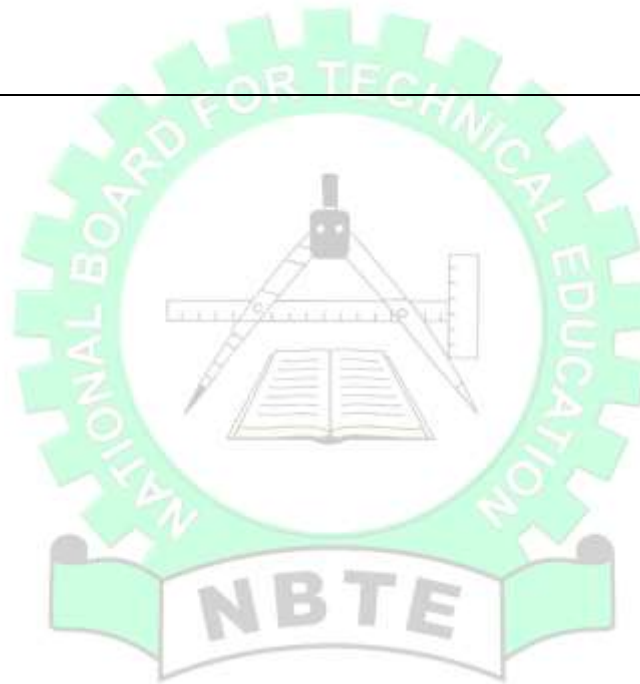
	<p>faults.</p> <p>3.2 Differentiate between symptoms and probable causes of faults identified in 3.1.</p> <p>3.3 Explain basic troubleshooting procedures.</p> <p>3.4 Explain corrective and reporting actions.</p> <p>3.5 Describe limitations of the operational-level intervention.</p>	discussions	Smart boards, white board,	<p>fuel system checks and record findings in the practical logbook.</p> <p>3.2 Diagnose faults in scenarios and suggest appropriate responses.</p>	exercises	<ul style="list-style-type: none"> <li>• Practical logbooks</li> </ul>
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**General Objectives 4.0: Know Maintenance, Safe Operation and Propulsion Readiness**

<b>12-15</b>	<p>4.1 Explain routine maintenance of propulsion machinery.</p> <p>4.2 Discuss how to apply correct procedures during engine start-up and shutdown.</p> <p>4.3 Describe monitoring propulsion systems for abnormal conditions.</p> <p>4.4 Discuss the need for maintaining accurate engine records and reports.</p> <p>4.5 Describe engine-room watchkeeping duties.</p>	<ul style="list-style-type: none"> <li>• Revision lectures</li> <li>• Maintenance planning discussions.</li> <li>• Explain correct operational sequences.</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board,</li> </ul>	<p>4.1 Perform engine start-up and shutdown following correct operational sequences.</p> <p>4.2 Demonstrate correct start-up and shutdown procedures and respond to common engine alarms.</p> <p>4.3 Use Simulator to monitor operating conditions of propulsion systems.</p> <p>4.4 Simulate watchkeeping duties using</p>	<ul style="list-style-type: none"> <li>• Scenario-based discussions and demonstrations.</li> </ul>	<ul style="list-style-type: none"> <li>• Maintenance schedules</li> <li>• Engine log samples</li> </ul>
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				simulator. 4.5 Demonstrate monitoring and reporting awareness.		
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**Course Assessment:**  
Course work: 10%  
Test/Assignments: 10%  
Practical: 40%  
Examination: 40%  
**Total: 100%**



<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: ELECTRICAL MACHINES AND SHIPBOARD POWER SYSTEMS</b>	<b>Course Code: MAR 222</b>	<b>Contact Hours: 4 hours/week</b>
<b>Year: II Semester: II</b>	<b>Credit Units: 4</b>	<b>Theoretical: 2 hours/week</b>
	<b>Pre-requisite: Marine Electro-Technology I</b>	<b>Practical: 2 hours/week</b>
<b>GOAL: This course is designed to equip students with knowledge and skills in the operation, protection, and maintenance of electrical machines and shipboard power systems, including generators, motors, switchboards, and distribution networks, aligned with STCW requirements for demonstrated competence.</b>		
<p><b>GENERAL OBJECTIVES:</b> On completion of this course, the student will be able to:</p> <ol style="list-style-type: none"> <li>1.0 Understand the principles and operating characteristics of electrical machines (AC and DC);</li> <li>2.0 Comprehend shipboard power generation arrangements and distribution systems;</li> <li>3.0 Understand the procedures for Shipboard Paralleling of Two or Three Generators for Synchronization;</li> <li>4.0 Understand switchboards, protective devices, and safety systems;</li> <li>5.0 Apply safe operating and isolation procedures in shipboard electrical systems;</li> <li>6.0 Demonstrate awareness of fault-finding and maintenance practices in marine electrical systems;</li> <li>7.0 Know how to relate electrical machines and power systems to STCW competencies for safe operation and maintenance;</li> <li>8.0 Know High Voltage (HV) systems (&gt;1,000 V), including operations, maintenance, isolation, and emergency response.</li> </ol>		
<p><b>COMPETENCES:</b></p> <ul style="list-style-type: none"> <li>• Maintenance and repair of electrical and electronic equipment</li> <li>• Safe operation of shipboard electrical systems.</li> <li>• Knowledge of High Voltage installations.</li> <li>• Safe working practices, PPE, isolation, and permit-to-work procedures.</li> <li>• Emergency response to HV faults.</li> </ul>		

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>						
<b>COURSE TITLE: ELECTRICAL MACHINES AND SHIPBOARD POWER SYSTEMS</b>		<b>Course Code: MAR 222</b>		<b>Contact Hours: 4 hours/week</b>		
		<b>Credit Unit: 3</b>		<b>Theoretical: 2 hours/week</b>		
<b>Year: II Semester: II</b>		<b>Pre-requisite: MARINE ELECTRO-TECHNOLOGY I</b>		<b>Practical: 2 hours/week</b>		
<b>COURSE SPECIFICATION: Theoretical and Practical</b>						
<b>General Objective 1.0: Understand the principles and operating characteristics of electrical machines (AC and DC).</b>						
<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>
1 - 3	1.1 Explain basic principles of electrical machines. 1.2 Distinguish between AC and DC machines. 1.3 Explain operating principles of generators and motors. 1.4 Identify common marine electrical machines.	<ul style="list-style-type: none"> <li>Lectures, worked examples, multimedia animations.</li> </ul>	<ul style="list-style-type: none"> <li>Electrical machine diagrams, rating plates, textbooks.</li> </ul>	1.1 Identify machine types and their principles of operations.	<ul style="list-style-type: none"> <li>Supervise identification exercises.</li> </ul>	<ul style="list-style-type: none"> <li>Machine samples, lab kits, etc.</li> </ul>
<b>General Objective: 2.0: Comprehend shipboard power generation arrangements and distribution systems.</b>						
4 - 5	2.1 Explain shipboard power generation arrangements. 2.2 Describe alternators and prime movers. 2.3 Explain shipboard distribution layouts. 2.4 Identify main and emergency power supplies. 2.5 Explain load	<ul style="list-style-type: none"> <li>Lectures, system walkthroughs, case studies.</li> </ul>	<ul style="list-style-type: none"> <li>Power system schematics, distribution diagrams.</li> </ul>	2.1 Trace power flow. 2.2 Identify power distribution components.	<ul style="list-style-type: none"> <li>Supervised tracing exercises.</li> </ul>	<ul style="list-style-type: none"> <li>Shipboard distribution boards, diagrams.</li> </ul>

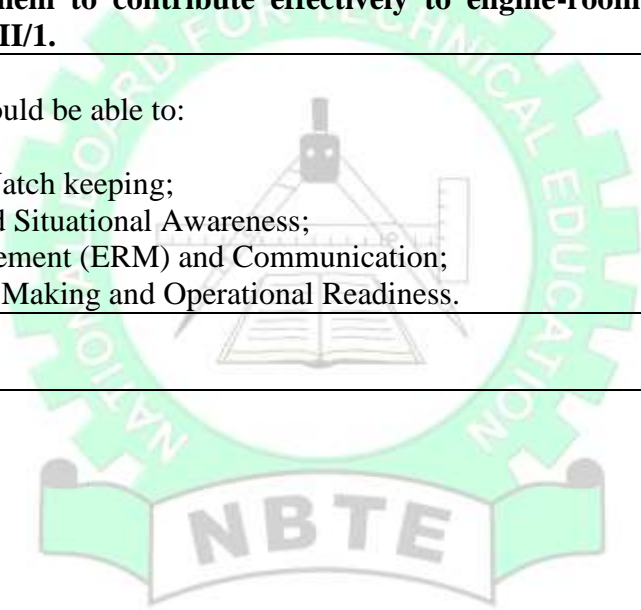
	management principles in Shipboard distribution systems.					
<b>General Objective: 3.0: Understand the procedures for Shipboard Paralleling of Two or Three Generators for Synchronization.</b>						
6 - 7	<p>3.1 Explain the principles of generator synchronization (voltage, frequency, phase sequence).</p> <p>3.2 Describe methods of paralleling two or more generators.</p> <p>3.3 Explain load-sharing principles and voltage drop characteristics.</p> <p>3.4 Discuss changeover arrangements between main and emergency generators.</p> <p>3.5 State SOLAS emergency power requirements and battery backup provisions.</p>	<ul style="list-style-type: none"> <li>Lecture with diagrams of synchronization panels; derive synchronization conditions; case studies of SOLAS requirements; worked examples of load-sharing calculations.</li> </ul>	<ul style="list-style-type: none"> <li>Generator diagrams; synchronization charts; SOLAS manuals; IMO/STCW references; projector.</li> </ul>	<p>3.1 Identify synchronization panel components and instruments.</p> <p>3.2 Demonstrate paralleling of two generators using trainer kits.</p> <p>3.3 Perform load-sharing adjustments and record current/voltage changes.</p> <p>3.4 Carry out changeover drill between main and emergency generator.</p> <p>3.5 Test emergency batteries and record performance.</p>	<ul style="list-style-type: none"> <li>Supervise synchronization exercises; guide paralleling and load-sharing drills; oversee changeover and battery testing; conduct safety briefing.</li> </ul>	<ul style="list-style-type: none"> <li>Generator trainer kits;</li> <li>Synchronization panels; battery test equipment;</li> <li>SOLAS/IMO manuals;</li> <li>PPE;</li> <li>Logbooks.</li> </ul>
<b>General Objective 4.0: Understand switchboards, protective devices, and safety systems.</b>						
8 - 9	<p>4.1 Explain functions of switchboards.</p> <p>4.2 Identify circuit breakers, fuses, protective relays.</p> <p>4.3 Explain overload and short-circuit protection.</p> <p>4.4 Describe earthing and</p>	<ul style="list-style-type: none"> <li>Lectures, safety discussions, case scenarios.</li> </ul>	<ul style="list-style-type: none"> <li>Switchboard layouts, protection device charts.</li> </ul>	<p>4.1 Identify protective devices and their safety features.</p>	<ul style="list-style-type: none"> <li>Scenario-based discussions, supervised identification.</li> </ul>	<ul style="list-style-type: none"> <li>Switchboard mock-ups, protective relays.</li> </ul>

	insulation monitoring. 4.5 Explain electrical hazards and how to mitigate them.					
<b>General Objective: 5.0: Apply safe operating and isolation procedures in shipboard electrical systems.</b>						
10 - 11	5.1 Apply safe operating procedures. 5.2 Explain isolation, lock-out and permit-to-work. 5.3 Identify common electrical faults. 5.4 Support routine inspection and reporting.	<ul style="list-style-type: none"> <li>Case-based lectures, revision sessions.</li> </ul>	<ul style="list-style-type: none"> <li>Safety manuals, isolation procedures.</li> </ul>	5.1 Demonstrate isolation steps. 5.2 Identify unsafe conditions.	<ul style="list-style-type: none"> <li>Scenario simulations, supervised drills.</li> </ul>	<ul style="list-style-type: none"> <li>Lock-out/tag-out kits, Electrical PPE.</li> </ul>
<b>General Objective: 6.0: Know how to relate awareness of fault-finding and maintenance practices in marine electrical systems.</b>						
12	6.1 Explain fault-finding principles. 6.2 Relate faults to shipboard systems. 6.3 Support maintenance planning.	<ul style="list-style-type: none"> <li>Lectures, fault case studies.</li> </ul>	<ul style="list-style-type: none"> <li>Fault scenarios, inspection checklists.</li> </ul>	6.1 Identify faults and suggest corrective actions.	<ul style="list-style-type: none"> <li>Supervised fault-finding exercises.</li> </ul>	<ul style="list-style-type: none"> <li>Fault simulation kits, shipboard diagrams.</li> </ul>
<b>General Objective: 7.0: Know how to relate electrical machines and power systems to STCW competencies for safe operation and maintenance.</b>						
13	7.1 Relate electrical machines to shipboard operation. 7.2 Demonstrate STCW compliance in electrical operations.	<ul style="list-style-type: none"> <li>Case-based lectures, STCW references.</li> </ul>	<ul style="list-style-type: none"> <li>IMO/STCW manuals, marine system drawings.</li> </ul>	7.1 Present electrical systems applications in marine context using simulator.	<ul style="list-style-type: none"> <li>Guided presentations, group discussions.</li> </ul>	<ul style="list-style-type: none"> <li>CAD projector, shipboard diagrams, Simulator.</li> </ul>
<b>General Objective 8.0: Know High Voltage Systems (&gt;1,000V), including operation, maintenance, isolation, and emergency response.</b>						
14 - 15	8.1 Explain principles of high-voltage systems (>1,000 V). 8.2 Identify hazards and risks associated with HV installations.	<ul style="list-style-type: none"> <li>Lecture on the difference between low-voltage and high-voltage systems,</li> </ul>	<ul style="list-style-type: none"> <li>IMO/STCW manuals.</li> <li>HV distribution schematics.</li> <li>Safety codes and PPE charts.</li> </ul>	8.1 Identify HV system components and their operating principles. 8.2 Demonstrate	<ul style="list-style-type: none"> <li>Supervise students in identifying HV components on training boards.</li> <li>Conduct hazard</li> </ul>	<ul style="list-style-type: none"> <li>HV training boards and simulators.</li> <li>Lock-out/tag-out kits.</li> <li>PPE (arc-flash</li> </ul>

<p>8.3 Describe shipboard HV distribution arrangements.</p> <p>8.4 Apply safe isolation and permit-to-work procedures.</p> <p>8.5 Explain emergency response actions when HV faults occur.</p>	<p>emphasizing insulation, clearances, and arc-flash risks.</p> <ul style="list-style-type: none"> <li>• Use diagrams to show typical shipboard HV distribution (e.g., propulsion drives, large alternators).</li> <li>• Discuss real case studies of HV accidents onboard ships to highlight hazards.</li> <li>• Explain PPE requirements and lock-out/tag-out procedures step by step.</li> <li>• Demonstrate how STCW Table A-III/6 integrates HV competence into operational training.</li> </ul>	<ul style="list-style-type: none"> <li>• Multimedia animations of HV switchgear.</li> </ul>	<p>awareness of HV hazards (arc flash, insulation failure, step potential).</p> <p>8.3 Trace HV distribution paths on diagrams and identify main/emergency HV supplies.</p> <p>8.4 Perform safe isolation steps</p> <p>8.5 Carry out permit-to-work procedures.</p>	<p>recognition drills (students point out unsafe practices in scenarios).</p> <ul style="list-style-type: none"> <li>• Guide tracing exercises on HV distribution diagrams.</li> <li>• Organize role-play of isolation and permit-to-work procedures with lock-out/tag-out kits.</li> </ul>	<p>suits, insulated gloves, face shields).</p> <ul style="list-style-type: none"> <li>• Shipboard HV distribution diagrams.</li> </ul>
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**Course Assessment:**  
 Course work: 10%  
 Test/Assignments: 10%  
 Practical: 40%  
 Examination: 40%  
**Total: 100%**

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: ENGINE-ROOM WATCHKEEPING AND RESOURCE MANAGEMENT</b>	<b>Course Code: MAR 223</b>	<b>Contact Hours: 2hours/Week</b>
<b>Year: II Semester: II</b>	<b>Credit Unit: 2</b>	<b>Theoretical: 2hours/Week</b>
	<b>Pre-requisite:</b>	<b>Practical: 0</b>
<p><b>GOAL:</b> This course is designed to equip the student with operational-level competence in maintaining a safe and efficient engineering watch, including watchkeeping duties, machinery monitoring, communication, situational awareness, fatigue management, and teamwork, enabling them to contribute effectively to engine-room safety, reliability, and performance, in accordance with STCW Code, Section A-III/1.</p>		
<p><b>GENERAL OBJECTIVES:</b> On completion of this course, the student should be able to:</p> <ol style="list-style-type: none"> <li>1.0 Know the Principles of Engineering Watch keeping;</li> <li>2.0 Understand Machinery Monitoring and Situational Awareness;</li> <li>3.0 Know Engine-Room Resource Management (ERM) and Communication;</li> <li>4.0 Know Fatigue Management, Decision-Making and Operational Readiness.</li> </ol>		
<p><b>COMPETENCES:</b></p> <ul style="list-style-type: none"> <li>• Maintain a safe engineering watch</li> </ul>		



<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>						
<b>COURSE TITLE: ENGINE-ROOM WATCHKEEPING AND RESOURCE MANAGEMENT</b>			<b>Course code: MAR 223</b>	<b>Contact hours: 2hours/week</b>		
			<b>Credit Unit: 2</b>	<b>Theoretical: 2hours/week</b>		
<b>Year: II Semester: II</b>			<b>Pre-requisite:</b>	<b>Practical: 0</b>		
<b>COURSE SPECIFICATION:</b>						
<b>General Objectives 1.0: Know the Principles of Engineering Watchkeeping</b>						
<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>
<b>1-3</b>	1.1 Explain the purpose and importance of engine-room watch keeping. 1.2 Describe duties and responsibilities of an engine-room watch keeper. 1.3 Identify watch keeping routines and handover procedures. 1.4 Explain the importance of log-keeping and record accuracy. 1.5 Explain operational limits and alarms in watchkeeping.	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Guided discussions.</li> <li>• Identify correct watchkeeping duties.</li> <li>• Explain proper handover procedures.</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board, etc.</li> </ul>			
<b>General Objective 2.0: Understand Machinery Monitoring and Situational Awareness.</b>						

<p><b>4-7</b></p>	<p>2.1 Monitor key machinery parameters during watch.                  2.2 Identify abnormal operating conditions.                  2.3 Explain alarm and indication systems.                  2.4 Identify common engine-room alarms and immediate actions.                  2.5 Apply situational awareness principles in the engine room.                  2.6 Demonstrate correct response to machinery deviations.</p>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Case-based explanations</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board</li> </ul>			
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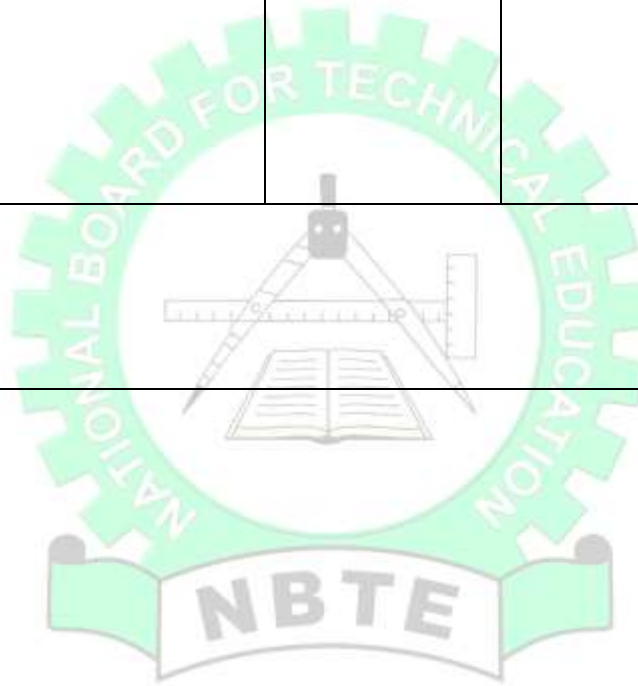
**General Objective 3.0 Know Engine-Room Resource Management (ERM) and Communication.**

<p><b>8-11</b></p>	<p>3.1 Explain principles of engine-room resource management.                  3.2 Demonstrate effective communication within the engine-room team.                  3.3 Explain leadership and followership roles at operational level.                  3.4 Discuss teamwork principles during routine and emergency operations.                  3.5 Describe cultural and human-element factors.</p>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Group discussions</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board</li> </ul>			
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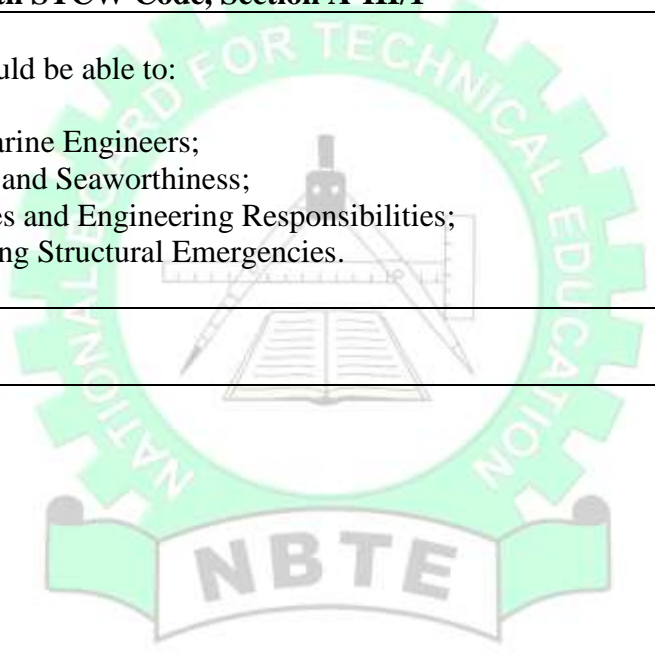
**General Objective 4.0: Know Fatigue Management, Decision-Making and Operational Readiness.**

12-15	<p>4.1 Explain causes and effects of fatigue in engine-room operations.</p> <p>4.2 Explain fatigue-mitigation strategies.</p> <p>4.3 Explain sound decision-making during watchkeeping.</p> <p>4.4 Describe how to respond appropriately to simulated watchkeeping emergencies.</p> <p>4.5 Discuss readiness for engine-room watchkeeping duties.</p>	<ul style="list-style-type: none"> <li>• Case-based lectures</li> <li>• Revision sessions</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board</li> </ul>			
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**Course Assessment:**  
 Course work: 20%  
 Test/Assignments: 20%  
 Examination: 60%  
**Total:** 100%



<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: NAVAL ARCHITECTURE AND SHIP CONSTRUCTION II</b>	<b>Course Code: MAR 224</b>	<b>Contact Hours: 4hours/week</b>
<b>Year: II Semester: II</b>	<b>Credit Unit: 4</b>	<b>Theoretical: 2hours/week</b>
	<b>Pre-requisite: MAR 214</b>	<b>Practical: 2hours/week</b>
<b>GOAL: This course is designed to equip the students with competence in ship stability, damage effects, and damage control, including engineering actions required to maintain seaworthiness during structural emergencies, enabling them to support safe ship operation and emergency response, in accordance with STCW Code, Section A-III/1</b>		
<b>GENERAL OBJECTIVES:</b> On completion of this course, the student should be able to: <ol style="list-style-type: none"> <li>1.0 Know Ship Stability Principles for Marine Engineers;</li> <li>2.0 Know Effects of Damage on Stability and Seaworthiness;</li> <li>3.0 Understand Damage Control Principles and Engineering Responsibilities;</li> <li>4.0 Understand Engineering Actions During Structural Emergencies.</li> </ol>		
<b>COMPETENCES:</b> <ul style="list-style-type: none"> <li>• Safety and seaworthiness of the ship</li> </ul>		



<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>						
<b>Course Title: NAVAL ARCHITECTURE AND SHIP CONSTRUCTION II</b>		<b>Course Code: MAR 224</b>		<b>Contact Hours: 4hours/week</b>		
		<b>Credit Unit: 4</b>		<b>Theoretical: 2hours/week</b>		
<b>Year: II Semester: II</b>		<b>Pre-requisite: MAR 214</b>		<b>Practical: 2hours/week</b>		
<b>COURSE SPECIFICATION:</b>						
<b>General Objective 1.0: Know Ship Stability Principles for Marine Engineers</b>						
<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>
1-4	1.1 Explain the concept of ship stability. 1.2 Explain state of equilibrium, positives, neutral and negative 1.3 Distinguish between stable, neutral, and unstable equilibrium. 1.4 Differentiate between stability principles from machinery loading and operation. 1.5 Discuss factors affecting ship stability. 1.6 Explain transverse and longitudinal stability 1.7 Explain terms such as centre of gravity, buoyancy, and meta-centre. 1.8 Determine centre of gravity and metacentric height by inclining	<ul style="list-style-type: none"> <li>Lectures</li> <li>Worked examples</li> </ul>	<ul style="list-style-type: none"> <li>PowerPoint slides, Smart boards, white board,</li> </ul>	1.1 Determine centre of gravity and metacentric height by inclining experiment(s). 1.2 Determine the Instability effect of shifting and changes of cargo on stability	<ul style="list-style-type: none"> <li>Diagram interpretation exercises</li> </ul>	<ul style="list-style-type: none"> <li>Stability diagrams.</li> <li>Hydrostatic curves.</li> <li>Simulator</li> </ul>

	<p>experiment</p> <p>1.9 Determine the instability effect of shifting and changes of cargo on stability.</p> <p>1.10 Describe stability of a ship under damage condition.</p> <p>1.11 Determine stability during small and big angle of heel.</p> <p>1.12 Describe loss of Buoyancy using added Weight methods.</p> <p>1.13 Describe free surface effects as it affects ship stability.</p>					
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**General Objective 2.0: Know Effects of Damage on Stability and Seaworthiness.**

<b>5-7</b>	<p>2.1 Explain causes of Hull damage and flooding.</p> <p>2.2 Describe effects of flooding on ship stability.</p> <p>2.3 Explain free surface effect and its consequences.</p> <p>2.4 Distinguish between structural damage from machinery safety.</p> <p>2.5 Discuss progressive flooding risks.</p>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Case discussions</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board,</li> </ul>	<p>2.1 Identify stability changes due to damage.</p> <p>2.2 Simulate the effects of flooding on ship stability using simulator.</p>	<ul style="list-style-type: none"> <li>• Scenario-based discussions</li> </ul>	<ul style="list-style-type: none"> <li>• Damage stability sketches</li> <li>• Flooding scenarios</li> </ul>
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**General Objective 3.0: Understand Damage Control Principles and Engineering Responsibilities**

<b>8 - 12</b>	<p>3.1 Explain principles of shipboard damage control.</p>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Emergency response</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white</li> </ul>	<p>2.1 Identify damage control systems.</p>	<ul style="list-style-type: none"> <li>• Scenario simulations</li> </ul>	<ul style="list-style-type: none"> <li>• Damage control plans</li> <li>• System</li> </ul>
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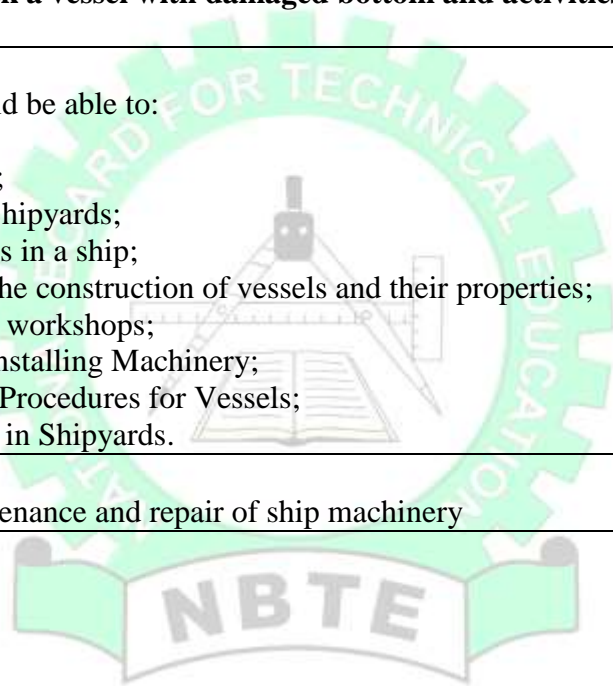
	<p>3.2 Identify damage control equipment and systems.</p> <p>3.3 Explain the roles of EOOW during damage control operations (watch engineer).</p> <p>3.4 Explain isolation of damaged systems.</p> <p>3.5 Discuss coordination with bridge team.</p>	<p>discussions</p> <ul style="list-style-type: none"> <li>• Explain isolation actions.</li> </ul>	<p>board</p>			<p>diagrams</p> <ul style="list-style-type: none"> <li>• Emergency procedures (e.g. collision, grounding, and bad weather)</li> </ul>
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**General Objectives 4.0: Understand Engineering Actions During Structural Emergencies**

<p>13 - 15</p>	<p>4.1 Explain engineering actions during collision or grounding.</p> <p>4.2 Discuss emergency pumping and stability recovery actions.</p> <p>4.3 Explain machinery operation considerations during emergencies.</p> <p>4.4 Describe stability and machinery status effectively.</p> <p>4.5 Discuss readiness for emergency response duties.</p>	<ul style="list-style-type: none"> <li>• Case-based lectures</li> <li>• Revision sessions</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board</li> </ul>	<p>4.1 Use Simulation exercises to:</p> <ol style="list-style-type: none"> <li>i. Recommend appropriate engineering actions.</li> <li>ii. Demonstrate situational awareness in emergencies.</li> </ol>	<ul style="list-style-type: none"> <li>• Scenario-based exercises</li> </ul>	<ul style="list-style-type: none"> <li>• Emergency procedures</li> <li>• Stability case studies, etc.</li> </ul>
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**Course Assessment:**  
 Course work: 10%  
 Test/Assignments: 10%  
 Practical: 40%  
 Examination: 40%  
**Total: 100%**

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: SHIPYARD TECHNOLOGY</b>	<b>Course Code: MAR 225</b>	<b>Contact Hours: 4hours/week</b>
<b>Year: II Semester: II</b>	<b>Credit Unit: 4</b>	<b>Theoretical: 2hours/week</b>
	<b>Pre-requisite:</b>	<b>Practical: 2hours/week</b>
<p><b>GOAL: This course is designed to equip students with general understanding of Shipyard Technology and Practice, layout of shipyards, basic ship design and construction, layout plan of shipyard and various workshops and their activities in a shipyard. How to dock and undock a vessel, and how to dock a vessel with damaged bottom and activities carried out before docking and undocking a vessel.</b></p>		
<p><b>GENERAL OBJECTIVES:</b> On completion of this course, the student should be able to:</p> <ol style="list-style-type: none"> <li>1.0 Know the Scope of a Modern Shipyard;</li> <li>2.0 Understand Modern and Ultramodern Shipyards;</li> <li>3.0 Understand activities of various sections in a ship;</li> <li>4.0 Understand various materials used for the construction of vessels and their properties;</li> <li>5.0 Understand safety practices in shipyard workshops;</li> <li>6.0 Know Piping Systems and Method of Installing Machinery;</li> <li>7.0 Know Inspection, Launching and Trial Procedures for Vessels;</li> <li>8.0 Understand General Safety Precautions in Shipyards.</li> </ol>		
<p><b>COMPETENCES:</b></p> <ul style="list-style-type: none"> <li>• Maintain seaworthiness of the Ship, maintenance and repair of ship machinery</li> </ul>		



**PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY**

<b>Course Title: SHIPYARD TECHNOLOGY</b>	<b>Course Code: MAR 225</b>	<b>Contact Hours: 4hours/week</b>
	<b>Credit Unit: 4</b>	<b>Theoretical: 2hours/week</b>
<b>Year: II Semester: II</b>	<b>Pre-requisite:</b>	<b>Practical: 2hours/week</b>

**COURSE SPECIFICATION: Theoretical and Practical**

**General Objective 1.0: Know the Scope of a Modern Shipyard**

<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>
<b>1-2</b>	1.1 Describe the types of shipyards 1.2 Give examples of shipyard workshops 1.3 Draw general plan of shipyards 1.4 Describe the layout of shipyard and working areas 1.5 Explain the functions of a ship drawing office 1.1 Describe steel ordering and storage.	<ul style="list-style-type: none"> <li>• Explain types of shipyards</li> <li>• Draw general shipyard plan</li> </ul>	<ul style="list-style-type: none"> <li>• Photographs, Sketches</li> <li>• Multimedia, Projector, Overhead projectors and slides, CDs etc.</li> </ul>	1.1 Write a technical report on individual visit to Shipyard(s)	<ul style="list-style-type: none"> <li>• Organise a visit to Shipyard(s)</li> </ul>	<ul style="list-style-type: none"> <li>• Practical manual, camera, writing materials, etc.</li> </ul>

**General Objective 2.0: Understand Modern and Ultramodern Shipyards**

<b>3-4</b>	2.1 Explain facilities and equipment used in a shipyard. 2.2 Describe the functions of the various production departments in a shipyard e.g., Engine shop, Boiler Shop, Foundry and	<ul style="list-style-type: none"> <li>• List the facilities and equipment found in shipyard</li> <li>• Use diagrams and videos to explain the operations of a shipyard</li> <li>• Summarize the factors to be</li> </ul>	<ul style="list-style-type: none"> <li>• Photographs, Sketches</li> <li>• Multimedia, Projector, Overhead projectors and slides, CDs, diskettes etc.</li> </ul>	2.1 Write a technical report on industrial visit to a shipyard(s).	<ul style="list-style-type: none"> <li>• Organise a visit to Shipyard(s)</li> </ul>	<ul style="list-style-type: none"> <li>• Practical manual, camera, writing materials, etc.</li> </ul>
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	<p>blacksmith's shop, sawmills, carpentry and joinery shop, pipe shop, light plate shop, mould lift shop, mould loft shop, mini-loft shop, prefabrication shop and different stores.</p> <p>2.3 Explain various ship building sites in a shipyard.</p> <p>2.4 Describe quality control in ship building explaining its relevance in modern day ship building practice and how it can be achieved during ship construction</p>	<p>considered before establishing a shipyard.</p>				
<b>General Objectives 3:0 Understand Activities of various Sections in a Shipyard</b>						
4-5	<p>3.1 Describe the processes of steel production.</p> <p>3.2 Describe steel production used for the hull of the ship.</p> <p>3.3 Describe L-D process of steel production and the amount of carbon contained in steel used for the ship's hull.</p> <p>3.4 Explain steel ordering, grading, storage and heat treatment of steels used for ship building such as annealing normalizing, hardening</p>	<ul style="list-style-type: none"> <li>Refer the students to online resources on steel production</li> <li>Engage the students in group discussions</li> </ul>	<ul style="list-style-type: none"> <li>Photographs, Sketches Multimedia, Projector, Overhead projectors and slides, CDs, diskettes etc.</li> </ul>	3.1	<p>Write a technical report on industrial visit to a Shipyard(s)</p>	<ul style="list-style-type: none"> <li>Visit Shipyard (shipbuilding)</li> </ul>

	<p>and tempering.</p> <p>3.5 Explain production of aluminium and its alloys, meaning of BS, N, P and E types of alloys.</p> <p>3.6 Describe ships lines plans e.g. plan, profile and section (half breadth plan) of ships plan.</p>					
<b>General Objectives 4.0: Understand various Materials used for the Construction of Vessels and their Properties</b>						
6-7	<p>4.1 Explain hull processing and fabrication, prefabrication, sub-assemblies and unit fabrication, unit erection etc.</p> <p>4.2 Describe surface preparation and painting of ship's hull. Mangles, shot blasting, sand blasting, hydro-blasting, pickling process, oxy-acetylene flames and hand cleaning.</p> <p>4.3 Explain priming painting, painting of regions below the water line, the superstructure, regions above water line and the internal structures.</p>	<ul style="list-style-type: none"> <li>• Explain hull processing and fabrication.</li> <li>• Give assignments to students on materials for constructing vessels.</li> </ul>	<ul style="list-style-type: none"> <li>• Photographs, Sketches Multimedia, Projector, Overhead projectors and slides, CDs, etc.</li> </ul>	4.1	<p>Write a technical report on industrial visit to a Shipyard(s)</p>	<ul style="list-style-type: none"> <li>• Visit Shipyard (shipbuilding)</li> <li>• Practical manual, camera, writing materials, etc.</li> </ul>

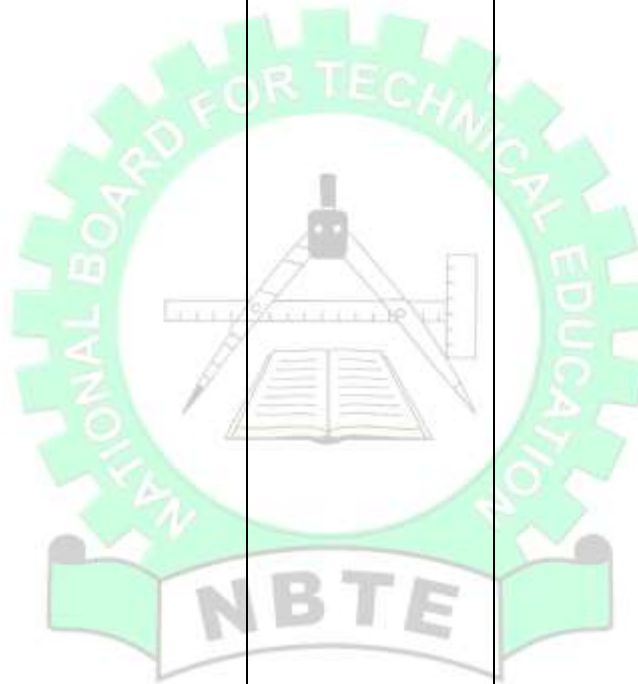
	<p>4.4 Describe the ships framing system, longitudinal and transverse systems.</p> <p>4.5 Discuss docking and undocking of vessels.</p> <p>4.6 Explain actions taken by ship's crew before going to dock.</p> <p>4.7 State how to dock a vessel with damaged bottom.</p> <p>4.8 Explain the processes taken to undock a vessel.</p>					
<b>General Objective 5.0: Know Piping Systems and Method of Installing Machinery</b>						
8-11	<p>5.1 Describe the general layout of deck machinery.</p> <p>5.2 List the criteria used in location of deck machinery.</p> <p>5.3 List the criteria for location of main propulsion unit and auxiliary machines.</p> <p>5.4 Explain with sketches, shafting arrangement of a ship.</p> <p>5.5 Sketch the pipe layout system for sea water system.</p>	<ul style="list-style-type: none"> <li>• Give a list of relevant textbooks to the students.</li> <li>• Introduce the standards to software applications to design pipeline systems.</li> </ul>	<ul style="list-style-type: none"> <li>• Photographs, Sketches, Multimedia, Projector, Overhead projectors and slides, CDs, etc.</li> </ul>	5.1	Use CAD/CAM software to develop Piping and Instrumentation Diagram(s)	
<b>General Objective 6.0: Know Inspection, Launching and Trial Procedures for Vessels</b>						
12-13	6.1 Outline the procedure of opening machinery	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Group discussions</li> </ul>	• Teaching	6.1	Use AI applications to	<ul style="list-style-type: none"> <li>• Explain with sketches,</li> </ul>

	<p>for inspection by classification societies</p> <p>6.2 Outline necessary preparation for dry docking of a vessel</p> <p>6.3 Outline the general services for a ship during dry docking</p> <p>6.4 List the information required for sea trial</p> <p>6.5 Outline necessary preparation for the launching of a new ship.</p>	<ul style="list-style-type: none"> <li>• Play videos that show how to launch a new ship</li> </ul>	<p>Aids</p> <ul style="list-style-type: none"> <li>• Visit to a dockyard</li> </ul>	<p>create contents of launching new ships</p>	<p>yard visit</p>	
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**General Objective 7.0: Understand General Safety Precautions in Shipyards**

<b>14-15</b>	<p>7.1 List all firefighting applications in a shipyard.</p> <p>7.2 Enumerate the precautions necessary to avoid electrical fire in welding workshop.</p> <p>7.3 List precautions necessary during welding.</p> <p>7.4 Observe shop safety and safe working conditions.</p> <p>7.5 List sources of hazards in a wood workshop such as:</p> <ol style="list-style-type: none"> <li>Handling and using hand tools, power tools and machines</li> <li>Stepping on or</li> </ol>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Expatiate on safety measures to be observed in Shipyards</li> <li>• Explain the risks associated with hazards in a shipyard</li> </ul>	<ul style="list-style-type: none"> <li>• Teaching Aids</li> <li>• Visit to a dockyard</li> </ul>	<p>7.1 Demonstrate firefighting equipment</p> <p>7.2 Wear personal protective equipment as required in Shipyards</p> <p>7.3 Use AI applications to create immersive contents on general safety precautions in shipyard.</p>	<ul style="list-style-type: none"> <li>• Explain with sketches and samples</li> <li>• Arrange shipyard visits</li> </ul>	<ul style="list-style-type: none"> <li>• AI apps, fire-fighting equipment, PPE, etc.</li> </ul>
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	<p>striking obstruction left on the floor or bench</p> <ul style="list-style-type: none"><li>iii. Lifting, moving and storing materials, using inflammable liquids</li><li>iv. Installing vapour or fumes</li><li>v. Identify how accident can occur through the various items in 7.5</li></ul> <p>7.6 Explain how accidents listed in 7.6 can be prevented</p> <p>7.7 List personal protective equipment essential in wood/welding workshop and their application in working situation e.g., shoes, non-flowing gowns, eye goggles, fire extinguishers, sand buckets, and water buckets.</p> <p>7.8 Apply the safety rules relating to:</p> <ul style="list-style-type: none"><li>i. Clothing and health hazards</li><li>ii. Working hygiene</li><li>iii. Movements and other behaviour of</li></ul>					
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	workers in a workshop					
	iv. Material handling					
	v. Tool handling, storage and uses					
	vi. Machines operation					
	vii. Fire prevention					

**Course Assessment:**

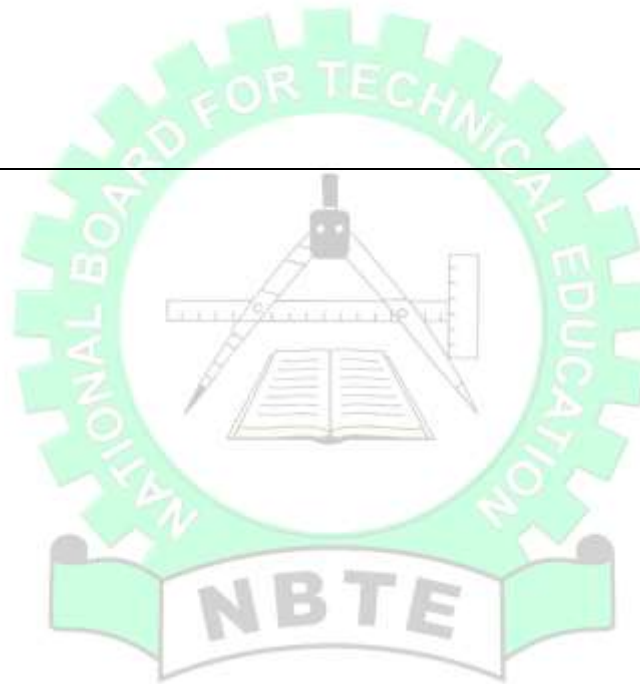
Course work: 10%

Test/Assignments: 10%

Practical: 40%

Examination: 40%

**Total: 100%**



<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: MARINE AUXILIARY MACHINERY II</b>	<b>Course Code: MAR 226</b>	<b>Contact Hours: 4hours/week</b>
<b>Year: II Semester: II</b>	<b>Credit Unit: 4</b>	<b>Theoretical: 2hours/week</b>
	<b>Pre-requisite: MAR 212</b>	<b>Practical: 2hours/week</b>
<p><b>GOAL: This course is designed to equip students with competence in marine auxiliary machinery and ship plant services, including applied boiler systems, compressors, steering gear, freshwater generation, and planned maintenance practices, enabling them to operate, monitor, and support maintenance of auxiliary machinery safely and efficiently, in accordance with STCW Code, Section A-III/1.</b></p>		
<p><b>GENERAL OBJECTIVES:</b> On completion of this course, the student should be able to:</p> <ol style="list-style-type: none"> <li>1.0 Understand Ship Plant Services and Auxiliary Machinery Integration;</li> <li>2.0 Know different kinds of Marine Pumps;</li> <li>3.0 Know different kinds of Compressors and Air Receivers;</li> <li>4.0 Know auxiliary boilers and steam condensers;</li> <li>5.0 Understand the freshwater system generator onboard ship;</li> <li>6.0 Understand Steering Gear Systems and Maintenance Awareness;</li> <li>7.0 Understand Capstan, Windlass and Winches;</li> <li>8.0 Understand Power Generating Machinery;</li> <li>9.0 Understand Bunkering System;</li> <li>10.0 Know Planned Maintenance Systems and Operational Readiness.</li> </ol>		
<p><b>COMPETENCES:</b></p> <ul style="list-style-type: none"> <li>• Operate auxiliary machinery and associated control systems</li> </ul>		

<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>						
<b>Course Title: MARINE AUXILIARY MACHINERY II</b>			<b>Course Code: MAR 226</b>		<b>Contact Hours: 4hours/week</b>	
			<b>Credit Unit: 4</b>		<b>Theoretical: 2hours/week</b>	
<b>Year: II Semester: II</b>			<b>Pre-requisite: MAR 212</b>		<b>Practical: 2hours/week</b>	
<b>COURSE SPECIFICATION: Theoretical and Practical</b>						
<b>General Objective 1.0: Understand Ship Plant Services and Auxiliary Machinery Integration</b>						
<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher's Activities</b>	<b>Resources</b>
<b>1</b>	1.1 Explain the concept of ship plant services. 1.2 Identify auxiliary systems supporting propulsion and hotel services. 1.3 Explain interdependence of auxiliary machinery systems. 1.4 Distinguish between plant services from safe and continuous ship operation. 1.5 Describe operational risks associated with auxiliary failures.	<ul style="list-style-type: none"> <li>Lectures 1.1-1.5</li> <li>System integration discussions</li> <li>Explain the operational roles of auxiliary systems supporting propulsion systems and hotel services.</li> </ul>	<ul style="list-style-type: none"> <li>PowerPoint slides, Smart boards, white board,</li> </ul>	1.1 Identify major plant service systems. 1.2 Operate common auxiliary machinery 1.3 Perform routine maintenance tasks.	<ul style="list-style-type: none"> <li>Diagram-based identification exercises</li> </ul>	<ul style="list-style-type: none"> <li>Plant service schematics</li> <li>Machinery layout drawings</li> </ul>
<b>General Objective 2.0: Know different kinds of Marine Pumps</b>						
<b>2</b>	2.1 List classifications of marine pumps. 2.2 Give examples of each class with their general characteristics. 2.3 Describe the construction and operation of a centrifugal	<ul style="list-style-type: none"> <li>Lectures 2.1-2.6</li> </ul>		2.1 Perform coupling and decoupling of pumps. 2.2 Operate centrifugal pumps and observe their characteristics.		<ul style="list-style-type: none"> <li>Centrifugal pumps, practical manuals, toolboxes, software packages,</li> </ul>

	<p>pump.</p> <p>2.4 Describe a submersible centrifugal pump with the aid of graphs.</p> <p>2.5 Explain the performance characteristics of a centrifugal pump using graphs (e.g. suction head, flow and efficiency).</p> <p>2.6 List shipboard applications of centrifugal pumps.</p>			<p>2.3 Perform pump priming and alignment, compressor maintenance checklist, purifier strip-down demonstration.</p> <p>2.4 Use competency checklists and require supervisor sign-off.</p> <p>2.5 Use software packages to simulate operation and performance of centrifugal pumps under different load conditions.</p> <p>2.6 Interpret pump performance curves and select appropriate pump operating points.</p>		<p>etc.</p>
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**General Objective 3.0 Know different kinds of Compressors and Air Receivers.**

<p>3</p>	<p>3.1 Explain operation of air compressors in starting air systems.</p> <p>3.2 Classify marine compressors (e.g. reciprocating, rotary centrifugal, low pressure and high pressure) and their drive systems.</p>	<ul style="list-style-type: none"> <li>• Lectures 3.1-3.9</li> </ul>	<ul style="list-style-type: none"> <li>• Diagrams</li> <li>• Photographs</li> <li>• Sketches</li> <li>• O/H projectors</li> <li>• Multimedia Projector</li> <li>• Models of compressors, slides,</li> </ul>	<p>3.1 Use CAD/CAM software to draw compressor systems and have Students practice same.</p> <p>3.2 Troubleshoot basic faults in compressors and</p>		
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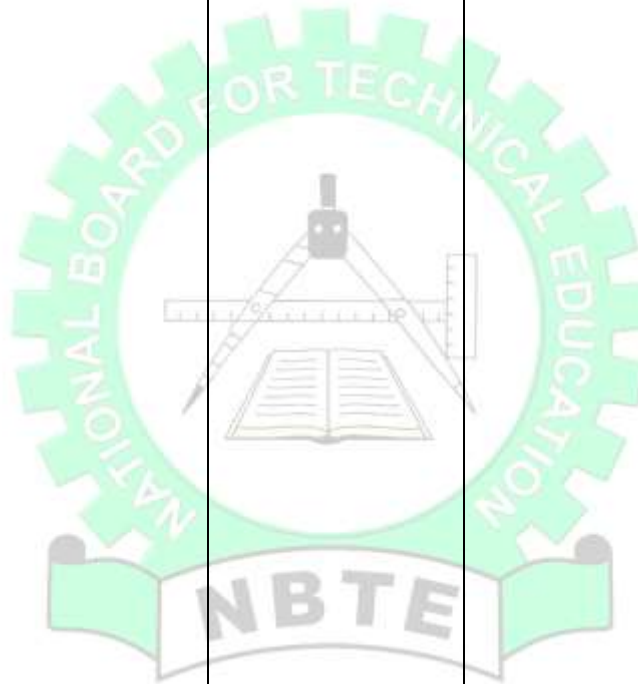
	<p>3.3 Explain the stages of compression (e.g. two and three stages).</p> <p>3.4 Carry out simple calculation based on an air-compressor (e.g. clearance volumetric efficiency).</p> <p>3.5 Explain the terms intercoolers and after cooler in relation to air compressors.</p> <p>3.6 Explain the essence of pressure relief valves, effect of leaking valves and automatic drain system.</p> <p>3.7 Illustrate how air receiving vessels are connected to a compressor.</p> <p>3.8 Describe construction and operation of air receivers.</p> <p>3.9 Describe the mountings and regulating systems of air receivers.</p> <p>3.10 Describe the safety devices and automatic drain systems.</p>		<p>transparencies, diskettes, CDs etc.</p>	<p>cooling systems and document corrective actions.</p>		
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**General Objective 4.0: Know auxiliary boilers and steam condensers.**

<p>4</p>	<p>4.1 Describe the working principles of steam condensers</p> <p>4.2 Describe the characteristics and regulations of a condenser</p> <p>4.3 Classify steam boiler.</p> <p>4.4 Describe the layout of a</p>	<ul style="list-style-type: none"> <li>• Lecture 4.1-4.10</li> <li>• Explain with sketches and have Students practice same.</li> </ul>	<ul style="list-style-type: none"> <li>• Diagrams</li> <li>• Photographs</li> <li>• Sketches</li> <li>• O/H projectors</li> <li>• Multimedia</li> <li>• Projector</li> <li>• Models of</li> </ul>	<p>4.1 Simulate the operation of a boiler.</p>	<ul style="list-style-type: none"> <li>• Arrange ship visits to see steam condensers and boilers</li> </ul>	<ul style="list-style-type: none"> <li>• Ship Visit</li> <li>• Full Mission Engine Simulator</li> </ul>
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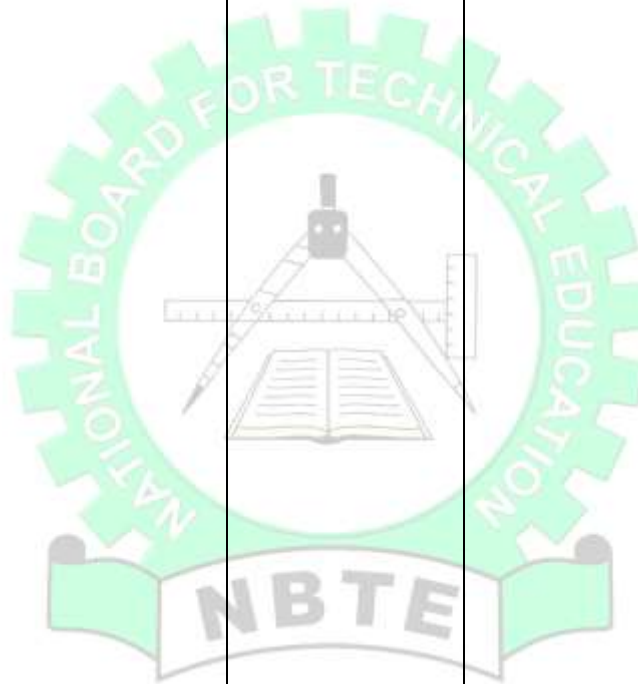
	<p>steam boiler.</p> <p>4.5 Describe the construction of the water tube boiler, fire tube boiler.</p> <p>4.6 Describe the methods of supplying feed water to a boiler.</p> <p>4.7 Describe the methods of firing a boiler, and boiler safety valves.</p> <p>4.8 Enumerate the safety, rules and regulations governing installation and operation of steam boilers.</p> <p>4.9 Differentiate between main boiler and auxiliary boilers.</p>		<p>compressors, slides, transparencies, diskettes, CDs etc.</p>			
<b>General Objective 5.0: Understand the freshwater system onboard.</b>						
5-6	<p>5.1 Describe the layout of domestic freshwater system in a ship using diagrams.</p> <p>5.2 Explain the uses and effect of misuse of freshwater onboard a ship.</p> <p>5.3 Mention some freshwater storage facilities onboard a ship.</p> <p>5.4 Describe the procedure for testing salinity of freshwater.</p> <p>5.5 Explain the sanitary system</p> <p>5.6 Describe a vacuum system on board.</p> <p>5.7 Enumerate the various uses of salt water on board a ship.</p>	<ul style="list-style-type: none"> <li>• Lecture</li> </ul>	<ul style="list-style-type: none"> <li>• Teaching Aids</li> <li>• Models of components e.g., freshwater generator, evaporator, hydrosphere systems.</li> <li>• Explain with sketches and have Students practice same</li> <li>• Arrange visits to see water systems</li> </ul>	<p>4.1 Use CAD/CAM software to draw the layout of domestic freshwater systems.</p> <p>4.2 Perform simple pipe joining task for distribution.</p>		

	<p>5.8 Explain the usefulness of a distilling plant on board a ship.</p> <p>5.9 List all types of distilling plants employed in the marine service.</p> <p>5.10 List the various parts of a distilling plant.</p> <p>5.11 Distinguish between evaporator type and vapour compression type of distilling plants.</p> <p>5.12 State the functions of the heating oil in the evaporator shell distiller.</p> <p>5.13 Describe how the brine density is controlled in a distiller.</p> <p>5.14 List all the causes of priming in the evaporator shell distiller.</p> <p>5.15 Describe the periodic maintenance carried out on distillers.</p> <p>5.16 Describe freshwater generator principles and operation.</p> <p>5.17 Classify types of valves (e.g. non-return, gate, safety, relief).</p> <p>5.18 Explain the construction of various types of valves.</p> <p>5.19 Explain the construction of a cock.</p>					
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**General Objective 6.0: Understand Steering Gear Systems and Maintenance Awareness**

7-8	<p>6.1 Explain the operation of hydraulic and electro-hydraulic steering gear systems.</p> <p>6.2 Identify main components and safety features of steering gear.</p> <p>6.3 Classify the steering gear system (e.g. Mechanical, Hydraulic, Electro-hydraulic, Electric)</p> <p>6.4 Describe the steering gear system.</p> <p>6.5 Describe steering gear central system, e.g. tele-motors, receiver rams, steering pumps, transmitter, follow-on system.</p> <p>6.6 Discuss the rules governing steering gears.</p> <p>6.7 Describe types and arrangements of rudders in connection with a steering gear.</p> <p>6.8 List the various parts of the tele-motor system of the steering gear.</p> <p>6.9 State the functions of the hunting rod of a steering gear.</p> <p>6.10 Explain the term creep test and how the test is carried out.</p> <p>6.11 Explain the meaning of</p>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Case-based discussions</li> <li>• Explain emergency response actions.</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board,</li> </ul>	<p>6.1 Identify steering gear components.</p> <p>6.2 Simulate the operation of a steering gear system using simulators.</p>	<ul style="list-style-type: none"> <li>• Scenario-based discussions</li> </ul>	<ul style="list-style-type: none"> <li>• Steering gear layouts</li> <li>• Safety manuals</li> <li>• Full Mission Engine Simulator</li> </ul>
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	<p>secondary steering position, local control and engineering steering.</p> <p>6.12 Explain routine inspection and maintenance requirements.</p> <p>6.13 Describe emergency steering arrangements.</p> <p>6.14 Discuss steering gear failure consequences.</p>					
<b>General Objectives 7.0: Understand Capstan, Windlass and Winches</b>						
<b>9-10</b>	<p>7.1 State the primary function of a capstan.</p> <p>7.2 State the primary function of a windlass.</p> <p>7.3 Distinguish between a windlass and a capstan.</p> <p>7.4 List out the security arrangement of the capstan, anchors and cables.</p> <p>7.5 Enumerate the use of winches.</p>	<ul style="list-style-type: none"> <li>Lectures</li> </ul>	<ul style="list-style-type: none"> <li>Internet, white board, computer, marker board, textbooks, etc.</li> </ul>			
<b>General Objective 8.0: Understand Power Generating Machinery.</b>						
<b>11-12</b>	<p>8.1 Define shipboard power generation.</p> <p>8.2 State the two traditional power distribution technique employed on board marine ships</p> <p>8.3 Distinguish between alternating and direct current supply.</p> <p>8.4 State the mode of supplying power to the main control switchboard.</p>	<ul style="list-style-type: none"> <li>Lectures</li> </ul>	<ul style="list-style-type: none"> <li>Internet, white board, computer, marker board, textbooks, etc.</li> </ul>	<p>8.1 Perform measurement of AC and DC voltages and currents using measuring instruments.</p> <p>8.2 Use simulator to demonstrate paralleling of generators (for auto and manual</p>	<ul style="list-style-type: none"> <li>Carryout the simulation and ask students to do same.</li> </ul>	

	<p>8.5 Illustrate the techniques of running generators in parallel.</p> <p>8.6 Demonstrate how to put a generator on-load and off-load</p> <p>8.7 Explain the three modes of power distribution onboard a ship.</p>			synchronization)		
<b>General Objective 9.0: Understand Bunkering Systems</b>						
13-14	<p>9.5 Discuss the term “Bunkering”.</p> <p>9.6 Explain the preparation for bunkering.</p> <p>9.7 Explain the methods of bunkering.</p> <p>9.8 State the functions of bunkering system.</p> <p>9.9 State the precautions while bunkering.</p>	<ul style="list-style-type: none"> <li>• Lectures</li> </ul>				
<b>General Objective 10.0: Know Planned Maintenance Systems and Operational Readiness.</b>						
15	<p>10.1 Explain principles of Planned Maintenance Systems (PMS).</p> <p>10.2 Analyse basic maintenance schedules and job cards.</p> <p>10.3 Describe routine maintenance procedures to auxiliary machinery.</p> <p>10.4 Explain basic maintenance records.</p> <p>10.5 Discuss readiness for engine-room</p>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Maintenance planning exercises</li> <li>• Explain maintenance priorities.</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board, etc.</li> </ul>	<p>10.1 Execute routine maintenance plans and schedule.</p>	<ul style="list-style-type: none"> <li>• Maintenance planning exercises</li> </ul>	<ul style="list-style-type: none"> <li>• PMS samples</li> <li>• Maintenance logs</li> </ul>

	watchkeeping and maintenance duties.					
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**Course Assessment:**

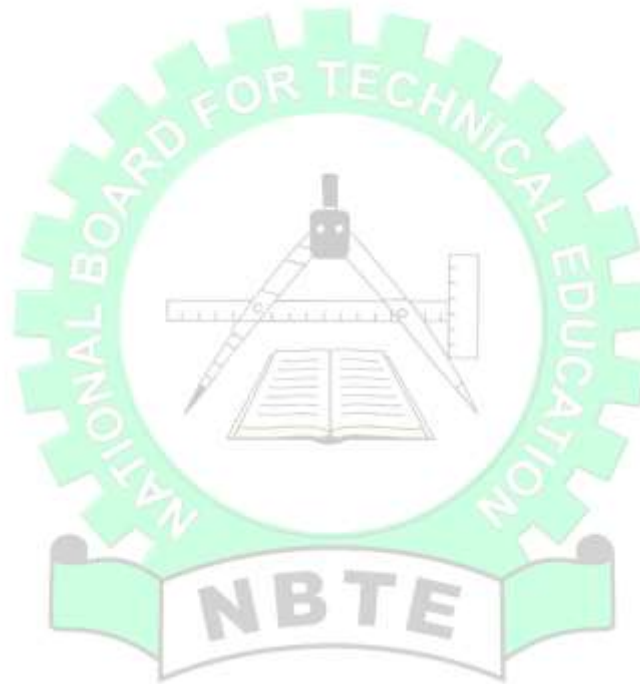
Course work: 10%

Test/Assignments: 10%

Practical: 40%

Examination: 40%

**Total: 100%**



<b>PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY</b>		
<b>COURSE TITLE: INTRODUCTION TO ENGINEERING MANAGEMENT AND MARITIME CONVENTIONS</b>	<b>Course code: MAR 227</b>	<b>Contact Hours: 2hours/week</b>
<b>Year: II Semester: II</b>	<b>Credit Unit: 2</b>	<b>Theoretical: 2hours/week</b>
	<b>Pre-requisite:</b>	<b>Practical: 0</b>
<p><b>GOAL: This course is designed to acquaint the students with competence in engineering management and maritime regulatory awareness, including basic management principles, safety management systems, international maritime conventions, compliance obligations, and professional responsibility, enabling them to support safe, efficient, and compliant engine-room operations, in accordance with STCW Code, Section A-III/1.</b></p>		
<p><b>GENERAL OBJECTIVES:</b></p> <p>At the end of this course, the students are expected to:</p> <ol style="list-style-type: none"> <li>1.0 Know Fundamentals of Engineering Management;</li> <li>2.0 Know the Basic Management Functions;</li> <li>3.0 Know Personnel Management Functions;</li> <li>4.0 Know Industrial Relations;</li> <li>5.0 Know Elements of Law;</li> <li>6.0 Know Basic Economics;</li> <li>7.0 Understand Maritime Conventions and Regulatory Frameworks;</li> <li>8.0 Know Safety Management Systems (SMS) in International Safety Management (ISM), and Documentation;</li> <li>9.0 Understand Leadership, Teamwork and Professional Judgment.</li> </ol>		
<p><b>COMPETENCES:</b></p> <ul style="list-style-type: none"> <li>• Apply leadership and teamwork skills; monitor compliance</li> </ul>		

**PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING TECHNOLOGY**

<b>Course Title: INTRODUCTION TO ENGINEERING MANAGEMENT AND MARITIME CONVENTIONS</b>	<b>Course Code: MAR 227</b>	<b>Contact Hours: 2hours/week</b>
	<b>Credit Unit: 2</b>	<b>Theoretical: 2hours/week</b>
<b>Year: II Semester: II</b>	<b>Pre-requisite:</b>	<b>Practical: 0</b>

**COURSE SPECIFICATION:**

**General Objectives 1.0: Know Fundamentals of Engineering Management**

<b>THEORETICAL CONTENT</b>				<b>PRACTICAL CONTENT</b>		
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher’s Activities</b>	<b>Resources</b>	<b>Specific Learning Outcome</b>	<b>Teacher’s Activities</b>	<b>Resources</b>
<b>1-2</b>	1.1 Explain the concept and scope of engineering management. 1.2 Explain the nature and scope of Management. 1.3 Explain objectives of Management. 1.4 Describe basic management functions (planning, organizing, directing, controlling). 1.5 Explain the role of management in engine-room operations. 1.6 Distinguish between management principles to maintenance and safety. 1.7 Describe professional responsibility in engineering roles.	<ul style="list-style-type: none"> <li>Lectures</li> <li>Guided discussions</li> <li>Relate management concepts to engine-room scenarios.</li> <li>Explain management decisions verbally.</li> <li>Scenario-based discussions</li> </ul>	<ul style="list-style-type: none"> <li>PowerPoint slides, Smart boards, white board, Management notes, Case examples</li> </ul>			

**General Objectives 2.0: Know the Basic Management Functions.**

<p><b>3-4</b></p>	<p>2.1 Outline the functions of Directors.                  2.2 Outline the functions of Managers.                  2.3 Discuss the influence of production on the viability of the company.                  2.4 Explain planning and control process.                  2.5 Explain the effect of work study, job analysis and specification to the decision-making process.                  2.6 Discuss the functions of a Ship's Master and Chief Engineer Officer.                  2.7 Discuss the functions of the Engineering Officer of the Watch (EOOW).</p>	<ul style="list-style-type: none"> <li>• Lecturers</li> <li>• Ask students questions</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board, Management notes, Case examples</li> </ul>			
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**General Objective 3.0: Know Personnel Management Functions.**

<p><b>5-6</b></p>	<p>3.1 State various manpower selection and training methods.                  3.2 State various methods of advertising for recruitment.                  3.3 Discuss interview techniques.                  3.4 Outline industrial training schemes.                  3.5 Discuss the merits of on-the-job training.                  3.6 Discuss the effect of incentive on production level.</p>	<ul style="list-style-type: none"> <li>• Lecturers</li> <li>• Ask students questions</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board, Management notes, Case examples</li> </ul>			
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**General Objective 4.0: Know Industrial Relations**

7-8	<p>4.1 Outline employee-employer relationship in an organization.</p> <p>4.2 Discuss trade unions, strikes and lockouts.</p> <p>4.3 Discuss the advantages and disadvantages of having trade unions in an organization and collective bargaining.</p> <p>4.4 Discuss the role of industrial arbitration.</p> <p>4.5 Discuss workers participation in management.</p>	<ul style="list-style-type: none"> <li>• Lecturers</li> <li>• Ask students questions</li> <li>• Refer students to relevant textbooks, e-book and online resources</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board, Management notes, Case examples</li> </ul>			
<b>General Objective 5.0: Know Elements of Law.</b>						
9-10	<p>5.1 Discuss elements of legislation, wages act, workman’s compensation etc.</p> <p>5.2 Define a contract.</p> <p>5.3 Distinguish between an agreement and a contract.</p> <p>5.4 Explain elements of a valid contract.</p> <p>5.5 Enumerate contract obligations on both parties.</p>	<ul style="list-style-type: none"> <li>• Lecturers</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board, Management notes, Case examples</li> </ul>			
<b>General Objective 6.0: Know Basic Economics.</b>						
11-12	<p>6.1 Outline the basic concept and scope of economics.</p> <p>6.2 Explain the demand and supply theory.</p> <p>6.3 Discuss costing and pricing concepts.</p> <p>6.4 Describe the straight-line method of evaluating</p>	<ul style="list-style-type: none"> <li>• Lecturers</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board, Management notes, Case examples</li> </ul>			

	equipment depreciation.					
<b>General Objective 7.0: Understand Maritime Conventions and Regulatory Frameworks.</b>						
<b>13</b>	<p>7.1 Identify major international maritime conventions affecting engineers and EOOWs.</p> <p>7.2 Explain the purpose of SOLAS, MARPOL, and STCW (awareness level).</p> <p>7.3 Explain flag-state and company compliance responsibilities.</p> <p>7.4 Explain consequences of non-compliance.</p>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Convention overview sessions</li> <li>• Identify conventions relevant to given scenarios.</li> <li>• Explain compliance requirements.</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board,</li> </ul>			
<b>General Objective 8.0: Know Safety Management Systems (SMS) in International Safety Management (ISM), and Documentation.</b>						
<b>14</b>	<p>8.1 Explain the purpose of the ISM Code.</p> <p>8.2 Describe safety management responsibilities of engineering personnel.</p> <p>8.3 Explain the importance of procedures and documentation.</p> <p>8.4 Discuss reporting of non-conformities and incidents.</p> <p>8.5 Describe awareness of safety culture on-board ships.</p>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Documentation walkthroughs</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board,</li> </ul>			
<b>General Objective 9.0: Understand Leadership, Teamwork and Professional Judgement</b>						
<b>15</b>	<p>9.1 Explain basic leadership and teamwork principles at operational level.</p> <p>9.2 Describe effective communication within the engine-room team.</p> <p>9.3 Explain decision-making</p>	<ul style="list-style-type: none"> <li>• Case-based lectures</li> <li>• Group discussions</li> </ul>	<ul style="list-style-type: none"> <li>• PowerPoint slides, Smart boards, white board,</li> </ul>			

	responsibilities of marine engineers. 9.4 Discuss professional judgment in compliance-related scenarios. 9.5 Describe responsible shipboard conduct.					
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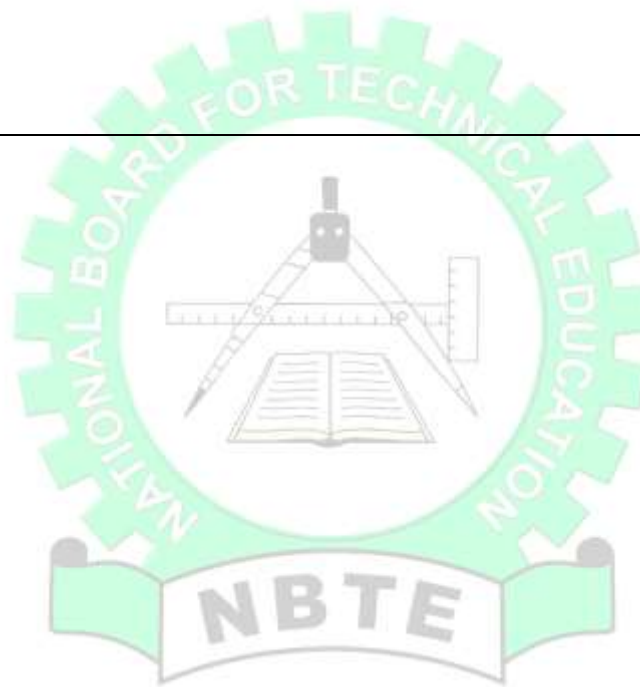
**Course Assessment:**

Course work: 20%

Test/Assignments: 20%

Examination: 60%

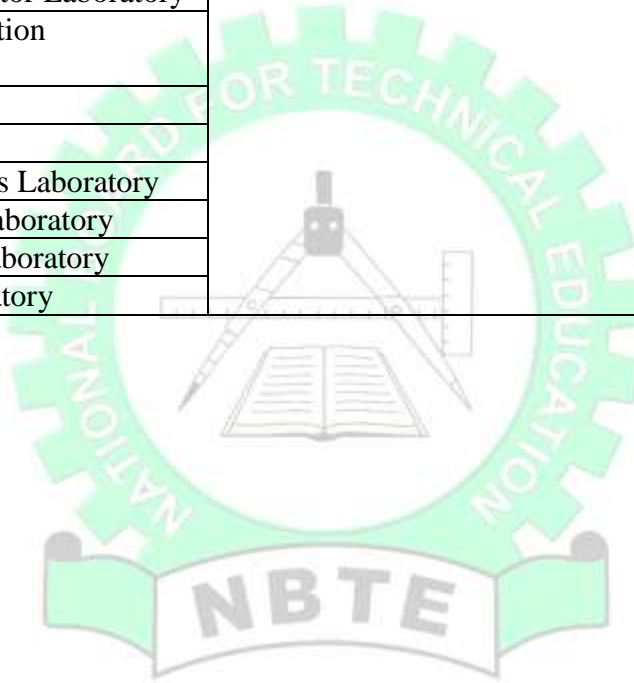
**Total: 100%**



## LIST OF MINIMUM RESOURCES

### FACILITIES REQUIRED FOR ND MARINE ENGINEERING TECHNOLOGY PROGRAMME

S/N	LABORATORIES	WORKSHOPS	OTHER
1.	Marine Auxiliary Systems Laboratory	Marine Engineering Workshop	1. Drawing Studio 2. Safety and Firefighting Training Yard
2.	Marine Propulsion and Engine Simulator Laboratory		
3.	Naval Architecture and Ship Construction Laboratory		
4.	Electrical and Electronics Laboratory		
5.	Computer and CAD Laboratory		
6.	Thermodynamics and Fluid Mechanics Laboratory		
7.	Materials and Strength of Materials Laboratory		
8.	Refrigeration and Air Conditioning Laboratory		
9.	Communication and Language Laboratory		



**LIST OF EQUIPMENT AND TOOLS REQUIRED FOR ND MARINE ENGINEERING TECHNOLOGY**

Laboratory/Workshop Type	Category	Specific Tools/Equipment	Recommended Quantity	Notes
<b>1. MARINE ENGINEERING WORKSHOP</b>	<b>Hand Tools</b>	Ball peen hammers	20	Various sizes
		Chisels (flat, cross-cut)	20 sets	Assorted sizes
		Files (flat, round, half-round, triangular)	40 sets	Complete sets
		Hacksaws with blades	20	With spare blades
		Screwdrivers (flat, Phillips, Pozidriv)	40 sets	Insulated handles
		Adjustable spanners	20	6-12 inch range
		Ring spanners set	20 sets	Metric and imperial
		Socket sets	20 sets	¼" and ½" drive
		Pliers (combination, needle-nose, side cutters)	40 sets	3 types minimum
		Vice grips	20	Various sizes
		Punches (centre, pin, drift)	20 sets	Assorted
		Scribers	20	
		Try squares	20	150mm and 300mm
		Marking gauges	20	
		Dividers	20	
		Calipers (inside, outside)	20 sets	
		Tap and die sets	20 sets	Metric and imperial
		Riveting hammers and sets	10 sets	
		<b>Measuring Instruments</b>	Steel rules (150mm, 300mm, 600mm)	40 sets
	Vernier calipers (0.02mm accuracy)		20	Digital preferred
	Micrometers (external, internal, depth)		20 sets	0-25mm, 25-50mm
	Height gauges		10	Digital readout
	Dial indicators with stands		20 sets	0.01mm resolution
Slip gauge sets	5 sets		Grade 2	

		Sine bars	10	100mm and 200mm
		Surface plates (granite)	4	Grade A, 1000x750mm
		Spirit levels (precision)	20	300mm length
		Feeler gauges	20 sets	Metric and imperial
		Thread pitch gauges	20 sets	
		Radius gauges	10 sets	
	<b>Machine Tools</b>	Centre lathes (with chucks, faceplates, steadies)	8	Minimum 1m bed
		Drilling machines (bench, pillar, radial)	8	13mm capacity minimum
		Milling machines (vertical/horizontal)	6	
		Shaping machines	4	
		Grinding machines (pedestal, tool and cutter)	4	
		Power hacksaws	4	
		Bending machines	2	Manual or hydraulic
		Shearing machines	2	Bench type
		CNC machines (basic training models)	2	Optional but recommended
		<b>Welding and Fabrication</b>	Arc welding machines (AC/DC)	10
	Gas welding sets (oxygen and acetylene cylinders, regulators, torches)		10 sets	Complete sets
	TIG welding sets		4	
	MIG welding sets		4	
	Welding electrodes (various types/sizes)		Bulk	Yearly supply
Welding screens/curtains	10			
Chipping hammers	20			
Wire brushes	40			

		Soldering irons/stations	20	40W minimum	
		Brazing equipment	10 sets		
		Plasma cutter (training model)	2	Optional	
	<b>Safety Equipment</b>	Safety goggles/face shields	100	One per student plus spares	
		Welding helmets (auto-darkening)	20		
		Earmuffs/plugs	100		
		Gloves (leather, heat-resistant, rubber)	100 pairs	Various types	
		Aprons/boiler suits	100		
		Safety boots (steel toe)	100 pairs		
		Fire extinguishers (CO <sub>2</sub> , foam, dry powder)	20	Strategically placed	
		First aid kits	5	Wall mounted	
		Fume extractors	10	Mobile units	
		Safety signage	Complete set	All required signs	
		Non-slip mats	10	For workshop floor	
		<b>Consumables</b>	Cutting fluids/coolants	Bulk	Yearly supply
			Lubricating oils/grease	Bulk	Yearly supply
	Emery cloth/sandpaper		Bulk	Various grits	
	Cleaning solvents		Bulk	Yearly supply	
	Marking inks/dyes		Bulk		
	Workshop rags		Bulk		
<b>2. ELECTRICAL AND ELECTRONICS LABORATORY</b>	<b>Electrical Machines</b>	DC motors/generators (various ratings)	10 sets	0.5-2kW range	
		AC motors (single/three-phase)	10 sets	0.5-3HP range	
		Transformers (step-up/down)	10 sets	Various ratios	
		Alternators	5	Small capacity	
		Starters (DOL, star-delta, auto-transformer)	10 sets		
	Motor control panels	10	With protection devices		
<b>Measuring Instruments</b>	Digital multimeters	20	Auto-ranging preferred		

	Analog multimeters	10	For basic training
	Clamp meters	10	
	Insulation testers (meggers)	10	500V/1000V
	Wattmeters (single/three-phase)	10	
	Energy meters	10	Single phase
	Oscilloscopes (dual trace)	10	50MHz minimum
	Function generators	10	2MHz minimum
	Power supplies (variable AC/DC)	20	Dual output preferred
	Frequency counters	5	
	Phase sequence indicators	10	
<b>Electrical Panels and Components</b>	Distribution boards (single/three-phase)	10	With meters and protection
	Circuit breakers (MCB, MCCB, ELCB)	40 sets	Various ratings
	Relays (overcurrent, under-voltage, time delay)	40 sets	
	Contactors	40	Different sizes
	Switches (toggle, rotary, push-button)	100	Various types
	Fuses and fuse carriers	100 sets	
	Terminal blocks	200	
	Wiring cables (various sizes/colors)	Bulk	Yearly supply
	Conduit and trunking	Bulk	PVC and metal
	<b>Electronics Kits</b>	Breadboards	40
Resistors, capacitors, inductors (assorted)		Bulk	Complete range
Diodes, transistors, LEDs		Bulk	Various types
Integrated circuits (op-amps, timers, regulators)		Bulk	Common types
Soldering stations with vacuum pumps		20	Temperature controlled
PCB etching kits		10	Complete sets
<b>Safety Equipment</b>	Insulated tools	40 sets	Screwdrivers,

				pliers
		Rubber mats	20	For floor
		Warning signs	Complete set	
		Emergency stop buttons	10	Wall mounted
<b>3. COMPUTER AND CAD LABORATORY</b>	<b>Hardware</b>	Desktop computers (minimum i5, 8GB RAM, dedicated graphics)	40	1:2 student ratio
		A3/A4 printers	4	Networked
		Plotters	2	A1 size
		Scanners	4	
		Projectors with screens	2	Ceiling mounted
		Network switches/routers	4	24-port minimum
		Uninterruptible power supplies	10	For computers and servers
		<b>Software</b>	Windows/Linux OS	40 licenses
	AutoCAD/Autodesk Inventor		40 licenses	Educational version
	SolidWorks/CATIA		40 licenses	Educational version
	Microsoft Office		40 licenses	
	Programming IDEs (Python, C++)		40 licenses	
	Marine simulation software		5 licenses	Optional
	<b>Furniture and Accessories</b>	Computer tables/chairs	40 sets	Ergonomic
		Drawing tables with parallel motion	20	For manual drafting
		T-squares, set squares, French curves	40 sets	
		Drawing boards	20	A2 size
		Scales (metric/imperial)	40 sets	
		Compasses, dividers	40 sets	
Drawing instrument sets		40	Complete sets	
<b>4. THERMODYNAMICS AND FLUID MECHANICS LABORATORY</b>	<b>Thermodynamics Equipment</b>	Fire-tube boiler model	2	Working models
		Water-tube boiler model	2	Working models
		Steam engine demonstration unit	2	
		Bomb calorimeter	2	
		Constant pressure calorimeter	4	

		Heat exchanger models (shell and tube, plate)	4 sets	
		Refrigeration test rig	4	
		Air compressor test rig	4	
		Psychrometers	10	Sling type
	<b>Fluid Mechanics Equipment</b>	Hydraulic benches	8	With accessories
		Centrifugal pump test rig	4	
		Reciprocating pump test rig	4	
		Pelton wheel turbine	2	
		Francis turbine model	2	
		Kaplan turbine model	2	
		Orifice/venturi flow meters	8 sets	
		Pipe friction apparatus	4	
		Bernoulli's theorem apparatus	4	
		Metacentric height apparatus	4	
	<b>Measuring Instruments</b>	Reynolds apparatus	4	
		U-tube/inclined manometers	20	
		Pitot-static tubes	10	
		Pressure gauges (Bourdon tube)	40	Various ranges
		Temperature sensors (RTD, thermocouple)	40	With indicators
		Flow meters (rotameter, electromagnetic)	20	
<b>5. MATERIALS AND STRENGTH OF MATERIALS LABORATORY</b>	<b>Testing Machines</b>	Tachometers (digital/contact)	10	
		Universal testing machine (100kN capacity)	2	Computerized preferred
		Impact testing machine (Izod/Charpy)	2	
		Hardness testers (Brinell, Rockwell, Vickers)	4 sets	
		Torsion testing machine	2	
		Fatigue testing machine	1	Optional
	Creep testing apparatus	2		
<b>Metallurgy</b>	Metallurgical microscopes (with	4	1000x	

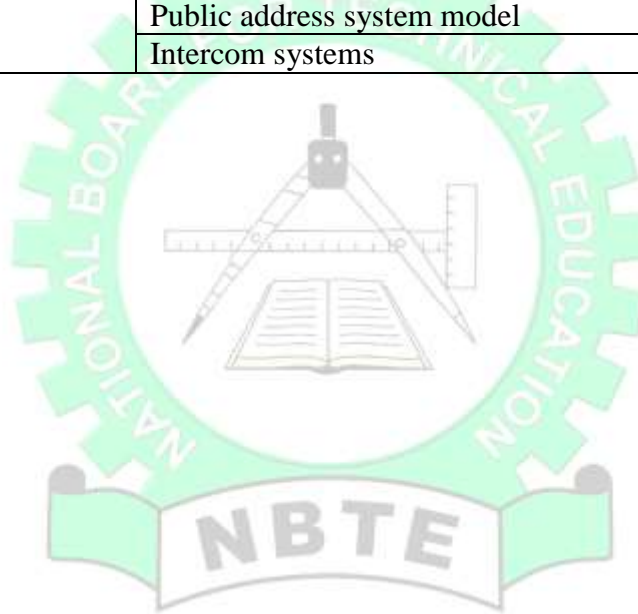
<b>6. MARINE AUXILIARY SYSTEMS LABORATORY</b>	<b>Equipment</b>	cameras)		magnification
		Sample cutting machines	2	
		Mounting presses	2	
		Grinding/polishing machines	4	
		Etching equipment	4 sets	
		Muffle furnaces	2	Up to 1200°C
		Jominy end-quench apparatus	2	
	<b>Measuring Instruments</b>	Extensometers	10	
		Strain gauges with data acquisition	10 sets	
		Dial gauges (0.01mm accuracy)	20	
		Vernier height gauges	10	
		Surface roughness tester	2	
	<b>Pumps</b>	Centrifugal pumps (single/multi-stage)	8	Various sizes
		Reciprocating pumps	4	
		Gear pumps	4	
Screw pumps		2		
Diaphragm pumps		2		
<b>Compressors</b>		Reciprocating air compressors	4	
		Rotary screw compressors	2	
<b>Heat Exchangers</b>		Shell and tube heat exchangers	4	
		Plate heat exchangers	4	
		Finned tube heat exchangers	2	
<b>Valves (working models)</b>	Gate, globe, check valves	20 sets	Various sizes	
	Butterfly, ball, diaphragm valves	20 sets		
	Safety/relief valves	10		
	Control valves (pneumatic/electric)	10		
<b>Piping Systems</b>	Pipe sections (steel, copper, PVC)	Bulk	Various diameters	
	Flanges, gaskets, fittings	Bulk	Assorted	
	Pipe bending/threading tools	8 sets		
	Pipe support systems	8 sets		
<b>Other Equipment</b>	Oil-water separator model	2		
	Incinerator model	2		
	Sewage treatment plant model	2		

<b>7. MARINE PROPULSION AND ENGINE SIMULATION LABORATORY</b>	<b>Engine Models</b>	Fresh water generator model	2	
		Cutaway 2-stroke diesel engine	2	Large size for clarity
		Cutaway 4-stroke diesel engine	2	Large size for clarity
		Working diesel engine test bed (50-100HP)	2	Fully instrumented
		Gas turbine model	1	
		Steering gear model	2	
	<b>Simulators</b>	Propeller models (FPP, CPP)	4 sets	
		Engine-room simulator (full mission or part task)	4 consoles	20 terminals total
		Propulsion plant simulator	2 consoles	
	<b>Special Tools</b>	Bridge-engine room communication system	2 sets	
		Cylinder liner pulling tools	4 sets	
		Valve grinding tools	8 sets	
		Torque wrenches (various ranges)	10 sets	
		Bearing pullers	8 sets	
	<b>Measuring Instruments</b>	Hydraulic jacking equipment	4 sets	
		Compression pressure gauge	10	
		Peak pressure indicator	4	
		Fuel injection pressure tester	10	
		Exhaust gas analyzer	2	
	<b>8. NAVAL ARCHITECTURE AND SHIP CONSTRUCTION LABORATORY</b>	<b>Models and Demonstrators</b>	Vibration analyzer (basic)	2
Ship hull form models (various types)			10	Different ship types
Stability demonstrator (free surface effect)			4	
Load line mark model			4	
Ship construction sectional model			4	Showing framing, plating
Welded joint samples (butt, fillet, lap)	20 sets	Polished and etched		

	<b>Drawing and Design</b>	Corrosion protection samples	20 sets		
		Ship curves (French curves)	40 sets		
		Naval architectural scales	40		
		Stability calculation software	20 licenses		
		Hull form design software (basic)	20 licenses		
	<b>Testing Equipment</b>	Inclining experiment apparatus	4	Laboratory scale	
		Draft measuring system model	4		
		Tank testing small models	2	Optional	
<b>9. SAFETY AND FIREFIGHTING TRAINING YARD</b>	<b>Firefighting Equipment</b>	Fire extinguishers (water, foam, CO <sub>2</sub> , dry powder)	40	All types, refillable	
		Fire hoses (various diameters) with nozzles	20 sets	20m length each	
		Fire hydrants and monitors	4	Training type	
		Fire suits (proximity, entry)	20 sets		
		Breathing apparatus (SCBA)	20 sets	With spare cylinders	
		Fire blankets	20		
		Hose reels and cabinets	10		
	<b>Life-Saving Equipment</b>	Life jackets (inflatable/inherent buoyancy)	100	Various types	
		Life rafts (inflatable, demonstration model)	4	10-person capacity	
		Lifebuoys with lights/smoke	20		
		First aid kits (comprehensive)	10	Wall mounted	
		Stretchers (Neil Robertson, standard)	10		
		Survival suits	20		
	<b>Training Aids</b>	Fire simulators (liquid, electrical, gas)	4 sets		
		Smoke generating machines	2		
		Training pool (for survival drills)	1	Minimum 10x5x2m	
		Oil spill containment boom/kit	4 sets		
		Abandon ship drill equipment	4 sets		
		<b>Safety Equipment</b>	Emergency showers/eye wash	4	

		stations		
		Gas detectors (O <sub>2</sub> , H <sub>2</sub> S, combustible)	10	Portable
		Safety harnesses/lifelines	20 sets	
		Warning signs/barricade tapes	Bulk	
		Hearing protection test equipment	2	
<b>10. REFRIGERATION AND AIR CONDITIONING LABORATORY</b>	<b>Systems</b>	Domestic refrigerator (cutaway)	4	
		Commercial refrigeration system	2	
		Ice plant model	2	
		Window AC unit (working/demonstration)	4	
		Split AC system	4	
		Central AC model (with ducting)	2	
		Chiller system model	2	
		Cold room/storage model	2	
		<b>Tools</b>	Refrigeration manifold gauge sets	20
	Vacuum pumps		10	Dual stage
	Charging hoses and cylinders		10 sets	
	Leak detectors (electronic, soap solution)		20	
	Tube cutters, flaring tools, swaging tools		20 sets	
	Brazing/soldering equipment		10 sets	
	Recovery/recycling machines		4	
	<b>Measuring Instruments</b>		Digital thermometers/hygrometers	20
		Psychrometric charts/sling psychrometer	20	
		Pressure-temperature charts	20	For common refrigerants
		Ammeters/voltmeters for compressor circuits	20	
<b>11. COMMUNICATION AND LANGUAGE LABORATORY</b>	<b>Language Lab</b>	Computerized language lab consoles	40	1:2 student ratio
		Headsets with microphones	80	One per student
		Language learning software	40 licenses	

	<b>Maritime Communication</b>	Interactive whiteboard	2	
		Audio-visual recording equipment	4 sets	
		VHF radio trainers	10	
		GMDSS simulator	4 consoles	Optional but recommended
		Signal flag sets	10	Complete sets
		Morse code practice sets	10	
		EPIRB/SART demonstration units	4	Non-transmitting
	<b>General</b>	Projector and screen	4	
		Video conferencing equipment	2	
		Public address system model	2	
		Intercom systems	4	



**LIST OF WORKSHOP PARTICIPANTS**

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