NATIONAL BOARD FOR TECHNICAL EDUCATION KADUNA

NATIONAL DIPLOMA (ND)

IN

MARINE ENGINEERING

CURRICULUM AND COURSE SPECIFICATION

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

GENERAL INFORMATION

Goal of Marine Engineering Programme

1.0 The programme is intended to impart theoretical knowledge and practical skill to students on engineering design practice, planning, management, operation and maintenance of Marine Engineering system and equipment suitable for a technician.

1.1 General Entry Requirements:

(a) NATIONAL DIPLOMA (ND)

The general entry requirement for the ND programme is General Certificate of Education (GCE) Ordinary Level, or the Senior Secondary School Certificate (SSSC) with credit passes in four relevant subjects. The relevant subjects are: Mathematics, Physics, Chemistry and one other subject from Metal Work, Wood Work, Technical Drawing, Basic Electronics, Economics, Statistics English Language, Additional Mathematics plus a pass in English Language at not more than two sittings.

(b) Passes at credit level in the four relevant subjects at the Preliminary National Diploma Examination.
(c) The National Technical Certificate (NTC) with credit passes in the four relevant subjects and a pass in English Language.

1.2 Higher National Diploma (HND) Programme:

The general entry requirements for the HND programme include:
(a) all the requirements for admission into the ND programme as stated above;
(b) a minimum of lower credit pass (CGPA 2.50 and above) in the cognate ND examination; and
(c) a minimum of one year cognate work experience.
In exceptional cases, ND diplomates with a pass (CGPA 2.00-2.49) in the ND Examination that had two or more years of cognate experience in the specific field may be considered for admission into the HND programme.

2.0 Curriculum:

2.1 The curriculum of all ND and HND programmes consist of four main components. These are:
i) General Studies/Education

ii) Foundation Courses
iii) Professional Courses
iv) Supervised Industrial Work Experience Scheme (SIWES)

2.2 The General Education Component shall include courses in:
Art and Humanities- English Language, Communication, History.
Social Studies- Citizenship (the Nigerian Constitution) Political Science, Sociology, Philosophy, Geography, Entrepreneurship Studies

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

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

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

2.6 Student Industrial Work Experience Scheme (SIWES) shall be taken during the long vacation following the end of the second semester of the first year. See details of SIWES at paragraph 7.0.

3.0 Curriculum Structure:

3.1 ND Programme
The structure of the ND programme consists of four semesters of classroom, laboratory and workshop activities in the college and a semester (3-4 months) of Student Industrial Work Experience Scheme (SIWES). Each semester shall be of 17 weeks of duration made up as follows:
15 contact weeks of teaching, i.e. recitation, practical exercises, quizzes, test, etc; and
2 weeks for examinations and registration. SIWES shall take place at the end of the second semester of the first year.

3.2 HND Programme:

The structure of the programme is similar to that of the ND save that the SIWES at the end of the first year is not compulsory.

4.0 ACCREDITATION

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

5.0 Conditions for the Award of the ND/HND:

Institutions offering accredited programmes will award will award the National Diploma to candidates who successfully completed the programme after passing prescribed course-work examinations, diploma project and the supervised industrial work experience. Such candidates should have completed a minimum of between 72 and 80 semester credit units.

6.0 Guidance Note for Teachers Teaching the Programme:

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

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

6.3 As the success of the credit unit system depends on the articulation of programmes between the institution and industry, the curriculum content has been written in behavioural objectives, so that it is clear to all the expected performance of the student who successfully completed some of the courses or the diplomats of the programme. There is a slight departure in the presentation of the performance based curriculum which requires the conditions under which the performance are expected to be carried out and the criteria for the acceptable levels of performance. It is a deliberate attempt to further involve the staff of the department teaching the programme to write their own curriculum stating the conditions existing in their institution under which the performance can take

place and to follow that with the criteria for determining an acceptable level of performance. Departmental submission on the final curriculum may be vetted by the Academic Board of the institution. Our aim is to continue to see to it that a solid internal evaluation system exists in each institution for ensuring minimum standard and quality of education in the programmes offered throughout the polytechnic system.

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

7.0 GUIDELINES ON SIWES PROGRAMME.

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

Responsibility for placement of students

a) Institutions offering the ND programme shall arrange to place the students in industry. by April 30 of each year, six copies of the master list showing where each student has been placed shall be submitted to the Executive Secretary, NBTE which shall in turn, authenticate the list and forward it to the Industrial Training Fund, Jos.

b) The Placement Officer should discuss and agree with industry on the following:

i) a task inventory of what the students should be expected to experience during the period of attachment. It may be wise to adopt the one already approved for each field.

ii) the industry-based supervisor of the students during the period, likewise the institution based supervisor.

iii) the evaluation of the student during the period. It should be noted that the final grading of the student during the period of the attachment should be weighted more on the evaluation by his industry-based supervisor.

7.2 Evaluation of students during the SIWES

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

a) Punctuality

b) Attendance

c) General Attitude to Work

d) Respect for authority

e) Interest in the field/technical area
f) Technical competence as a potential technician in his field.

7.3 Grading of SIWE

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

7.4 The Institution Based supervisor

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

7.5 Frequency of visit

Institution should ensure that students placed on attachment are visited within one month of their placement. Other visits shall be arranged so that:
(1) there is another visit six weeks after the first visits; and
(2) a final visit in the last month of the attachment.

7.6 Stipends for Students in SIWES

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

.7.7 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 a skilled technician in his field. The SIWES should be graded on a fail or pass basis. Where a student has satisfied all other requirements but failed SIWES, he may only be allowed to repeat another four months SIWES at his own expense.

National Board for Technical Education Kaduna.

1st SEMESTER: ND I

Course Code	Course Title	L	T	P	CU	CH
MAR 112	TECHNICAL DRAWING & DESC. GEOMETRY	1	-	3	4	4
MTH 112	ALGEBRA & ELEMENTARY TRIG.	2	-	-	2	2
GNS 127	CITIZENSHIP	2	-	-	2	2
MEC 1O3	MECHANICAL ENGINEERING SCIENCE	2	-	3	5	5
MAR 105	WORKSHOP THEORY & PRACTICE	1	-	3	4	4
EEC 115	ELECTRICAL ENGINEERING SCIENCE	2	-	2	4	4
MAR 113	INTRO. TO COMPUTING + EEC 117+EEC 247	1	-	2	3	3
MGS 101	FRENCH I	2	-	-	2	2
MND 101	PERSONAL SURVIVAL TECHNIQUES	1	-	1	2	2
GNS 101	USE OF ENGLISH I	2	-	-	2	2
TOTAL		16	-	14	30	30

2nd SEMESTER: ND I

Course Code	Course Title	L	T	P	CU	CH
GNS 102	COMMUNICATION IN ENGLISH I	2	-	-	2	2
MTH 211	CALCULUS	2	-	-	2	2
MEC 104	THERMODYNAMICS	2	-	2	4	4
MEC 206	PROPERTIES OF MATERIALS	1	-	2	3	3
MAR 103	MARINE POLLUTION	2	-	-	2	2
MAR 102	NAUTICAL SCIENCE & SEAMANSHIP	1	-	3	4	4
MAR 104	ELECTRO TECHNOLOGY	2	-	3	5	5
MAR 106	WORKSHOP TECHNOLOGY	1	-	3	4	4
MTH 122	TRIG & ANALYTICAL METHODS	2	-	-	2	2
MGS 102	FRENCH II	2	-	-	2	2
MND	PERSONAL SAFETY AND SOCIAL RESPONSIBILITIES	1	-	1	2	2
TOTAL		18	-	14	32	32

3RD SEMESTER: ND II

Course Code	Course Title	L	T	P	CU	CH
MTH 111	LOGIC & LINEAR ALGEBRA	2	-	-	2	2
MEC 201	MACHINE DRAWING	1	-	4	5	5
MEC 203	ENGINEERING MEASUREMENT	1	-	2	3	3
MEC 205	STRENGTH OF MATERIALS	1	-	2	3	3
MEC 207	FLUID MECHANICS	1	-	2	3	3
MAR 201	NAVAL ARCHITECTURE	3	-	2	5	5
MAR 203	MARINE ENGINES & PROPULSION SYSTEM	3	-	2	5	5
MGS 201	FRENCH III	2	-		2	2
MNA 201	SIWES (3 MONTHS)	-	-	-	3	-
MAR 207	FIRE PREVENTION & FIRE FIGHTING	1	-	1	2	2
TOTAL		15	-	15	33	30

4TH SEMESTER: ND II

Course Code	Course Title	L	T	P	CU	CH
GNS 202	COMMUNICATION IN ENGLISH II	2	-	-	2	2
MEC 208	REFRIGERATION & AIRCONDITIONING	1	-	2	3	3
MEC 204	DEVELOPMENT & ASSEMBLY DRAWING	1	-	3	4	4
MAR 202	MARINE PLANT SERVICES & MAINTENANCE	2	-	3	5	5
MAR 204	MARINE AUXILIARY MACHINERY	3	-	2	5	5
MAR 206	SHIPYARD TECHNOLOGY	2	-	2	4	4
MAR 208	INTRODUCTION TO ENGINEERIN MANAGEMENT	2	-	-	2	2
MAR 210	FINAL YEAR PROJECT	-	1	3	4	4
MGS 202	FRENCH IV	2	-	-	2	2
MND 202	ELEMENTARY FIRST AID	1	-	1	2	2
TOTAL		16	1	16	33	33

PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: MARINE POLLUTION		**Course Code: MAR 103**	**Contact Hours: 2**
Course Specification:			
WEEK	**General Objective:1.0: Define marine pollution**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1.	DEFINITION OF POLLUTION 1.1 Explain the full meaning of marine pollution. 1.2 List all sources of marine pollution.	Teacher to collect sample of pollutant (e.g. crude oil) & demonstrate in front of students the action of crude oil etc on marine biota	2 Beakers and Pollutants
	General Objective 2.0: Know sources of oil		
2.	SOURCES OF OIL 2.1 List important areas in the world where crude oil is found in commercial quantities. 2.2 List and explain the uses of the different types of Tankers.	Teacher to use world map to indicate areas around the world where crude oil is found in commercial quantities. Teacher to use models or profile drawings of the various types of Tankers.	WORLD MAP Profile drawings or models of different types of Tankers.
	General Objective 3.0: Know sources of oil pollution		
3 - 4	SOURCES OF OIL POLLUTION 3.1 Trace the historical background of pollution by Neolithic man. 3.2 Explain how the Industrial Revolution helped in the causation of oil pollution. 3.3 List various other sources of oil pollution e.g. drilling spillage; gaseous discharges; operational discharges from tankers; bilge discharges; spills caused by marine accidents,	Discuss the history of oil as a source of energy. Mention various major Maritime accidents that caused pollution e.g. Torrey Canjon Exxon Valdez, etc.	Relevant historical books Large photographs of marine accidents

	collisions, groundings etc.		
	General Objectives 4.0: Know effects of marine pollution		
5 - 6	EFFECFTS OF OIL POLLUTION 4.1 State the effects of oil pollution on marine, shore life and vegetation. 4.2 Explain risk to man from the consumption of oil derived carcinogens (PNAH). 4.3 Describe substances that are emitted into the air from the use of fuel oil. 4.4 Explain why oil pollution is a fire and explosion risk.	Show photographs of major pollution effects Show pictures of cancers, etc. from shipboard medical book Use chemical formulae to demonstrate these effects	Photographs of polluted beaches and marine biota Shipboard Medical Book
	General Objective 5.0: Know prevention of oil spills from ships		
7 – 8	OIL SPILLS FROM SHIPS 5.1 Sketch a hose and a loading arm of a tanker. 5.2 Explain how good communication can help to reduce spillage. 5.3 Describe various pollution control methods. 5.4 List the precautions to be observed when bunkering.	Show a sketch of hose and loading arm Show photographs of e.g. the use of oil booms.	Photographs
	General Objectives 6.0: Know rules relating to pumping systems		
9	RULES RELATING TO PUMPING SYSTEMS 6.1 List the rules relating to pumping systems onboard ships especially Tankers. 6.2 List international conventions on marine pollution.	Sketch, label and describe the various equipment Highlight from the International conventions, MARPOL, M-NOTICES, etc.	White board and marker. Books on International Conventions from IMO.
	General Objectives 7.0: Know equipment for marine pollution and prevention		

10– 11	MARINE POLLUTION PREVENTION EQUIPMENTS 7.1 Sketch and describe oily water separator. 7.2 Sketch and describe oil content monitoring device. 7.3 Sketch and describe an incinerator. 7.4 Discuss oil-water Ballast systems. 7.5 Sketch and describe Main and Bilge injection valves. 7.6 Sketch and describe Marine sewage treatment system.	Sketch, label and describe the various equipment Also use photograph	White board & Marker Chalk Board, photographs.
	General Objectives 8.0: Know other sources of marine pollution and how to prevent them.		
12 -15	OTHER SOURCES OF MARINE POLLUTION 8.1 Sketch and describe an engine exhaust scrubber. 8.2 Describe the effects of poor combustion on marine pollution. 8.3 Describe the effects of sewage and garbage as marine pollutants.	Use chemical equations to demonstrate effects. Also use photographs	White board & Marker Board & Photographs

ASSESSMENT: 40% Continuous Assessment (assignments and tests every 5 Weeks)
60% Semester Examination.

PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: Technical Drawing & Descriptive Geometry		**Course Code: MAR 112**	**Contact Hours: 5**
Course Specification:			
WEEK	**General Objective:1.0: Know different drawing instruments, equipment and materials**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	DRAWING INSTRUMENTS, EQUIPMENT AND MATERIALS 1.1 Identify the different types of drawing instruments, equipment and materials. 1.2 Outline the uses of the various instruments, equipment and materials. 1.3 State the precautions necessary to preserve the items in 1.1 above.	Show the different instruments equipment and materials e.g. compasses & dividers drawing board and T-square pencils, etc. Demonstrate the use of the instruments, equipment and material	The various instruments, equipment and materials: Drawing Board + T-Square Compasses and Dividers Pencils and erasers 60^0 x 45^0 set squares Protractor and French Curves Drawing Board Clips Rulers (Scale and Common)
	General Objective 2.0: Understand the essentials in graphical communications		
2	GRAPHICAL COMMUNICATIONS 2.1 Explain graphics and the different types of graphical presentations. 2.2 Illustrate the various conventional representations in graphical productions of construction lines, hidden and overhead finished lines, projections, centre lines, break lines, dimensioning of plane, elevations and sections of objects. 2.3 Layout drawing sheets with the following: • Margin line • Title block 2.4 State the various standards of drawing sheets. 2.5 Print letters and figures of various forms and	Demonstrate the uses of the various conventional representations. Demonstrate drawing paper layout.	DITTO

	characters. 2.6 Illustrate conventional signs and symbols. 2.7 Layout a given set of drawings on a given sheet using the conventional signs, symbols and appropriate lettering characters.		
	General Objective 3.0: Know the construction of simple geometrical figure and shapes.		
3-5	SIMPLE GEOMETRICAL FIGURES AND SHAPES 3.1 Explain the purpose of geometrical construction in drawing. 3.2 Construct parallel and perpendicular lines. 3.3 Construct and bisect lines, angles and areas. 3.4 Divide a straight line into given number of equal parts. 3.5 Identify polygons (regular or irregular). 3.6 Construct regular polygons with a) Any given number of sides in a given circle; b) A given base, length and any number of sides. 3.7 Define a circle. 3.8 Explain the properties of a circle e.g. radius, diameter, normal, tangent, circumference, etc. 3.9 Carry out simple geometrical constructions on circles, e.g. a) given the diameter; b) find the circumference of a circle of a given diameter; c) a circle to pass through 3 points; d) a circle to pass through 2 points and touch a given line; e) a circle to touch a given smaller circle and a given line, f) tangents to circles at various points; g) an arc of known radius tangent to two lines at an angle of less than and more than 90 degree; h) an arc externally	Demonstrate the construction of parallel and perpendicular lines, and ask students to practice same. Demonstrate the construction and technique and ask the students to practice same.	DITTO

	tangent to two circles; I) inscribing or circumscribing circles. 3.10 Define an ellipse. 3.11 Construct an ellipse by using a) trammel method; b) concentric circle method. 3.12 Explain the following draught techniques: projection, measurement & transposition method. 3.13 Construct plane scales & diagonal scales rule & using appropriate instruments.		
	General Objective 4.0: Know the construction of isometric and oblique drawing and projection		
6 - 8	ISOMETRIC AND OBLIQUE PROJECTIONS 4.1 Explain isometric and oblique projections. 4.2 Draw a cube in isometric and oblique forms. 4.3 Draw a sphere in isometric and oblique forms. 4.4 Dimension holes, circles, arcs and angles correctly on isometric and oblique drawings. 4.5 Draw a solid with minimum of eight sides in isometric and oblique forms. 4.6 Use appropriate conventional symbols and abbreviations.	Demonstrate the construction of isometric and oblique projection and ask the students to do same.	DITTO
	General Objective 5.0: Understand principles of orthographic projections		

9 - 11	SINGLE ORTHOGRAPHIC PROJECTIONS 5.1 Explain the principles of orthographic projection. 5.2 Illustrate the principal planes of projection: vertical plane horizontal plane. 5.3 Explain why the first and third angles are used and the second and fourth angles are not used. 5.4 Project views of three-dimensional objects on to the basic planes of projection in both first and third angle to obtain: the front view or elevation the top view or plan.	Demonstrate and ask students to do same, as demanded 5.2 – 5.4	DITTO
	General Objective 6.0: Understand the intersections of regular solids.		

12 - 15	INTERSECTION OF SOLIDS 6.1 Explain interpenetration of intersections of solids. 6.2 Draw the lines of intersections of the following regular solids and planes in both first and third angles: • two square prisms meeting at right angles; • two dissimilar square prisms meeting at an angle; • a hexagonal prism meeting a square prism at right angles; • Two dissimilar cylinders meeting at right angle. • two dissimilar cylinders meeting at an angle; • Two dissimilar cylinders meeting at right angle, their centres not being in the same vertical plane.	Demonstrate 6.1 & 6.2 and ask students to do same	DITTO

ASSESSMENT: 60% - Examination
40% - Continuous Assessment

PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: BASIC WORKSHOP TECHNOLOGY		**Course Code: MAR 105**	**Contact Hours: 4**
Course Specification:			
WEEK	**General Objective:1.0: Know general workshop safety precautions**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	SAFETY PRECAUTION 1.1 Observe all safety rules and regulations. 1.2 Operate safety equipment e.g. fire extinguisher, fire hydrants, etc. 1.3 Use protective wears	Demonstrate 1.1 – 1.3 and ask students to do same.	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.
	General Objective:2.0: KNOW THE USE AND MAINTENANCE OF VARIOUS BENCH TOOLS		
2 – 3	HAND TOOLS 2.1 Use marking-out tools on the bench correctly. 2.2 Produce simple objects using bench/hand took, such as files, chisels, scrapers, saws, callipers, gauges, etc.	Demonstrate 2.1 – 2.2 and ask students to do same.	Bench, Bench vice, files, cold chisels, scrapers, hack saws, hammer, calipers, gauges, steel rule, scribers, combination head, center punch, dividers, DTI, calipers, steel rules, depth gauge, vernier height gauge, slip gauges and sine bars, bevel-edge, etc.
	General Objective:3.0: Know the use of simple measuring and testing equipment		

4	MEASUREMENTS AND TESTING 3.1 Perform simple measuring exercises using rules, calipers and micrometers. 3.2 Use dial indicators to: set up jobs on the lathe test for roundness etc. 3.3 Carry out exercise involving flatness, square-ness, straightness and surface finish test. 3.4 Perform taper measurement on jobs using vernier protractor and sine bars. 3.5 Inspect jobs using simple comparators.	Demonstrate 3.1 – 3.5 and have students practice same	Combination head, DTI, calipers, micrometers, vernier calipers, steel rules, depth gauge, vernier height gauge, dividers, hand files scrapers, try squares, protractor, v-block, center punch, bell gauge, spirit level.
	General Objective:4.0: Know drilling operations		
5	DRILLING OPERATIONS 4.1 Operate different types of drilling machines. 4.2 Carry out drilling operations such as counter-boring and counter-sinking. 4.3 Grind drill bits accurately. 4.4 Select correct drilling speeds.	Demonstrate 4.1 – 4.4 and have students practice same.	Column drilling machines, hand drilling machines, electric hand drilling machines, drill bits (straight & taper shanks) Drill chucks, grinding machines
	General Objective 5.0: Know reaming operations.		
6	REAMING OPERATIONS 5.1 Carry-out reaming operations: • on the bench • On drilling/lathe machines.	Demonstrate 5.1 and have students practice same	Hand and machine reamers.
	General Objective:6.0: Know tapping operations		
7	TAPPING OPERATIONS 6.1 Select taps. 6.2 Select correct tapping size drills. 6.3 Carry out tapping operation: on bench vice	Demonstrate 6.1 – 6.3 and have students practice same	Taps and wrenders, drill bits, cutting lubricant.
	General Objective:7.0: Know various non-permanent metal joining operations		

8 – 9	METAL JOINING 7.1 Fabricate metal container by knock-up joining. 7.2 Join metals by the grooving technique. 7.3 Join metals by mechanical fastening e.g. bolting.	Demonstrate 7.1 – 7.3 and have students practice same.	Bolts and nuts, spanner, bending machine, hammer, cutting snips or hand shears.
	General Objective:8.0: Know various permanent metal joining operations		
10-14	GAS WELDING 8.1 Assemble oxy/acetylene welding plant. 8.2 Select various welding regulators, clips, blow pipe and nozzles. 8.3 Perform gas welding by various welding technique. 8.4 Cut by flame cutting technique. ELECTRIC ARC WELDING 8.5 Regulate current and determine polarity for metal Arc Welding. 8.6 Determine polarity and select current. 8.7 Perform various arc welding joints by down and up hand operations. 8.8 Select and prepare metal edges for various thickness and techniques. RIVETING 8.9 Identify various types of rivets. 8.10 Describe the riveting process. 8.11 Carryout the riveting operations and observe safety precautions.	DITTO	Oxy-Acetylene welding set, wire brush, chipping hammer, safety goggling, welding apron, hand gloves, safety shoes, welding rods, flux. Arc-welding machine, electrodes, faces shield, leather apron, chipping hammer, and leather hand gloves wire brush. Rivet sets, rivets, riveting pop machine, hammer.
	General Objective: 9.0 Know the techniques for controlling distortion in welding.		

15	TECHNIQUES CONTROLLING DISTORTION 9.1 Apply correctly the step back and skip method of controlling distortion. 9.2 Apply pre and post heating technique.	DITTO	Furnace, Black Smith hearth, Gas-welding set.

PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: WORKSHOP TECHNOLOGY		**Course Code: MAR 106**	**Contact Hours: 4**
Course Specification:			
WEEK	**General Objective:1.0: Understand the importance of heat processes**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 - 2	HEAT PROCESSES 1.1 Carry out forging, soldering and brazing operations and observe safety rules. 1.2 Distinguish between hand forging and drop forging. 1.3 Identify the tools used for heat processes. 1.4 Perform the following operations; upsetting, drawing down, bending, punching, drifting and stamping and observe safety rules.	Demonstrate and have students practice 1.1-1.4	Blacksmith hearth, forging tools, Anvil, swage block, hammers, leather aprons, hardis, bending machine, punches.
	General Objective 2.0: Know the properties and functions of tool steels		
3	TOOL STEELS 2.1 Define tool steels. 2.2 Distinguish among types of tool steels. 2.3 Explain the metallurgical properties of tool steels. 2.4 Describe the following heat treatment processes – case hardening, annealing normalizing and tempering.	Explain, demonstrate and have students practice the heat treatment processes	Mini-furnace, quenching media (sand, water, oil) pyrometer.
	General Objective 3.0: Know the art of welding operations and observe safety precautions.		

4 - 5	WELDING PROCESSES 3.1 List the various types of welding and state the safety rules applicable to each welding process. 3.2 Carry out the metallic arc welding operation and observe safety rules. 3.3 Explain and carry out the oxyacetylene welding operations with safety precautions. 3.4 Perform the inert gas shielded arc welding operation. 3.5 Enumerate the advantages and disadvantages of welding methods in 3.1.	Demonstrate, explain and have students practice the welding processes.	Oxy-Acetylene welding set, arc welding machine, welding shield, chipping hammer, wire brush, welding electrodes, filler rod/wire, and flux
	General Objective 4.0: Understand the various metal cutting processes of metals the safety precautions.		
6	METAL CUTTING PROCESSES 4.1 Enumerate the various cutting methods and the safety precautions e.g. use of hacksaw, use mechanical hacksaw, flame cutting, oxy-arc and gorging, guillotine, chisel, and hand snips. 4.2 Carry out flame cutting, oxy-arc and gorging operations and observe safety precautions. 4.3 Carry out cutting by hacksaw and by mechanical hacksaw (power).	Demonstrate and explain and students practice the cutting processes	Hacksaws, power/mechanical hacksaws, oxy-Acetylene cutting sets, arc-welding, chisels, gorging electrodes, guillotine, hand snips.
	General Objective: 5.0: Know various types of lathe machines and their functions		

7 – 8	LATHE MACHINES 5.1 List the various types of lathe (such as capstan lathe, turret lathe, center lathe,) and their accessories. 5.2 Describe the features of the various types, of lathe machines. 5.3 Define feed and cutting speed as applied to machine tool work e.g., material to be cut, use of coolant and type of finish. 5.4 Select and use the appropriate cutting tools for efficient machining of various metals and observe safety rules. 5.5 Name the types and explain the need for cutting-tools fluids. 5.6 List the safety preconditions. 5.7 Use job pieces to perform various lathe operations. 5.8 Identify any attachment necessary for 5.7. 5.9 List the safety precautions necessary while working on the lathe. 5.10 Carry out the following operations on the lathe and observe safety rules: taper turning, step screw cutting, multi-start square thread cutting, etc.	Demonstrate, explain and have students practice on the lathe machine.	Lathe machines, cutting tools, measuring tools, cutting fluids, work pieces, goggles, and hand gloves.
	General Objectives 6.0: Understand the features, functions and uses of milling machines		

9 – 10	MILLING MACHINES 6.1 Describe the main features of milling machines. 6.2 Outline the safety and operational precautions to be observed when milling. 6.3 Perform the mounting of cutters on the milling machine. 6.4 Assemble a work piece and cutter holding device and attachment on a milling machine. 6.5 Identify cutters according to materials to be milled and type of milling operations with the safety precautions. 6.6 Determine cutting speeds and feeds for a given milling work. 6.7 Perform the up and down milling operations. 6.8 Describe straddle and gang milling operations. 6.9 Describe the various features of the tool and cutter grinder. 6.10 List and state the uses of different types of milling cutters (arbor cutters, plain cutters, shank cutters and mills, T-slot side and mill cutter). 6.11 Describe the features and working principles of the dividing head. 6.12 Carry out various indexing methods on a miller, e.g., direct, simple, differential, angular indexing.	Explain, Demonstrate and have students practice milling operations	Milling Machines, cutting fluids, milling cutters, work pieces, goggles, prons/overalls, gloves, safety shoes, tool and cutter grinder.
	General Objectives 7.0: Understand the features and functions of shaping machines		

11 – 12	SHAPING MACHINES 7.1 Describe the main features of shaping machines. 7.2 Identify appropriate shaping tools for different surface forms. 7.3 List the advantages of a swan-necked tool on a shaping machine. 7.4 Perform the setting up of work piece on the shaping machine. 7.5 Perform the adjusting of the length and position of the stroke of the shaping machine. 7.6 Describe the table feed on a shaping machine. 7.7 Carry out the setting of a clapper box for a given operation. 7.8 Carry out slotting, surface planning, and keyway cutting on a shaping machine.	Explain, demonstrate and have students practice shaping operations	Shaping machine, shaping tools, work pieces, cutting fluids goggles, gloves, apron/overalls and safety shoes, parallels.
	General Objectives 8.0: Understand the features and functions of a grinding machine.		

13 - 14	GRINDING MACHINES 8.1 Describe different types of grinding machines. 8.2 Identify the main features of grinding machines in 8.1. 8.3 Carry out the grinding of job pieces on the machine and observe safety rules. 8.4 Identify the wheels for grinding different types of materials. 8.5 Perform the following operations. - surface grinding - taper grinding - tool and cutter grinding - centre-less grinding - gauge grinding - Wheel testing and mounting - Wheel balancing and alignment Wheel dressing and truing.	DITTO	Pedestal grinding machine, goggles, hand gloves, aprons, safety shoes, cylindrical grinding machine, and surface grinders.
	General Objective 9.0: Know the art of woodwork and the safety precautions		
15	WOODWORK 9.1 Identify woodworking tools. 9.2 Perform wood joint operations and observe safety rules. 9.3 Operate woodworking machines to produce patterns for foundry work and observe safety rules. 9.4 Explain the care of woodworking tools.	Explain, demonstrate and have students practice on/with woodworking machines and tools	Woodworking lathe machine, band saw, planning machine, tenon saw, cross-cut saws, bradawl, hand drilling machine, rafters, scraper, planes files, sand paper, sanders.

ASSESSMENT - 60% Continuous Assessment (Tests every 5 Weeks Minimum)
40% Semester Examination.

PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: ELECTRO-TECHNOLOGY		**Course Code: MAR 104**	**Contact Hours: 5**
Course Specification:			
WEEK	**General Objective:1.0: Know electrical installations on ships**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 - 3	SHIPBOARD ELECTRICAL INSTALLATION 1.1 List main rules and regulations of shipboard electrical installation; 1.2 Identify types of electrical fittings common in ships. 1.3 State the difference between the main propulsion unit and power generating plants. 1.4 List power utilization devices. 1.5 Describe A.C. generators, A.C. motors and D.C. motors. 1.6 Describe series, compound and shunt windings. 1.7 Describe the use of alternators and starters. 1.8 Describe, and differentiate between single phase and 3-phase motors. 1.9 Describe 3-phase induction motors 1.10 Describe switchboard arrangements for A.C. and D.C. currents. 1.11 Explain types and uses of relays 1.12 Explain with diagrams battery charging	Demonstrate and illustrate with diagram the requirements of 1.1 – 1.15, conduct ship visit	A/C motors, D/C motors batteries, rheostats, solenoids, step-down transformer, single phase and 3 phase motors, switches, contactors and ships.

	systems. 1.13 Draw and explain electrical starting system of diesel engine 1.14 Identify the location and the sequential starting of the emergency generator in the case of a blackout. 1.15 Explain with diagrams the standby battery used for automatic supply of light during blackout in ships.		
	General Objectives 2.0: Know marine electrical instruments		
4 – 5	ELECTRICAL EQUIPMENT 2.1 Explain the operating procedure of a radio phone on board vessel. 2.2 Describe with diagrams the electrical alarm systems on board ship. 2.3 Describe switchboard instruments such as moving coil and moving iron ammeters volt meters, shunt and series connections. 2.4 Describe watt-meter and frequency meter.	Describe and demonstrate the use of the various instruments	Radio phone, model of alarm system, moving coil and moving iron ammeters and voltmeters, wattmeter and frequency meter.
	General Objective 3:0 Understand basic electrical control systems		

6 – 7	BASIC ELECTRICAL CONTROL SYSTEMS 3.1 Explain the functions of induction coils. 3.2 Explain the use of capacitors. 3.3 Describe types of switches and circuit breakers. 3.4 With diagrams, describe the various types of transformers solenoids and rectifiers. 3.5 Explain precautions for putting generators on and off load. 3.6 Describe the method of running two generators in parallel and sharing of load. 3.7 Explain with circuit diagrams overload protection devices. 3.8 Explain the use of transistors. 3.9 Explain earthing procedures. 3.10 With circuit diagrams, explain the control relay timing system.	Demonstrate and explain/ describe the requirements of 3.1 – 3.10	Capacitors, circuit breakers, coils, wires and ship, single phase and three phase transformer.
	General Objective 4.0: Understand basic electronic systems		
8 – 9	BASIC ELECTRONIC SYSTEMS 4.1 Identify electronic components and devices. 4.2 Explain the basic characteristics of semi-conductors and thematic valves. 4.3 State the characteristics of semi-conductors rectifiers, and sketch circuit diagrams. 4.4 Explain voltage stabilization. 4.5 Explain with circuit diagrams the principle of amplification. 4.6 State various types of amplifiers and filters.	Demonstrate and explain/ describe the requirements of 4.1 – 4.6.	Thematic valves, diodes, rectification bridge, transistors and thyristors
	General Objective 5.0: Understand fault-finding procedure and how to remedy the faults		

10 – 11	FAULT FINDING 5.1 Demonstrate the use of meggers, test lamps and Multimeters. 5.2 Carry out testing procedure for resistivity. 5.3 Test armature winding for short circuit and continuity. 5.4 Trace the faults and rectify shift circuit, continuity, breakdown of insulation. 5.5 Interpret circuit diagrams. 5.6 Select for use appropriate cable for wiring.	DITTO	Samples of various types of cables, megger, multimeter, test lamp, screw drivers and pliers, electrical circuit diagrams.
	General Objectives 6.0: Know the maintenance procedure of electrical equipment		
12 - 15	MAINTENANCE PROCEDURE 6.1 Outline the maintenance procedure for motors, generators and starters. 6.2 Outline the maintenance procedure for relays and circuit breakers. 6.3 List the method of servicing batteries and state the precautions to be observed.	Demonstrate the requirements of 6.1-6.3 and ask students to carry out the same activities.	Motors, Generators, Starters, Relays, Circuit Breakers, Batteries and Hydrometers.

ASSESSMENT: 60% Semester Examination
40% Continuous Assessment

PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: NAUTICAL SCIENCE AND SEAMANSHIP		**Course Code: MAR 102**	**Contact Hours: 4**
Course Specification:			
WEEK	**General Objective:1.0: KNOW VARIOUS PARTS OF A SHIP**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1 - 2	IDENTIFICATION OF A SHIP'S PARTS 1.1 Name parts of the hull structure of a ship. 1.2 Name parts of a ship, the different types of deck e.g. foc'sle poop deck, weather deck twin deck, monkey Island. 1.3 Sketch the profile of a ship and label it.	Sketch and Explain Visit to a ship	Ship, Teaching Aids: Diagrams photographs Sketches O/H projector Media projector etc.
	General Objective: 2.0: Know the names of all major deck machinery.		
3 – 4	IDENTIFCATION OF DECK MACHINERY 2.1 Identify and list the various deck machinery on board a merchant ship (cargo ship and tankers). 2.2 Explain cargo handling systems for cargo ships and for tankers. 2.3 Explain cargo protection arrangements for cargo ships and for tankers. 2.4 State the location of fire fighting equipment for cargo ships and for tankers.	DITTO	DITTO
	General Objectives: 3.0: Know boats using oars or engines.		

5 – 6	USE OF LIFE BOATS AND CRAFTS 3.1 Operate life-boats and crafts. 3.2 Start and stop life boat engines 3.3 Steer life boat and crafts 3.4 Lower, raise, secure and anchor life boats 3.5 Swim and float at sea 3.6 Describe rigging as applicable to ship.	DITTO & Demonstrate	Life Boats and crafts Davits Oars Life Jackets Life Buoys Ship Rigs
	General Objectives: 4.0: Know merchant ship departmental organisation.		
7 – 8	SHIP ORGANISATION 4.1 List the main departments of a merchant ship 4.2 Draw organo-gram of the ship department. 4.3 State the duties of all officers and ratings of a merchant ship.	Sketch and Explain	Teaching Aids
	General Objective: 5.0: Understand various aspects of sea life		
9 – 10	LIFE AT SEA 5.1 Explain the need for discipline at sea. 5.2 Explain the necessity for self reliance, reliability and loyalty in the performance of assigned duties. 5.3 List the equipment used for predicting bad weather at sea. 5.4 Describe the process of occurrence of a storm.	Explain	DITTO
	General Objective: 6.0: Know navigational systems and aids		
11 – 12	NAVIGATION 6.1 Explain the use of navigational aids such as lights, radar, direction finder, magnetic compass, and echo sounder. 6.2 Explain the basic methods of locating a Ship's position.	DITTO	DITTO

	General Objective: 7.0: know the functions of national and international maritime organisations		
13-15	MARITIME ORGANISATIONS 7.1 State the functions of the National Maritime Authority and the Government Inspector of shipping of the Federal Ministry of Transport. 7.2 State the functions of the International Maritime Organisation (IMO). 7.3 State the functions of Classifications Societies. 7.4 State the functions of United Nations Conference on Tariffs and development (UNCTAD).	DITTO	DITTO

ASSESSMENT: 40% Continuous Assessment
60% Semester Examination

PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: FINAL YEAR PROJECT		**Course Code: 210**	**Contact Hours: 4**
Course Specification:			
WEEK	**General Objective:1.0:** THIS MODULE IS INTENDED TO ALLOW EACH STUDENT WORK ON AN INDEPENDENT PROJECT AND TO INCULCATE IN THE STUDENTS, THE ABILITY TO INTEGRATE ALL THE OBJECTIVES LEARNT DURING HIS/HER COURSE OF STUDY AND TO UTILIZE THE ACQUIRED SKILL IN FINDING SOLUTIONS TO PROBLEMS RELATING TO HIS/HER PROFESSION AND THE MARITIME INDUSTRY AS A WHOLE.		
1-15	**SUGGESTED PROJECT TOPICS** 1. Condition monitoring as maintenance tool e.g. vibration measurements, temperature monitoring, pressure monitoring, etc. 2. Repair/Maintenance of: • Diesel Engines • Centrifugal pumps. • Air compressors. • Refrigeration & Air conditioning Plants. • Sewage Plants. • Main Switchboard • Alternators/Generators • Emergency Lighting • Steering Gear • Domestic Hydrophor Plant • Fresh Water Generators	Guide in selection of project and supervise and advice throughout duration of project work	Materials/Systems for projects.

Assessment: Oral Defence 45%-By a Panel, Written Report 40%-By External Moderator, Supervisor Assessment 15%-By Project Supervisor.

PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: MARINE AUXILIARY MACHINERY		**Course Code: 204**	**Contact Hours: 5**
Course Specification:			
WEEK	**General Objective:1.0: Know different kinds of marine pumps**		
1.	MARINE PUMPS 1.1 Classify the marine pumps (e.g. positive displacement and rotodynamic pumps and give examples of each class with their general characteristics). 1.2 Describe the construction and operation of a centrifugal pump. 1.3 Describe a submersible centrifugal pump with the aid of graphs explain the performance characteristics of a centrifugal pump. 1.4 With aid of graphs, explain the performance characteristics of a centrifugal pump (e.g. suction head, flow rate and efficiency)	Explain, distinguish and classify items 1.1 – 1.6 and have student dismantle and assemble various pumps.	Centrifugal pumps, reciprocating pump, screw pump, gear pump. Tool box.

	General Objective: 2.0: Understand the principles of heat exchangers		
2	HEAT EXCHANGERS 2.1 Classify and explain the principles of heat exchangers. 2.2 Describe different types of heat exchangers. 2.3 Sketch and explain flow principles of heat exchangers. 2.4 State how the flow can be regulated.	Explain with sketch 2.1 – 2.4 and have students do same	Heat exchanger and tool box
	General Objective: 3.0: Know different kinds of compressor		
3	3.1 Classify the marine compressors (e.g. reciprocating rotary and centrifugal, low pressure and high pressure. 3.2 Describe the working principles of steam condensers. 3.3 Explain the stages of compression (e.g. two and three stages). 3.4 Carry out simple calculations based on an air-compressor (e.g. clearance volumes, swept volume, volumetric efficiency). 3.5 State methods of compressor drives. 3.6 Explain the essence of pressure relief valves, effect of leaking valves and automatic drain system. 3.7 Explain the terms intercoolers and after-cooler in relation to air compressors. 3.8 Illustrate how air receiving vessels are connected to a compressor.	Explain with sketches and have students practice same	Teaching Aids
	General Objectives: 4.0: Know steam condensers and the different kinds of boilers		

4	STEAM CONDENSERS 4.1 Describe the working principles of steam condensers. 4.2 Describe the characteristics and regulations of a condenser. 4.3 Classify steam boilers. 4.4 Describe the layout of a steam boiler. 4.5 Describe the construction of the water tube, boiler, fire tube boiler. 4.6 Describe the methods of supplying feed water to a boiler. 4.7 Describe the methods of firing a boiler. 4.8 Describe the methods of governing boilers. 4.9 Enumerate the rules and regulations governing installation and operation of steam boilers.	Explain with sketches and have students practice same	Teaching Aids
	General Objectives: 5.0: Understand the domestic water system		

5 – 6	FRESH WATER SYSTEM 5.1 With diagrams, describe the layout of domestic water system in a ship. 5.2 Explain the uses and effect of misuse of fresh waster onboard a ship 5.3 Mention some fresh water storage facilities on board a ship 5.4 Describe the procedure for testing salinity of fresh water. 5.5 Explain the sanitary system. 5.6 Describe a vacuum system on board. 5.7 Enumerate the various uses of salt water onboard a ship. 5.8 Explain the usefulness of a distilling plant on board a ship. 5.9 List all types of distilling plants employed in the marine service. 5.10 List the various parts of a distilling plant. 5.11 Distinguish between evaporator type and vapour compression type of distilling plants. 5.12 State the functions of the heating coil in the evaporator shell distiller. 5.13 Describe how the brine density is controlled in a distiller. 5.14 List all the causes of priming in the evaporator shell distiller. 5.15 Describe the periodic maintenance carried out on distillers.	Explain with sketches and have students practice same	Teaching Aids and samples
	General Objectives 6.0: Know different kinds of ejectors		

7	6.1 State the working principle of a bilge ejector. 6.2 Trace the fire ring mains on board. 6.3 Explain the basic principles of steam ejectors. 6.4 Outline the different kinds of ejectors	Explain with sketches and have students practice same	Teaching Aids
	General Objectives 7.0: Know different kinds of valves and cocks		
8	VALUES 7.1 Classify types of valves (e.g. non-return, gate valve, safety valve relief valve and screw lift valve). 7.2 Explain the construction of various types of valves. 7.3 Explain the functions of exhaust valves. 7.4 Explain the construction of a cock.	DITTO	DITTO AND SAMPLES OF VALVES AND COCKS
	General Objectives 8.0: Understand the steering gear system		

9 – 10	STEARING GEAR SYSTEM 8.1 Classify the steering gear system (e.g. mechanical, hydraulic, electron-hydraulic, and electric). 8.2 Describe the steering gear system. 8.3 Describe steering gear control system, e.g., telemeters, receiver rams, steering pumps, transmitter, follow-on system. 8.4 Discuss the rules governing steering gears. 8.5 Describe types and arrangements of rudders in connection with a steering gear. 8.6 List the various parts of the tele-motor system of the steering gear. 8.7 State the functions of the hunting rod of a steering gear. 8.8 Explain the term creep test and how the test is carried out. 8.9 Explain the meaning of secondary steering position, local control and emergency steering.	DITTO SHIP VISIT	DITTO
	General Objectives 9.0: Understand capstan, windlass and winches		

11	CAPSTAN, WINDLASS AND WINCHES 9.1 State the primary function of a capstan. 9.2 State the primary function of a windlass. 9.3 Distinguish between a windlass and a capstan. 9.4 List out the security arrangement of the capstan, anchors and cables. 9.5 Enumerate the use of winches	DITTO	DITTO
	General Objectives: 10.0: Understand power generating machinery		
12 – 13	POWER GENERATING MACHINERY 10.1 Define power generation. 10.2 State the two traditional power distribution techniques employed on board marine ships. 10.3 Distinguish between alternating and direct current supply. 10.4 State the mode of supplying power to the main control switchboard. 10.5 Illustrate the technique of running generators in parallel. 10.6 Demonstrate how to put a generator on-load and off-load. 10.7 Explain the three modes of power distribution on board a ship.	Demonstrate, explain and have students practice same Ship visit	Teaching Aids
	General Objectives 11.0: Understand bunkering system		

14	BUNKERING SYSTEM 11.1 Define the term "bunkering". 11.2 Explain the preparation for bunkering. 11.3 Explain the methods of bunkering. 11.4 State the precautions while bunkering.	Explain Ship visit	Teaching Aids

ASSESSMENT : 40% Continuous Assessment
60% Semester Examination.

PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING		
COURSE: NAVAL ARCHITECTURE	**Course Code: MAR 201**	**Contact Hours: 5**
Course Specification:		

WEEK	General Objective:1.0: Know functions of a ship and ship types		
1 - 2	SHIP TYPES AND FUNCITONS OF A SHIP 1.1 Name the various types of merchant ships. 1.2 State the difference between a merchant ship and a naval ship. 1.3 State the functions of a merchant ship and a naval ship. 1.4 Sketch the layout of 3 types of merchant ships.	Explain, sketch and have students sketch the various types of merchant ships.	Drawing Books, writing materials. Photograph/drawings of merchant ship types.
	General Objectives: 2.0: Know shipbuilding terms		
3	SHIP BUILDING TERMS 2.1 Define the various terms used in ship building. 2.2 State the various terms used in shipbuilding calculation.	Explain and demonstrate with ship models/sketches.	Ship models, sketches, etc.
	General Objectives: 3.0: Perform ship calculations		

4 – 5	SHIP CALCULATION 3.1 Calculate the areas and volumes of various shapes of an object. 3.2 Calculate the areas of ship sections and wetted surface areas using trapezoidal and Simpson's rules 3.3 Calculate moments of area and centroid by Simpson's rule 3.4 Calculate form coefficients for ship sections.	Perform the various ship building calculations and have students do the same	Writing materials
	General Objectives: 4.0: Know elements of ship stability		
6 – 8	SHIP STABILITY 4.1 Define ship stability 4.2 Explain state of equilibrium: positive neutral and negative 4.3 Explain stability terms and criteria 4.4 Explain transverse and longitudinal stability 4.5 Determine center of gravity and metacentric height by including experiment. 4.6 Determine the effect of shifting and changes of cargo on stability. 4.7 Describe stability of a ship under damage condition. 4.8 Determine stability during small and big angle of heel 4.9 Describe loss of buoyancy using added weight methods. 4.10 Describe free surface effect as it affects ship stability.	Demonstrate ship stability with models. Explains terms and criteria	Tow tank, models of ships

	General Objectives: 5.0: Know elements of ship motion		
9	SHIP MOTION 5.1 State the effect of waves on the motion of a ship. 5.2 Define rolling, heaving, pitching, trimming, Swaying, yawing, sagging, hogging and pounding of a ship. 5.3 State the method of reduction of rolling of a ship	Explain and demonstrate the various ship terms under 5.1 – 53	Ship models and tow tanks
	General Objectives: 6.0: Know ship structures		
10 – 11	**SHIP STRUCTURES** 6.1 Outline types of ship structures 6.2 Determine load acting on ship structures 6.3 Explain the function of ship structural components 6.4 Determine wave loading, weight distribution, loading, shearing force and bending moments. 6.5 State the method of constructing single and double bottoms of a ship 6.6 Describe the framing system 6.7 Describe the construction of the bow and stern of as a ship.	Set up numerical problems for the determination of loads acting on ship structure and describe 6.3 – 6.7	Writing materials Photographs/sketches
	General Objectives: 7.0: Know elements of ship resistance.		

12 – 13	SHIP RESISTANCE 7.1 State types of resistance. 7.2 Carry out various methods of resistance calculations. 7.3 Use the procedures for the experiments on resistance of ships using models.	Explain and perform experiment on ship resistance using ship models	Tow tank and ship models
	General Objectives: 8.0: Know the functions of a propeller and rudder		
14	FUNCTIONS OF A PROPELLER AND RUDDERS 8.1 Define the various dimensions of a propeller. 8.2 Explain the action of a marine propeller. 8.3 Differentiate between fixed pitch propeller and controllable pitch propeller. 8.4 State the used of a rudder. 8.5 Stated the types of rudders in use. 8.6 Calculate the force on a rudder	Show models of propellers and rudders and explain requirements of 8.1 – 8.6	Propeller and Rudder models
	General Objectives: 9.0: Understand national and international and international regulations		
15	REGULATIONS 9.1 Outline the principles of IMO regulations on load line, safety of life at sea and pollution. 9.2 Outline classification society's rules and regulations.	Discuss 9.1 – 9.2	IMO and Classification Societies Rule Books

ASSESSMENT: 60% Semester Examination
40% Continuous Assessment

PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: Introduction To Engineering Management		**Course Code: MAR 208**	**Contact Hours: 2**
Course Specification:			
WEEK	**General Objective:1.0: Know the organisation of an industry**		
1 - 2	INDUSTRIAL ORGANISATION 1.1 Differentiate small, medium and large industries. 1.2 Explain the structure of various type of industries 1.3 State the functions of the various departments in an industry 1.4 State the functions and responsibilities of a Director, Manager and Supervisor 1.5 Explain the decision making process and communication in an organization 1.6 Explain the structure of shipboard management 1.7 Explain the structure of shipyard management. 1.8 List the different types of businesses and explain their structures e.g. sole proprietorship, partnership, limited liability and public liability company.	Explain	Teaching Aids

	General Objectives: 2.0: Know industrial relations		
3 – 4	MANAGEMENT FUNCTIONS 2.1 Outline the functions of all directors. 2.2 Outline the functions of all 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	Explain	Teaching Aids
	General Objectives: 3.0: Know the basic management functions		
5 – 7	PERSONNEL MANAGEMENT 3.1 State various man-power selection and training methods. 3.2 State various methods of advertising for recruitment. 3.3 Discuss interview technique. 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	Explain	DITTO
	General Objectives: 4.0: Know personnel management functions		

8 – 10	INDUSTRIAL RELATIONS 4.1 Outline employee-employers relations in an organization. 4.2 Discuss trade unions, strikes and lockouts. 4.3 Discuss the advantages and disadvantages of having trade unions in organizations and collective bargaining. 4.4 Discuss the role of industrial arbitration. 4.5 Discuss workers participation in management	DITTO	DITTO
	General Objectives: 5.0: Know basic economics		
11 – 13	FUNDAMENTAL OF ECONOMICS 5.1 Outline the basic concept and scope of economics. 5.2 Explain the demand and supply theory. 5.3 Discuss costing and pricing concept. 5.4 Describe the straight line method of evaluating equipment depreciation.	DITTO	DITTO
	General Objectives: 6.0: Know elements of law		
14 – 15	LAW 6.1 Discuss elements of legislation, wages act, workman's compensation etc. 6.2 Discuss elements of contract and contract obligation. 6.3 Discuss the provisions of the ISM – Code 6.4 Differentiate between port-state and flag-state control.	DITTO	DITTO

ASSESSMENT: 40% Continuous Assessment
60% Semester Examination

PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING		
COURSE: SHIP YARD TECHNOLOGY	**Course Code: MAR 206**	**Contact Hours: 4**
Course Specification:		

WEEK	General Objective:1.0: Know the scope of a modern shipyard		
1 –2	MODERN SHIPYARD 1.1 Describe types of shipyards. 1.2 Describe and 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. 1.6 Describe steel ordering and storage procedure.	Explain with sketches and have students practice same Visit shipyard (Shipbuilding).	Teaching Aids, Photographs, sketches
	General Objective 2.0: Understand ship-building materials.		
3	SHIP BUILDING MATERIALS 2.1 Describe the production of various types of steel for ship hull. 2.2 Describe casting and forging process of materials. 2.3 Describe the composition of various aluminum alloys.	Explain with samples of materials	Teaching Aids samples of materials
	General Objectives: 3.0: Know hull processing and fabrication method		
4 – 5	HULL PROCESSING AND FABRICATION 3.1 Give the general introduction of hull fabrication. 3.2 Describe the functions of hull processing Shop. 3.3 Explain the unit fabrication. 3.4 Explain the sub-assembly pre-fabrication. 3.5 Describe unit erections.	DITTO	DITTO

	General Objectives: 4.0: Know the methods of joining structural parts of a ship		
8 – 9	JOINING STRUCTURAL PART OF A SHIP 4.1 Sketch and describe transverses and longitudinal framing. 4.2 Describe shell plating, bulk heads how and stern structures, flat and bar keel and superstructures. 4.3 Perform welding and riveting operations in ship-building and observe safety precautions.	Demonstrate and explain and have students practice same	Samples for demonstrations. Teaching Aids.
	General Objectives: 5.0: Know the methods of material preparation and corrosion prevention		
8 – 9	MATERIAL PREPARAITON AND CORROSION PREVENTION 5.1 Describe surface preparation and painting technique for steel vessels. 5.2 Explain the sand blasting technique in detail 5.3 List types of marine paints. 5.4 Explain the general principle of corrosion. 5.5 Describe the cathodic method of preventing marine corrosion.	Explain with sketches and samples yard visit	Sketches sample
	General Objectives: 6.0: Know piping systems and method of installing machinery		

10 – 11	MACHINERY INSTALLATION AND PIPING SYSTEMS 6.1 Describe the general layout of deck machinery 6.2 List the criteria used in location of deck machinery 6.3 List the criteria for location of main propulsion unit and auxiliary machines. 6.4 Explain with sketches shafting arrangement of a ship 6.5 Sketch the pipe layout system for sea water system.	Explain with sketches and have students practice same	Teaching Aids.
	General Objectives: 7.0: Know inspection, launching, and sea trial procedures for vessels		
12 – 13	INSPECITON, LAUNCHING AND SEA TRIAL 7.1 Outline the procedure of opening machinery for inspection by classification societies. 7.2 Outline necessary preparation for dry-docking of a vessel. 7.3 Outline the general services for a ship during dry docking. 7.4 List the information required for sea trial. 7.5 Outline necessary preparation for the launching of a new ship.	Explain with sketches yard visit	Teaching Aids
	General Objectives: 8.0: Understand general safety precautions in shipyards		

14 – 15	SAFETY PRECAUTION 8.1 List all fire fighting applications in a shipyard. 8.2 Enumerate the precautions necessary to avoid electrical fire in welding workshop. 8.3 List precautions necessary during welding. 8.4 Observe shop safety and safe working conditions. 8.5 List sources of hazards in a wood workshop such as: • handling and using hand tools, power tools and machines • stepping on or striking obstruction left on the floor or bench; • lifting, moving and storing materials; using inflammable liquids; • inhaling vapour or fumes 8.6 Identify how accident can occur through the various items in 8.5. 8.7 Explain how accident listed in 8.6 can be prevented. 8.8 Name safety wears and equipment essential in a wood/welding workshop and their application in working situations: shoes, non-flowing gowns, eye goggles, fire extinguishers, sand and water buckets. 8.9 Apply the safety rules relating to: clothing and health hazards; workshop hygiene; movements and other behaviour of workers in a workshop; material handling; tool handling; storage and uses; machine operation; fire prevention	Explain with sketches yard visit	Teaching Aids

ASSESSMENT	:	40% Continuous Assessment 60% Semester Examination

PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: Marine Ship and Propulsion Systems		**Course Code: MAR 203**	**Contact Hours: 5**
Course Specification			
	General Objective: 1.0 Know the theoretical basis of heat engines		
1-2	LAWS OF THERMODYNAMICS AND HEAT TRANSFER 1.1 Explain the thermodynamics properties of fluids. 1.2 Define the term "reversibility "of a heat engine. 1.3 Explain carnot cycle's efficiency and its principle. 1.4 State the second law of thermodynamics. 1.5 Solve problems on entropy. 1.6 Distinguish between theoretical and actual cycles. 1.7 Solve problems on cycle efficiency and work ratio. 1.8 By means of diagrams and worked examples, distinguish among the Otto, Diesel, Dual (mixed), Rankine and Joule cycles. 1.9 Calculate efficiencies, BHP, IHP.	Set problems, explain, and give worked examples and have students solve tutorial questions	Teaching Aids
	General Objectives: 2.0: Understand the concept of propulsion engines		
3	PROPULSION ENGINES 2.1 List the types of marine propulsion engines. 2.2 Identify the differences between internal combustion engines and external combustion engines.		
	General Objectives: 3.0: Understand the construction and operating principles of internal combustion engines		

4 – 8	INTERNAL COMBUSTION ENGINES 3.1 Distinguish between four and two stroke cycles. 3.2 Discuss scavenging and supercharging. 3.3 Distinguish between a supercharger and a scavenge blower. 3.4 State the types and functions of superchargers. 3.5 Explain the constructional details and design considerations of I.C.E's i.e. bed plates, a-frame, tie rods, crankshafts, main bearings cylinder liner, cylinder head, piston rod, crosshead, connecting rod inlet and exhaust valves, fuel camshaft, gear drive, chain drive, motion couplings. 3.6 Identify the components of, and the operation of the following fuel\injection systems: fuel pumps (jerk, common rail, electronic injection); fuel injections. 3.7 Describe the procedure of phasing and calibrating of an injection pump. 3.8 Carry out the timing of an injection pump from the first principles. 3.9 Discuss the modes of engine lubrication systems and measures directed at ensuring efficient lubrication, viz: lubricating systems (liner, crosshead, and bearings), boundary and full-flow lubrication lubricating oil tests on board and recommended valves.	Demonstrate, explain and have students practice timing and calculations. Ship visits. Show video tapes.	Fully equipped fuel pump and injector maintenance room. Video tapes.

	3.10 Explain the cooling of pistons, cylinder heads and liners. 3.11 Identify coolant converging mechanisms and systems. 3.12 Discuss the relative merits of coolants. 3.13 Explain engine starting and manoeuvring systems, i.e. engine starting by manual, battery, air or hydraulic manoeuvring systems safety devices in starting systems. 3.14 Interpret indicator diagrams. 3.15 Explain fault detection power balancing, heat balance. 3.16 Explain ignition delay, delay period, after-burning, turbulence, atomization, and penetration. 3.17 Describe the influence of octane and cetane numbers and the addition of additives on engine components. 3.18 Identify and explain fuel oil purification methods. 3.19 Calculate fuel consumption.		
General Objectives: 4.0: Understanding the operating principle of steam boilers, steam turbines, and steam reciprocating engines			

9 – 12	STEAM BOILERS 8.1 Define a boiler. 8.2 Differentiate between a smoke-tube and a water-tube boiler. 8.3 Explain the principles of operation of water-tube boiler. 8.4 Explain the functions of the following components: water drum, steam drum, fire row tubes and down comers economizers, super heater furnace boiler feet. TURBINES 8.5 Classify various types of turbine. 8.6 Sketch the layout and explain the principles of operation of impulse and reaction turbines. 8.7 Sketch the layout and explain the principles of operation of gas turbine plant. STEAM RECIPROCATING ENGINES 8.8 Explain the principle of operation of a steam reciprocating engine.	Explain with sketches and have students practice. Ship visit. Show photographs and video tapes.	Teaching aids Photographs Video tapes
	General Objectives: 5.0: Understand propulsion systems		

13 – 15	**PROPULSION SYSTEMS** 5.1 List the various components of transmission system 5.2 Identify the functions of the components of the transmission systems. 5.3 Sketch a line diagram of the fuel oil system 5.4 Trace and sketch the lubricating oil system Explain the closed-feed cooling water system Sketch the air and hydraulic starting System	Explain with sketches and have students practice	Teaching Aids

ASSESSMENT : 40% Continuous Assessment

60% Semester Examination

PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: Marine Plant Service And Maintenance		**Course Code: MAR 202**	**Contact Hours: 5**
Course Specification:			
WEEK	**General Objectives: 1.0: Know the need for and type of plant maintenance**		
1	MARINE DIESEL ENGINE 1.1 Define breakdown maintenance, routine maintenance/servicing, planned maintenance, preventive maintenance. 1.2 State the importance of the use of machinery manufacturers' manual in plant maintenance.	Discuss 1.1 and 1.2	A typical machinery manufacturer's manual
	General Objective: 2.0: Know the components of a marine diesel engine		
2	MARINE DIESEL ENGINE 2.1 Identify the major components of a marine diesel engine.	Illustrate with a large diagram visit to engine plants	Writing material drawings and photographs samples of engine components.
	General Objectives: 3.0: Understand marine plant faults diagnosis and correctives actions		
3	FAULT DETECTION AND REMEDIES 3.1 Outline common faults. 3.2 Explain the causes of the faults in 2.0 above.	Discuss and Illustrate	DITTO
	General Objectives: 4.0: Understand the routine maintenance procedure of a marine diesel engine		

4 – 5	MAINTENANCE PROCEDURE OF COMPONENTS 4.1 State the maintenance procedure for each of the following marine engine component main bearing: piston and rings, fuel injectors, fuel pumps, heat exchangers and filters. 4.2 Explain the procedure for calibration of fuel pumps. 4.3 Blead the fuel system of the engine. 4.4 Check fuel system of the engine for tension. 4.5 Carry out emergency stopping procedure of the engine. 4.6 Service a turbo charger. 4.7 Replace worn piston and rings. 4.8 Check tappet clearances. 4.9 Grind poppet valves. 4.10 Assemble poppet valves and time them clean fouled coolers. 4.11 Explain shipboard tests for contamination of lubricating oil. 4.12 List the causes and prevention of crankcase explosions and scavenge fires. 4.13 Sketch indicator diagrams and identify possible faults. 4.14 Take cylinder liner bore gauge. 4.15 Take crankshaft deflections. 4.16 Explain common faults of governors. 4.17 Time the fuel pumps.	Demonstrate, explain and have students perform activities in 4.1 – 4.8. Conduct visits to ships and operate systems there.	Sample boiler burners, sample boiler gauge glasses, boiler water test kits, sample boiler safety valve.

	General Objectives: 5.0: Know the correct procedure for preparing a boiler an its mountings for survey		
6 – 8	MAINTENANCE PROCEDURE OF BOILER AND MOUNTINGS 5.1 Describe the blow down process of a boiler, open up, clean both water and gas sides in readiness for survey, e.g, economizers, super heaters, combustion chamber and furnace. 5.2 Dismantle, clean and prepare boiler mountings for survey paying particular attention to the safety valve and the gauge glasses. 5.3 Explain how boiler water is tested. 5.4 Describe the fuel line arrangement of the burner and also explain the operation of the remote control for shutting down the burner in an emergency 5.5 Explain how boiler valve seats are grounded 5.6 State the methods of detection of leaking boiler tubes and how to plug them 5.7 State the method of servicing the burner system, e.g., nozzle, electrodes and filter 5.8 Explain how to test alarm system.	Demonstrate, explain and have students perform activities in 5.1 – 5.8. Conduct visit to ships and operate systems there	Sample boiler burners, sample boiler gauge glasses, boiler water test kits, sample boiler safety valve.
	General Objectives: 6.0: Know the correct procedure for overhauling the compressor		

9 – 10	MAINTENANCE OF COMPRESSORS 6.1 Describe the precise order for dismantling the compressor. 6.2 Remove valves, inter-coolers and the after cooler. 6.3 State the common faults in compressor valves and coolers and how to detect these faults. 6.4 Over-haul bigend and main bearings emphasizing the need to check oil holes and passages in shaft volume and determine compression ratio of a compressor. 6.5 Check clearance	Demonstrate and have students perform tasks in 6.1 – 6.5	Samples of compressor valves, inter coolers, crankshaft, connecting rods and bearings. Demonstration compressor.
	General Objectives: 7.0: Know the correct procedure for preparing the air vessel and valves for survey		

11 – 12	MAINTENANCE OF AIR VESSELS 7.1 List the type of tools required for cleaning the internals. 7.2 State safety precautions necessary for servicing pressurized vessels. 7.3 Fill the air vessel and check for leaks and stress the importance of regular operation of the drain cock. 7.4 State the importance of the air vessel relief valve, fusible plug, manhole mud doors; also state the need for regular inspection of these fittings. 7.5 State the importance of the internal coating in air vessel and the need for the regular maintenance of this coating.	Demonstrate, explain and have students perform tasks in 7.1 – 7.5. Visit to a ship	Typical air vessel with fittings
	General Objectives: 8.0: Understand the steering gear system		
13 – 14	STERERING GEAR SYSTEM 8.1 Carry out tests and checks on steering gear system prior to sailing. 8.2 Explain actions required on total failure of the tele-motor system.	Demonstrate, explain and illustrate with sketches and have Cadet perform tasks in 8.1 – 8.2 Visit to a ship.	Staring gear model and printed digorams.
	General Objectives: 9.0: Understand the specific faults which occurs in pumps and how to rectify them		
15	MAINTENANCE OF PUMPS 9.1 Explain how to service a reciprocating pump. 9.2 Explain how to service a centrifugal pump 9.3 Explain how to service a gear pump 9.4 Explain how to service a screw pump	Demonstrate 9.1 – 9.4 and have student practice same	Reciprocating pump centrifugal pump, gear pump and screw pump, tool box.

ASSESSMENT	:	40% CONTINUOUS ASSESSMENT 60% SEMESTER EXAMINATION

PROGRAMME: NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: INTRODUCTION TO COMPUTING		**Course Code: MAR 103**	**Contact Hours: 3**
Course Specification: Theoretical/Practical			
WEEK	**General Objective: 1.0 Understand how to diagnose simple fault on a computer and rectify them**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
	1.1 Explain briefly the evolution of computer from ENIAC to present technology. 1.2 List major subunits of a computer (Motherboard (XT & AT), Drives (Hard disk, Floppy, CD-ROM, Zip), Ports. 1.3 Explain briefly the operation of computer. 1.4 Draw a block diagram showing the interconnection of the mother board. 1.5 Identify the memory, ports, CPU, power supply, battery supply for memory retention. 1.6 Identify the protocols of various types of port: Parallel, Serial, and USP. 1.7 Explain the functions of the ports listed 1.6 above. 1.8 Demonstrate how to connect computer ports to peripherals. 1.9 Explain the characteristics of monitors such as scanning speed, & colour resolution. 1.10 Explain briefly the functions and operation of monitors. 1.11 Select monitors for different mother boards speed and resolution.	Introduce the students to technical aspects of cables connecting the units. Explain how data is transferred down the cables and the type of hand-shake methods used. Explain the operational principles of monitors. Mention the criteria for selecting monitors. Dismantle and assemble different types of printers. Show the students the different components of a printer Ask the students to carryout market survey on computer hardware components.	Computer auxiliary units, Computer peripherals, tools and Central Processing Units, I/O devices. Printers, recommended textbooks, magic board

	1.12 Explain briefly the operation of a printer. 1.13 List different types of printer (e.g. Line, Dot, Laser, and DeskJet). 1.14 Understand the difference between various types of printer heads. 1.15 Identify pin connection role of printer ports such as Parallel, Serial USP. 1.16 Identify a modem. 1.17 Draw a block diagram of a modem. 1.18 Explain briefly he operation of a modem. 1.19 Explain the classification of modems (V Series and X Series). 1.20 Identify modem ports. 1.21 Demonstrate the connection of a modem to computer. 1.22 Understand what determines modem speed. 1.23 Introduce briefly the concepts of networking.		
	General Objective 2.0: Understand faults on a computer		

	2.1 Draw up a list of possible faults that could be easily identified from external systems (area of concern are power supplies, clocks, memory battery low, I/O ports, disk drives voltages, keyboard, monitors, disc drives, scratches on discs). 2.2 Identify faults on the mother board from systems on the monitor. 2.3 Evaluate if fault is hardware or software. 2.4 Connect drives to mother board. 2.5 Test the computer system. 2.6 Install and remove memory modules. 2.7 Identify various cards installed in bus slots. 2.8 Identify various cards installed in bus slots. 2.9 Do a literature survey of peripherals available in the market. 2.10 Note the trends of data transfer methods and ports used. 2.11 Install a modem. 2.12 Set modem parameters on the computer. 2.13 Install a UPS device making a suitable cable. 2.14 Make RS-232-C interface cable. 2.15 Assembling and disassembling a computer system.	In this module instructors should give students activity to explore with ample time to absorb the difficult issues involved, and to ask questions almost on a one to one basis. Instructor should help the students draw the list of faults to build up a database for diagnosis. Instructor should attempt to collect faulty boards for student use whenever possible and use them in the workshop.	Computer auxiliary units Computer Peripheral Units, Central Processing Units (CPU), I/O Devices, Tools and Measuring Instruments.

ASSESSMENT: 40% Continuous Assessments (assignments and tests every 5 weeks minimum)
60% Semester Examination

LIST OF MINIMUM EQUIPMENT FOR ND MARINE ENGINEERING TECHNOLOGY PROGRAMME FOR 30 STUDENTS

WORKSHOPS

MACHINE SHOP

1.	Centre lathe with the swing of 330 and length of bed 1500mm with complete accessories	4
2.	Universal milling machine complete with accessories	2
3.	Radial drilling machine complete with accessories (optional)	2
4	Universal engraving machine complete with accessories	2
5.	Sensitive drilling machine	2
6.	Power hacksaw	2
7.	Shaping maching with accessories	2
8.	Micrometers outside 0.25mm 25-50mm 50-75mm and sets of Inside micrometers	20 each
9.	Depth gauge	10
10.	Steel rule 300mm	20
11.	Calipers (inside and outside)	20 each
12.	Vee block with clamps	4
13.	Scribing block	4
14.	Surface plate	3
15	Grease gun	4
16	Fire extinguisher, water and sand buckets	4 each

FITTING SHOP

Work benches for 30 students	
Bench vices	30
Pillar drilling machine	2

Marking out table	1
Power hacksaw	1
Flat rough file (300mm)	30
Round rough file (300mm)	30
Square rough file (300mm)	30
Flat smooth file 250mm)	30
Half round rough file (150mm)	30
Triangular rough file (150mm)	30
Try-square	30
Dividers	30
Steel rule	30
Wallets of warding file	10 sets
Scribers	16
Vee block and clamp	2
Scribing block	2
Centre punches	30
Cold chisels (set)	10 sets
Scrapers (set)	5
Guilotine	2
Vernier Caliper	10
Hacksaw frame	30
Stock and dies (set) metric	3 sets
Taps and wrenches (set) metric	3 set
Hand drill	2
Centre drills	Lot
Tap extractor (set)	2 sets
Screw extractor (set)	4
Screw gauges (assorted)	2 sets
Screw driver (set)	4 sets
Hammers (assorted weight)	30

Wire brush		5
Micrometer (assorted)		5
Fire extinguisher, water and sand buckets		4 each
Feeler gauges		10
Goggles		30 pairs

WELDING AND FABRICATION SHOP

1	Welding transformer	2
2	MIG and MAG welding set	4
3	TIG Welding set	2
4	Acetylene gas cylinder	8
5	Oxygen gas cylinder	8
6	Welding table (gas)	5
7	Welding table (arc)	5
8	Protection screen for five booths for both arc and gas	10
9	Grinding machine (pedestal type)	2
10	Bench vice	6
11	Anvil and stand	4
12	Electrode holder	8
13	Clamp	8
14	Welding chipping hammer	6
15	Wire brush	6
16	Welding shield	6
17	Gloves	20
18	Gas bottle keys	6
19	Welding and cutting burner set	4
20	Gas cylinder truck	4
21	Flash gas lighter	4
22	Brazing rods	4 packets
23	Soldering flux	6 tins

24	Blow lamps	5
25	Goggles	10
26	Steel rule	10

ENGINE REPAIR SHOP

1	Engine diagnostic equipment	1
2	Hydraulic jack	1
3	Hydraulic press (100 tonne)	1
4	Brake testing equipment with control panel	1
5	Sensitive drilling machine	2
6	Valve grinder	1
7	Workshop service compressor	1
8	Work benches	4
9	Bench vices	6
10	Injector pump test bench	1
11	Universal battery charger	1
12	Engine mounting stand	3
13	Hydro-meters	5
14	Trolley Jacks	2
15	Complete mechanics tool kit	10
16	Electric hand drill	2
17	Breast drill (manual	2
18	Airline pressure gauge	4
19	Tachometer	2
20	Smoke meter	2
21	Lubrication equipment	1
22	Portable crane	1
23	Components of pumps	
24	Components of compressors	
25	Valve refacer	2

26	Diesel fuel pump test stand	1
27	Chain wrench (for removing oil filter)	2
28	Battery cell tester	2
29	Piston ring removal	2
30	Pullers (Various sizes)	6
31	Grease gun	6
32	Cylinder ridge removal	6
33	Engine sump drainer	2
34	Two (2) stroke diesel engine	
35	4 (four) cylinder petrol engine	
36	4 (four) cylinder petrol engine	
37	Clutch testing machine	
38	Spanners (assorted types and sizes)	
39	Transparent engines, gear boxes (for demonstration)	1
40	Vibration meter	1
41	Fuel consumption measuring system	1
42	Fire extinguishers, water and sand buckets	
V	Training Boat	
	All facilities required for the operation of a vessel that can accommodate 20 (twenty) students	

FOUNDRY/HEAT TREATMENT/FORGE WORKSHO*P*

1	Black smith forges	1
2	Anvil and stand	2
3	Tongs (assorted	5 each
4	Swage block	2
5	Leg vice	2
6	Black smith hand hammer (various sizes)	6 each
7	Sledge hammer	4
8	Flatters	6
9	Hardles	6

10	Hot chisels	6
11	Cold chisels	6
12	Fullers	6
13	Top and bottom swage (various sizes)	6 each
14	Heat treatment furnace	1
15	Electric furnace with control	1
16	Quenching bath	2
17	Thermocouples	2
18	Pickup tongs (assorted)	10
19	Combined portable thermocouple pyrometer	1
20	Hammers (assorted)	6 each
21	Wire brush	2
22	Pedestal grinder	2
23	Hacksaw frame and blades	10
24	Eye Goggles	10
25	Face shield	10
26	Heat resistant gloves	10 pairs
27	Knee leggings (foundry)	10 pairs
28	Leather apron	10 pairs
29	Safety boots (fire resistant)	10
30	Moulding bench	10
31	Bottom board	20
31	Moulding flask	20
32	Moulding sand shovel	20
33	Watering can	5
34	Wheel-barrow	4
35	Rammers (various types)	20
36	Moulding trowels (various sizes)	20
37	Strike-off-bars	20
38	Gate cutter or spoon	20

39	Sprue pins	20
40	Vent rods	20
41	Bellows	10
42	Lifters	10
43	Bold sponges	10
44	Draw pins	100
45	Bench vice	12
46	Hand vice	6
47	Cutting pliers	6
48	Combination pliers	20
49	Half round bastard file	20
50	Flat file second cut	20
51	Triangular file	20
52	Round file	20
53	Sand mixing machine	1
54	Moulding machine	5
55	Continuous mixer machine dispenser	1
56	Core boxes	10
57	G. Clamps	20
58	Core driver	1

DRAWING STUDIO

1	Drawing table complete with drafting machine/stood	20
2	Drawing set complete with pens for ink work	20
3	45o set squares	20
4	60o set squares	20
5	Blue printing machine	1
6	Adjustable set squares	4
7	Desk sharpener	20
8	Triangular scale rule (30mm)	20

9	Flat scale rule (300mm)	4
10	Blackboard ruler (1m)	4
11	Blackboard Tee squares	4
12	Blackboard set square (45o 60o)	4 each
13	Blackboard compasses	4
14	Blackboard protractor	4
15	French curve set	4
16	Letter stencils (full alphabet, plus S) height 3mm, 6mm	10
17	Number stencil (0-9 inclusive) height 3mm, 6mm	10

LABORATORIES

MECHANICS OF MACHINES

1	Screw Jack	1
2	Oldham coupling	1
3	Four bar chain mechanism	1
4	Whitworth quick return mechanism	1
5	Slider crank mechanism	1
6	Hooks joint	1
7	Geneva stop	1
8	Conservation of angular momentum	1
9	Dead weight tester	1
10	Forces on beam apparatus	1
11	Simple moment beam	1
12	Comprehensive fly wheel apparatus	1
13	Bourdon tube pressure gauge	1
14	Torsion of bar apparatus	1
15	Spring balance	1
16	Gearing system apparatus	1
17	Compression apparatus	1

18	Strut apparatus	1
19	Wheel and axle set	1
20	Centrifugal/centripetal apparatus	1
21	Polygon of force apparatus	1
22	Balancing of rotation masses	1
23	Static and dynamic balance apparatus	1
24	Governor apparatus	1
25	Efficiency of screw threads	1
26	Plate clutch friction apparatus	1
27	Friction on inclined plane apparatus	1
28	Sound friction apparatus	1
29	Extension and compression of springs apparatus	1
30	Universal cantilever apparatus	1
31	Gyroscope apparatus	1
32	Angular acceleration	1
33	Centripetal force apparatus	1
34	Whirling of shaft apparatus	1
35	Crank and connecting rod apparatus	1
36	Rope, belt and coil friction apparatus	1
37	Universal vibration apparatus	1
38	Cam and cam follower mechanism	1
39	Differential gear assembly	1
40	Fire extinguishers sand and water buckets	4

STRENGTH OF MATERIALS

1	Compression and tensile testing machine (140 tons)	1
2	Universal hardness testing machine (brinell, vickers)	1
3	Fatigue testing machine	1
4	Thick cylinder apparatus	1
5	Thin cylinder apparatus	1

6	Strutting apparatus	1
7	Torsion testing machine	1
8	Creep measuring apparatus	1
9	Universal cantilever apparatus	1
10	Portable strain meter	1
11	Beam apparatus	1
12	Shearing force apparatus	1
13	Bending moment apparatus	1
14	Cyroscope apparatus	1
15	Polygon and force apparatus	1
16	Young's modulus apparatus	1
17	Tensometer	1
18	Strain gauges	1
19	Closed coil spring apparatus	1
20	Leaf spring testing machine	1
21	Floor mounted tensile compressive testing machine with accessories	1
22	X-Y recorder for tensile testers	1
23	Table top tensometer with accessories	1
24	Macro hardness testing machine (brinell, Vickers, Rockwell)	1
25	Impact testers (izod, charpy)	1
26	Micro hardness testing machine	1
27	Strain measuring bridge	1
28	Creep testing machine/furnace	1
29	Steel rule (1/2m)	5
30	Inside caliper	5
31	Outside caliper	5
32	Set of open ended spanner	2
33	Set of ring spanner	2
34	Allen keys	2 sets
35	Screw driver	3

36	Universal measuring microscope	1
37	Tool maker‘s microscope	1
38	Horizontal comparator	1
39	Vertical comparator	1
40	Surface finish measuring instrument Tally surf	1
41	Roundness measuring instrument Tally round	1
42	Universal gear measuring machines OR	1
43	Involute gear measuring machine OR	1
44	Double flank gear testing machine or	1
45	Universal pitch measuring machine	1
46	Measuring projector	1
47	Bench testing centres	1
48	Optical dividing head (vertical and horizontal)	1
49	Auto collimator or	1
50	Clinometer	1
51	Angle dekkor	1
52	Height setting micrometer	1
53	Angle gauge	1
54	Slip gauge and holder	2 sets
55	Vernier protractor	2
56	Sine bars with centers	2
57	Block level	4
58	Measuring ball	2 sets
59	Measuring cylinder	sets
60	Vee block (various sizes)	3
61	Optical flats	2 sets
62	Magnetic vee block	4
63	Surface texture comparative standards	2 sets
64	Staight edge	6
65	Outside micrometer (0-25mm; 25-50mm; 50-75mm; 75-100mm; 100-200mm;	

	200-300mm, 300-400mm)	4 each
66	Gear tooth vernier caliper	3
67	Vernier height gauge (75mm-100mm)	4
68	Vernier caliper	20
69	Depth gauge micrometer	4
70	Thread micrometer	2
71	Screw pitch gauge	4
72	Inside micrometer	3
73	Angle plate	3
74	Surface plate	3
75	Marking out table	1
76	Parallel strips	6
77	Limit gauge for hole, shaft and thread	6 each
78	Engraver	1
79	Bevel protractor	3
80	Combination set	2
81	Profile measuring projector	1
82	Floating carriage micrometer	1
83	Dial gauge stand (magnetic)	3
84	Measuring wires	2
85	Dial indicator	3
86	Radius gauge	4
87	Standard ring gauge	2
88	Engineer’s square	4
89	Feeler guage	2
90	Fire extinguishers, water and sand buckets	

FLUID MECHANICS/HYDRAULICS/HYDRODYNAMICS

1	Turbine set (pelTon, francis pump, or Kaplan)	1
2	Hydraulics Bench with accessories for various	

	experiments in fluid flow measurements	1
3	Weir tank	1
4	Friction loss in pipes	1
5	Bernulli apparatus	1
6	Floating body apparatus	1
7	Losses in fitting and pipe bending apparatus	1
8	Universal pump testing unit	1
9	Centrifugal pump set	1
10	Reciprocating pump set	1
11	Manometer	1
12	Rotameter	1
13	Laminar flow apparatus	1
14	Pilot static tube	1
15	Free and force vortices apparatus	1
16	Parallel series centrifugal pump set	1
17	Universal radial flow apparatus	1
18	Water meter	2
19	Hot wire anaemometer	2
20	Pelton wheel apparatus	1
21	Towing tank	1
22	Ships model	1
23	Propeller and Rudders (used ones)	1

THERMODYNAMIC/HEAT ENGINES

1	Water- heater/stirrer unit with bath	1
2	Uncalibrated mercury in glass thermometer 10° to 110 °c	20
3	Resistance thermometer	1
4	Bench mounted aircooled 4 stroke diesel engine rig including dynamometer and instrumentation	1
5	Boyle gas calorimeter	1

6	Orsat gas calorimeter	1
7	Tachometer	2
8	Stroboscope	1
9	Air compressor test set	1
10	Thermal conductivity apparatus	1
11	Marcet boiler	1
12	Steam boiler plant (laboratory type)	1
13	Mechanical equivalent of heat apparatus	1
14	High pressure vapour unit	1
15	Vapour density apparatus	1
16	Pressure cooker	1
17	Stirling heat pump	1
18	Falling ball viscometer	1
19	Rotary viscometer	1
20	Gas laws apparatus	1
21	Single or two stage air compressor	1
22	Refrigeration demonstration unit	1
23	Air conditioning laboratory unit	1
24	Speedomax recorder	1
25	Thermal anemometer	1
26	Electric anemometer	1
27	Pyrometer, infrared, non-contact digital infratrace	1
28	Combined separating and throttling calorimeter	1
29	Air thermometer constant value	1
30	Piston pump test set	1
31	Gear pump test set	1
32	Fan test set	1
33	Surge in pipe apparatus	1
34	Heat transfer apparatus-parallel, counter flow	1
35	Smoke tunnel	1

36	Air flow measurement demonstration apparatus	1
37	Sensor dial thermometer set	4
38	Experimental heat pump and air cooler	1
39	Refrigeration cycle apparatus	1
40	Barometer	2
41	Reverse cycle refrigeration and air conditioning training unit	1
42	Vapour unit compression refrigeration unit	1
43	Bench top water cooling tower	1
44	Domestic deep-freezer	1
45	Complete set of manifold with gauges and lines	1
46	Semi hermotic compressor	1
47	Condensing unit (air cooled) with open type compressor	1
48	Vacuum pump	3
49	Graduated charging cylinder	2
50	Electronic leak detector	2
51	Amprobe	2
52	Thermostatic expansion valve	20
53	Automatic expansion valve	20
54	Time switches	20
55	Blower	20
56	Fan motor	10
57	Fan blade	15
58	Sectioned compressor	1
59	Environmental control apparatus	1
60	System analyzer	6
61	Sectioned component	2
62	Oil pump	2
63	Evaporator fan motor	10
64	Evaporator fan blade	5
65	Motor run capacitor	15

66	Motor capacitor	15
67	Fan capacitor	15
68	Condenser fan motor and blade	10
69	Electric relay	20
70	Electric overload	20
71	Flaring tool box	20
72	Refrigeration socket set	4
73	Refrigerant expansion	1
74	Multi purpose air duct	1
75	Sound level indicator	1
76	Fire extinguisher, sand and water buckets	1

LIST OF PARTICIPANTS

S/N	NAME	ADDRESS
1.	Engr. A.C.C.Peters	Institute of Marine Engineers, Lagos
2.	Engr. Richard Owolabi	Maritime Academy of Nigeria, Oron
3.	Mr. Bilam N. Niriyus	NBTE Kaduna
4.	Engr. E.I.E.Onyeocha	NBTE Kaduna
5.	Godwin Okpe	NBTE Kaduna