NATIONAL BOARD FOR TECHNICAL EDUCATION KADUNA

HIGHER NATIONAL DIPLOMA

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 SeniorSecondary 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, StatisticsEnglish Language, Additional Maths 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, Enterpreneurship 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 consist of four semester 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 studen who successfully completed some of the courses or the diplomates of the programme. There is a slight departure in the presentation of the performance based curriculum which requires the conditions under which the performance 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 th 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 g 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 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 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.

HND PROGRAMME IN MARINE ENGINEERING

1ST SEMESTER: HND I

Course Code	Course Title	L	T	P	CU	CH
GNS 302	COMMUNICATION IN ENGLISH III	2	-	-	2	2
MAR 305	ELECTROTECHNOLOGY	3	-	3	6	6
MAR 303	NAVAL ARCHITECTURE	3	-	3	6	6
MTH 321	NUMERICAL METHODS & COMPUTER	2	-	-	2	2
MAR 301	MARINE AUXILIARY MACHINERY	3	-	3	6	6
MAR 307	MARINE ELECTRONICS	2	-	2	4	4
MAR 309	SHIP AUTOMATION	2	-	-	2	2
	TOTAL	17	-	11	28	28

2ND SEMESTER: HND I

Course Code	Course Title	L	T	P	CU	CH
GNS 401	COMMUNICATION IN ENGLISH IV	2	-	-	2	2
GNS 311	ENGINEER IN SOCIETY	2	-	-	2	2
MAR 304	METALLURGY	2	-	3	5	5
MAR 306	MARINE OPERATIONS	2	-	-	2	2
MAR 302	SHIP ENGINE DESIGN & OPERATION	2	-	2	4	4
MEC 301	FUNDAMENTALS OF ENGINE DESIGN	2	-	-	2	2
MTH 311	ADVANCED ALGEBRA	2	-	-	2	2
MEC 306	FLUID MECHANICS	2	-	3	5	5
	TOTAL	16	-	8	24	24

3RD SEMESTER: HND II

Course Code	Course Title	L	T	P	CU	CH
MAR 401	HEAT AND MASS TRANSFER	2	-	2	4	4
GNS 401	INDUSTRIAL MANAGEMENT	2	-	-	2	2
MEC 305	MECHANICS OF MACHINES	2	-	3	5	5
MAR 403	THERMODYNAMICS PROPERTIES OF FLUIDS	2	-	3	5	5
MTH 312	ADVANCE OF CALCULUS	2	-	-	2	2
MEC 303	POWER & REFRIGERATION CYCLE	1	1	3	5	5
MAR 499	PROJECT	-	-	3	-	3
TOTAL		11	1	14	23	26

4TH SEMESTER: HND II

Course Code	Course Title	L	T	P	CU	CH
MTH 313	STATISTICAL METHODS	2	-	-	2	2
MEC 303	STRESS ANALYSIS	2	1	-	3	3
MAR 402	SHIP DESIGN & CONSTRUCTION	2	-	2	4	4
MAR 404	SHIP PROPULSION	2	-	2	4	4
MAR 406	MARITIME LAW & INDUSTRIAL RELATION	2	-	-	2	2
MAR 499	PROJECT	-	-	3	6	3
TOTAL		10	1	7	21	18

HND Curriculum and Module Specifications in Marine Engineering

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: metallurgy	**Course Code: MAR 304**	**Contact Hours 5**	
Course Specification:			
WEEK :	**General Objective 1.0 : UNDERSTAND THE PROCESS OF MELTING OF METALS**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	Melting of Metals 1.1 Describe melting of metals 1.2 List the furnaces used for melting. 1.3 Describe the procedure for melting cast iron, Aluminium alloys and copper- base alloys.	Explain with phase-diagrams the transformations that metal go through during the melting process. Demonstrate the melting process in a furnace.	Teaching Aids: - phase diagrams - O/H Projector - Multimedia projector - CDs, Diskettes - Small Furnace.

WEEK	General Objectives 2.0: KNOW THE DIFFERENT TYPES OF CASTING PROCESSES		
2-3	Casting Processes 2.1 Describe a casting process. 2.2 List the various casting processes 2.3 Explain ingot casting of steel and non-ferrous metals. 2.4 Enumerate the basic steps in a sand-casting process. 2.5 Describe die-casting methods. 2.6 Enumerate possible defects in the processes listed in 2.2.	DITTO	DITTO
WEEK	**General Objective 3.0** : UNDERSTAND POWDER METALLURGRY		
4	Powder Metallurgy 3.1 Describe and perform the operations of cement carbides manufacture 3.2 List the advantages and disadvantages of the process. 3.3 Discuss the applications of	DITTO	DITTO

	powder Metallurgy		

WEEK	General Objectives 4.0: Know the principles of rolling, forging, extrusion and drawing		
5-8	Rolling, Forging, Extrusion and Drawing 4.1 Describe the rolling operation of metals 4.2 List the types of rolling mills 4.3 Explain the principles of forging 4.4 Enumerate and describe the procedures for the various types of forging. 4.5 Identify forging defects. 4.6 List the common types of extrusion. 4.7 Differentiate between extrusion by direct and indirect methods. 4.8 Explain defects in extruded sections. 4.9 Explain the processes of drawing rod, wire and tubes. 4.10 Identify tools for cupping and re-drawing operations. 4.11 Carry out the following operations and observe safety precautions: deep drawing, re-	Model of Demonstrate, explain and have student practice same	Deep Drawing machines Furnace Teaching Aids as in 1.1

	drawing and lubrication. 4.12 Outline defects encountered in deep drawn components. 4.13 Explain malforming and hydro-forming		
WEEK	**General Objectives 5.0: Understand cold-working processes.**		
9	Cold-working processes. 5.1 Outline the procedures for shearing, bending, rubber -pressing, spinning, coining and embossing. 5.2 List the applications of the processes listed in 5.1.	Explain	Teaching Aids as in 1.1

WEEK	General Objectives 6.0: Understand the principles of heat treatment of metals		
10-11	Heat Treatment of metals 6.1 Describe the processes and furnaces used in heat treatment of steel 6.2 Outline the differences in using the different quenching media. 6.3 Describe annealing of aluminum and its alloys 6.4 Discuss annealing of copper and its alloys 6.5 Distinguish between bright and vacuum annealing 6.6 Outline solution and precipitation treatment 6.7 Describe the process of nitriding, case hardening, and electroplating 6.8 List the faults which may arise during heat treatment	DITTO	DITTO & Heat treatment furnace Quenching media.

WEEK	**General Objectives 7.0: Know the properties of non-ferrous metals as affected by heat treatment**		
12-13	7.1 Explain the structural and property changes of aluminum due to heat treatment. 7.2 List the engineering applications of heat-treated aluminum alloys. 7.3 Explain the structural and property changes of copper alloys due to heat treatment. 7.4 List the engineering applications of heat-treated copper alloys. 7.5 Explain the term "re-crystallisation temperature. 7.6 Explain diffusion of metals.	DITTO	Teaching Aids as in 1.1
WEEK	**General Objectives 8.0: UNDERSTAND THE ELEMENTS OF BINARY PHASE DIAGRAM**		
14	Binary Phase Diagrams 8.1 Describe the formation of solid solutions and dispersed phases. 8.2 Describe the formation of precipitation hardening. 8.3 State the influence of alloy structure on strength, ductility, fracture and creep characteristics.	DITTO	DITTO

WEEK	General Objectives 9.0: Understand metallurgical tests.		
15	Metallurgical Tests 9.1 Describe the following non-destructive test (NDT): liquid penetrant, magnetic crack detection, radiographic inspection and ultrasonic testing. 9.2 Carry out liquid penetrant and magnetic crack detection tests. 9.3 Outline the procedures and carry out the following tests. a) Creep Test b) Tensile Test (Stiffness and proof of Stress) c) Hardness test d) Impact test	Demonstrate, explain and have students practice same	Metallurgical Tests Equipment for NDT, magnetic crack dictation impact test hardness test.

Assessment: 40% Continuous Assessment (Assignments & Tests once in 5 weeks minimum)
60% Examination

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: MARINE ELECTRONICS		**Course Code: MAR 307**	**Contact Hours: 4**
Course Specification: Theoretical & Practical			
WEEK	**General Objective 1.0: Understand basic electronics**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1	1.1 Identify electronic components. 1.2 Describe the electronic theory of matter. 1.3 List semi-conductor devices.	Explain and show samples of electronic components	Teaching Aids Samples of electronic components
WEEK	**General Objectives: 2.0 Know the construction, principles of operation and application of various semi-conductor devices**		
2-3	Thyristors and Thermistors 2.1 Describe the construction of a thyristor 2.2 Draw the block diagram of a thyristor showing junctions and symbols. 2.3 State the practical application of a thyristor 2.4 Explain with aid of diagram the basic construction and the various types of thermistors. 2.5 State the characteristics of a thermistor	Demonstrate, Explain and have students practice	Thyristor samples Batteries Teaching Aids Thermistor samples

WEEK	General Objectives 3.0 Know thermionic devices		
4	3.1 Identify thermionic valves, diodes, triodes and Pentodes. 3.2 Explain the characteristics of devices stated in 3.1 above. 3.3 Explain thermionic emission.	Explain	Teaching Aids Thermionic valves Diodes Triodes Pentodes
WEEK	**General Objectives: 4.0: Know the construction, principles of operation and application of transistors.**		
5-6	4.1 Describe a transistor with reference to its i) Basic construction and operation ii) Equivalent circuit iii) Static characteristics 4.2 Describe the method of biasing transistor such as self bias, collector-to base bias etc. 4.3 Explain temperature effect and temperature Compensation.	Explain and Demonstrate	Teaching Aids Transistors

WEEK	General Objectives 5.0: Know the construction and principles of operation of amplifiers		
7-10	5.1 State different classes of amplifiers. 5.2 State biasing conditions for A,B,AB and C operation in its common base mode amplifier. 5.3 Distinguish between the mode of operation of amplifiers in 5.2 above. 5.4 Describe the operation and characteristics of common collector amplifier. 5.5 Explain the operation and characteristics of DC amplifiers. 5.6 Explain the effect of drifts in DC amplifiers. 5.7 Perform experiments to demonstrate the performance of different classes of amplifiers. 5.8 Explain positive and negative feed back phenomena in amplifiers. 5.9 Draw a block diagram of a basic feedback amplifier. 5.10 Derive the general expression for stage gain of a basic feedback amplifier, e.g. $AvF = Av/(1 \pm e\,Av)$ $Av\,xF = \frac{Ar}{1 + e\,Ar}$. 5.11 Explain the following negative feedback types using block diagram only:	Demonstrate, Explain and have students practice	Diodes, amplifiers, Transistors Teaching Aids

	i) Series - current feedback ii) Series - Voltage feedback iii) Parallel - (shunt) current iv) Parallel - (shunt) voltage 5.12 Apply feedback principles to practical transistor circuits. 5.13 Explain the principles of operation and characteristics of the following circuits: i) Emitter follower ii) Cathode follower iii) Base follower 5.14 State the effects of voltage feed-back on amplifier gain and input/output impedance. 5.15 Draw equivalent circuit diagram for amplifiers.		
WEEK	**General Objectives 6.0: Understand the construction and principles of operation of stabilised power supply**		
11-13	Stabilised Power Supply: 6.1 Explain with aid of circuit and wave form diagrams, the principles of half and full wave rectification. 6.2 Explain the need for a smoothing circuit at the output of a rectifier. 6.3 Describe the circuits that use the following filters: i) the capacitor input filters ii) the inductance input filters.	Demonstrate, explain and have students practice	Rectifier Bridge, Capacitors, Indictors, transformer, oscilloscope, ect.

	6.4 Compare the performance of the filters in 6.3 above, using the output voltage/load current characteristics. 6.5 Explain with the aid of sketches/diagrams the operation of a three-phase rectifier circuit. 6.6 Determine by experiment the output characteristics of a three-phase rectifier. 6.7 Explain with the aid of diagram the operation of a simple stabilised power supply device using: i) shunt regulator transistor ii) series regulator transistor iii) shunt/series regulator 6.8 Explain the limitation of the various methods of a stabilised power supply in 6.7 above.		

WEEK	General Objectives 7.0: Know and use output devices		
14-15	Output Devices: 7.1 Identity output devices such as cathode ray oscilloscope (CRO) oscillograph, X-Y plotter, U.V. recorder, and state their applications. 7.2 Describe output devices in 7.1 above 7.3 State the application of output devices in 7.1 above. 7.4 Perform the display of the following output from the devices stated in 7.1 above. i) Wave form display ii) Voltage and current display iii) Phase/frequency measurement 7.3 Plot graphs with X-Y plotters.	DITTO Explain and demonstrate the uses of the output devices.	Oscilloscope, X-Y Plotter U.V. Recorder Frequency Meter

ASSESSMENT: 40% Continuous Assessment (Assignments & Tests every 5 weeks minimum)
60% Examination

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: MARINE OPERATIONS		**Course Code MAR 306**	**Contact Hours: 2**
Course Specification: Theoretical			
WEEK	**General Objective 1.0: Know the types and characteristics of fuel**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1-2	**TYPES AND CHARACTERISTICS OF FUEL** 1.1 Sketch and describe crude oil refining process 1.2 Name and classify simple fuels. 1.3 State the composition and chemical formulae of simple fuels. 1.4 Define physical and chemical properties of fuel such as density, cetane number, carbon residue, sulphur content, flash and fire points etc. 1.5 Describe fuel oil treatment process. 1.6 Explain the process of microbial degradation of heavy fuel oil 1.7 State how the process in 1.6 is prevented. 1.8 State the factors to be considered in the selection of fuel for particular application.	Explain with sketches Arrange Ship visit	Teaching Aids Fuel oil samples

WEEK	**General Objectives 2.0: Know the types and characteristics of lubricants**		
3	**TYPES AND CHARACTERISTICS OF LUBRICANTS** 2.1 Name the types of lubricants 2.2 Define viscosity, gravity, cloud and pour point etc. 2.3 State the function of additives in lubricant. 2.4 Describe lubricating oil treatment process such as centrifuging.	Explain Arrange ship visit	DITTO Lub oil samples
WEEK	**General Objectives 3.0: Understand lubrication**		
4	**LUBRICATION** 3.1 Explain the types of friction 3.2 Describe boundary, hydrodynamics and mixed lubrication. 3.3 State the factors that improve hydrodynamic lubrication.	DITTO	DITTO

WEEK	**General Objectives 4.0: Know the causes, the effects and the methods of prevention of corrosion**		
6-8	**CORROSION** 4.1 Describe the principal types of corrosion. 4.2 Explain the causes of corrosion. 4.3 Describe direct chemical corrosion. 4.4 Describe corrosion due to electrolysis (Electro-chemical corrosion) (Anodic and cathodic reaction). 4.5 Discuss the relationship between micro-structure and corrosion resistance. 4.6 Describe pitting and impingement corrosion. (erosion)	DITTO	DITTO
WEEK	**General Objectives:**		
	4.7 Explain the effects of stress and cavitation on corrosion 4.8 List the factors that stimulate corrosion		

WEEK	General Objectives 5.0: Know how corrosion can be inhibited or minimized.		
9.	5.1 Describe briefly the various methods of inhibiting corrosion such as: i) Use of sacrificial anodes. ii) protective-coating metals (electroplating and galvanic protection). iv) Treatment of water to render it alkaline. v) De-activation of water by elimination of oxygen. 5.2 Compare metallic and non-metallic protection.	DITTO Arrange visit to shipyard	Samples of electro-plated metal samples of alkaline water.
WEEK	**General Objectives 6.0: Know causes and methods of preventing marine pollution**		
10-11	6.1 State the sources of marine pollution. 6.2 State the method of preventing marine pollution. 6.3 Describe the operation of oily water separator and how the oil content is monitored. 6.4 State the precaution to be observed during bunkering of fuel. 6.5 Briefly describe sewage treatment.	DITTO Arrange ship visit	DITTO

WEEK	General Objectives 7.0: UNDERSTAND SAFETY PRECAUTIONS ON BOARD A VESSEL

12-15	**SAFETY PRECAUTIONS** 7.1 List the types of fire fighting appliances on board a vessel. 7.2 Enumerate the precaution necessary to avoid electrical fire 7.3 List precautions necessary during welding. 7.4 List sources of hazard in engine rooms and confined spaces 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 - Entering coffadams, empty fuel and lubrication oil tanks, etc. 7.5 State how accident can occur through the various items in 7.4 7.6 Name safety wears and equipment for 7.4 above. 7.7 State the safety rule for 7.4 above. 7.8 Describe the initiation and propagation of crankcase explosion and scavenge fire. 7.9 Describe methods of preventing crankcase explosion 7.10 Describe the operation of an oil mist detector, relief valves, crankcase doors etc.	DITTO and show sample of safety equipment	DITTO and samples of safety equipment

ASSESSMENT: 40% Continuous Assessment (Assignments & Tests every 5 weeks minimum)
60% Examination

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: SHIP AUTOMATION		**Course Code: MAR 309**	**Contact Hours: 2**
Course Specification: Theoretical			
WEEK	**General Objective Recognise the four different control systems in use**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1-2	**Control systems** 1.1 Describe simple Mechanical, Pneumatic, Hydraulic and electrical/electronic control systems. 1.2 State the systems that are mostly used in the marine environment and why. 1.3 State the necessary control philosophy that must be adopted in order to attain successful automation 1.4 State reasons/objectives for the adoption of automation.	Explain	Teaching Aids O/H Projector & transparencies multimedia projectors Slides, CDs, diskettes, etc.

WEEK	General Objectives 2.0: Understand open and closed loop control systems		
3	**Control circuits:** 2.1 Sketch and describe continuous and sequential open loop control system and give examples in ships or oil rigs. 2.2 Sketch and describe on-off and continuous closed loop control systems, giving examples in ships or oil rigs. 2.3 Describe positive feedback and negative feedback.	Sketch & Explain and have students practice	Teaching Aids as in 1.1 above.
WEEK	**General Objectives 3.0: Know the control system component and process control.**		
4-5	**Control System Components:** 3.1 State the components of a simple control circuit 3.2 Describe and sketch a simplified data logger system. 3.3 Name some commonly used parameter sensing instruments and describe their modes of operation 3.4 Define process control and describe servo-mechanisms (Kinetic control). 3.5 Name and describe some recording and display equipment.	Explain. Arrange ship visit.	Teaching Aids Data logger, Oscillescope Ammeters, voltmeter Pyrometers, etc.

WEEK	General Objectives 4.0: Know schematic representation of control signals		
6	**Control Signals** 4.1 Sketch and describe the different signals in control system giving examples. 4.2 Explain the term "Time Lag" and "Sensitivity". 4.3 Derive the mathematical representation of the signals. 4.4 Describe signal conditioning methods.	Demonstrate, explain and have students practice	Teaching Aids as in 1.1 above.
WEEK	**General Objectives 5.0: Understand transfer functions**		
7-8	5.1 Derive transfer functions for block diagrams and system equations. 5.2 Solve system problems using Lap lace Transforms, D-Operators and partial differential equations 5.3 Describe proportional, derivative and integral control actions and responses. 5.4 Describe zero order, 1st order, and 2nd order control systems.	Explain, solve problems and have students practice same	Teaching Aids as in 1.1 above.

WEEK	General Objectives 6.0: Know frequency response methods		
9	**FREQUENCY RESPONSE METHODS.** 6.1 Define frequency response. 6.2 Describe transient and steady state response. 6.3 Design systems using Nyquist, Bode, Root-Locus and Nicholas plots and stability criteria. 6.4 Describe the use of Lisajeav figures. 6.5 Show zero response to step, square, ramp and sinusoidal input signals.	DITTO	DITTO

WEEK	General Objectives 7.0: Understand transducers		
10	**TRANSDUCERS:** 7.1 Define "Transducers" giving examples. 7.2 Use block diagram to typify transducer elements. 7.3 State the characteristics of a typical transducer. 7.4 Define transducer sensitivity. 7.5 Describe electrical transducer, resistance transducers, photosensitive transducer, piezo-electric transducer, electro-magnetic transducer, and mechanical transducer.	DITTO	DITTO Samples of transducers

WEEK	General Objectives 8.0: Know automatic control theory		
11	**Automatic Control Theory** 8.1 Describe an automatic control system. 8.2 Sketch typical automatic closed loop control system showing Detecting Element Unit Set Point and Motor Element, etc. 8.3 Define "GAIN" of an automatic controller. 8.4 Define proportional band. 8.5 Show the effects on proportional bound of introduction of derivative and integral control actions. 8.6 Describe CASCADE control	DITTO	DITTO Models of automatic control system.
WEEK	**General Objectives: 9.0: Know automatic control for boilers**		
12	<u>Boilers</u> 9.1 Describe boiler water level control system and steam control system. 9.2 Describe sequential boiler burner control system. 9.3 Describe boiler steam quality control system and closed feed system.	DITTO Arrange ship visit	Models of boiler control systems. Teaching Aids.

WEEK	General Objectives 10.0: Know automatic control for marine diesel engines		
13-14	**AUTO-CONTROL OF DIESEL ENGINES;** 10.1 Sketch and describe: i) Mechanical Governor ii) Hydraulic Governor identifying proportional, derivative and integral control spools and nozzles. iii) Electric/electronic. 10.2 Sketch and describe marine viscometer system. 10.3 Describe the remote starting and control arrangements for marine Diesel Engine indicating ECR and Bridge control station. 10.4 Sketch and describe practical automatic control circuits for control of L.O. temperature and for control of JCW temperature. 10.5 Sketch and describe a practical cascade control system for JCW of engine.	DITTO Arrange ship visit	DITTO Models of control systems Section models of governors.

WEEK	General Objectives 11.0: Know tanker cargo control system and dynamic positioning system for offshore vessels		
15	**CARGO CONTROL IN TANKERS:** 11.1 Describe automatic tank-washing systems, stating safety precautions. 11.2 Describe automatic tanks inert gas system for tankers. 11.3 Describe tanker automatic self, loading/discharge system for large oil tankers. 11.4 Describe and sketch a dynamic positioning system. 11.5 Describe tension-leg platform.	DITTO Arrange visits to SBMs, Rigs	DITTO

ASSESSMENT: 40% Continuous Assessment (Assignments & Tests in 5 weeks minimum)
60% Examination

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MARIN ENGINEERING			
COURSE: SHIP ENGINE DESIGN & OPERATION	**Course Code: MAR 302**		**Contact Hours: 4**
Course Specification: Theoretical & Practical			
WEEK	**General Objective 1.0: Know general arrangement of each of the various types of marine engines**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1-2	**GENERAL ARRANGEMENT OF MARINE POWER PLANT** 1.1 Make block diagrams identifying each piece of machinery in plant. 1.2 Explain the purpose of each piece of machinery in plant. 1.3 Suggest possible additions/ improvements to plant arrangement.	Explain	Teaching Aids - O/H Projector - Multimedia Project Slides, transparencies CDs, Diskettes. Etc.

WEEK	General Objectives 2.0: Know the reasons for the selection of either gas turbine plant, steam turbine plant or diesel engine plant for ship main propulsion.		
3	**PLANT TYPES** 2.1 State the reasons for the selection of a main propulsion plant. 2.2 Explain the advantages and disadvantages of each type of plant. 2.3 Suggest how each plant can be improved.	DITTO	DITTO
WEEK	**General Objectives 3.0: Understand gas turbines**		
4-5	**GAS TURBINES** 3.1 State the effect of inter-cooling, reheating, and heat exchangers on the efficiency of gas turbines. 3.2 State the influence of component efficiencies on performance. 3.3 State the influence of component losses, pressure ratio and maximum cycle temperature on performance. 3.4 Calculate performance of specified plant.	Explain, calculate and have students practice same	Teaching Aids
WEEK	**General Objectives 40: Understand steam turbines**		
6-7	**STEAM TURBINES** 4.1 Perform cycle analysis, of steam plant including effects of superheating, re-heating, regenerative feed heating, with specified arrangements of feed heaters, drain coolers and pumps. 4.2 Produce blade diagrams for impulse and reaction turbine	DITTO	DITTO Teaching Aids as in 1.1 - Entropy charts - Enthalpy-Entropy charts - Steam Tables

	4.3 Determine the influence on performance of impulse, reaction, blading, efficiency, stage and overall isentropic efficiencies, condition curve, reheat factor, and compounding. 4.4 Perform steady flow analysis of single and multiple effect evaporators. 4.5 Use entropy charts and steam tables, enthalpy- entropy charts to determine steam condition at stages. 4.6 Sketch the arrangement of axial flow and Radial flow turbines.		- Samples and models of turbine blades.
WEEK	**General Objectives 5.0: Understand marine diesel engines**		
	MARINE DIESEL ENGINES 5.1 Discuss the selection of materials for engine parts. 5.2 State the basic engine design considerations 5.3 Describe redesign analysis determining the number of cylinders dimensions, and arrangements. 5.4 Describe ignition and flame propagation in marine diesel engines. 5.5 Describe ignition and flame propagation in internal combustion engines.	Explain with sketches and have students practice same.	Photographs, Large live Diagrams, Teaching Aids As in 1.1.

	5.6 Describe the types of combustion chambers and their influences on ignition delay, fuel-air mixing, etc. 5.7 Describe dissociation and its influence on engine combustion chamber design. 5.8 Sketch and describe practical internal combustion engine cycles. 5.9 Describe modes of supercharging and natural aspiration. 5.10 Sketch and describe: a) Sulzer lost-motion device b) MAN-B&W lost motion device 5.11 Sketch and describe the air compressor start up-shut-down system including the unloading device. 5.12 Describe Marine diesel engine cylinder head design with particular reference to cylinder head cooling constraints and problems. 5.13 Describe Marine diesel engine piston and piston crown design with emphasis on problems related to ring grooves, cooling, strength of crown, scavenging, and ring lubrication. 5.14 Describe Marine diesel balancing. 5.15 Sketch and describe some engine		

	balancers.		
WEEK	**General Objectives 6.0: Know the testing and performance of marine heat engines**		
11-12	**PERFORMANCE AND TESTING OF MARINE HEAT ENGINES** 6.1 Determine the bhp, ip, aspect ratio, compression ratio, cp, pp stc, mep of a diesel engine unit. 6.2 Take indicator cards of a diesel engine unit and show the information which can be gleaned from these cards, about the state of the engine settings. 6.3 Determine engine heat balance. 6.4 Determine the ideal thermal efficiency of the following gas power cycles. a) Carnot cycle b) Otto cycle c) Diesel cycle d) Dual cycle e) Joule cycle. 6.5 Define "CUT OFF FACTOR" in respect of the Diesel cycle 6.6 Make the basic analysis of exhaust gases, and show the relation between volumetric and mass analysis of a gas mixture. 6.7 Make heat balance for engine and boiler trials.	Demonstrate, explain and have students practice same. Arrange ship visit.	Diesel Engine working Engine indicator Teaching Aids as in 1.1.
WEEK	**General Objectives 7.0: Understand electric propulsion plant**		
13-15	**ELECTRIC POWER PLANT**	Explain with sketches	Teaching Aids as in

	7.1 Describe the general arrangement of plant for turbo-electric propulsion and for diesel electric propulsion. 7.2 State the starting-up and shutting down sequence for plants. Also state reversing sequence. 7.3 Describe and operate the Ward-Leonard control system, the controlled current control, the constant current control, and the Rheostatic control for the diesel-electric direct current drives. 7.4 Describe the various control gears. 7.5 Describe the possible applications of supper conductors for electric propulsion. 7.6 Describe the use of electric propulsion for marine and offshore industries, e.g. for MSVs (Multifunctional Service Vessels). 7.7 Determine the advantages and disadvantages of the use of a) induction motors b) synchronous motors c) d.c. motors, for propulsion 7.8 Describe cyclo-converters, forced commutated invertors and synchrony converter drive, vacuum interrupters and power controllers.		1.1.
WEEK			

ASSESSMENT: 40% Continuous Assessment (Assignments & Tests every 5 weeks minimum)

60% Examination

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: SHIP DESIGNANDCONSTRUCTION	**Course Code: MAR 402**		**Contact Hours: 4**
Course Specification: Theoretical			
WEEK	**General Objective 1.0: Understand the basic design process of a ship**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1-2	**SHIP DESIGN PROCESS** 1.1 Define terms, principal dimensions and co-efficients associated in ship design and construction. 1.2 Sketch and explain Buxton's design spiral. 1.3 Explain factors that affect the design and construction of a ship. 1.4 Determine principal dimensions of a given ship. 1.5 Determine steel and outfit masses for 1.4 above.	Explain with sketches.	Teaching Aids - O/H Projector - Multimedia Projector - Diskettes, CDs, transparencies etc.
3-5	**General Objectives 2.0: Know hull form design**		
	HULL FORM DESIGN 2.1 Describe the factors affecting structural design of the hull and its elements 2.2 Explain standard strength requirement 2.3 Describe the straking of hulls (with sketches) in particular defining stringers, stealer plates, etc.	DITTO	DITTO

WEEK	General Objectives 3.0: Know structural organisation of steel ship hull.		
6-8	**STRUCTURAL ORGANISATION OF STEEL SHIP HULL** 3.1 State the principal function of strength members 3.2 Sketch a general arrangement of the principal framing systems	DITTO	DITTO

WEEK	General Objectives 4.0: Know the function and fabrication of steel ship			
9-13	4.1	State the advantages of welded plating.	DITTO	DITTO
	4.2	Explain the strength characteristics of welded and riveted plating.		
	4.3	Draw a general layout of the frames, deck, bulkhead, pillars and girders of a cargo ship.		
	4.4	Draw the shell expansion plan of a cargo ship.		
	4.5	Draw and describe the framing arrangement of single and double bottom of a cargo ship.		
	4.6	Explain how super-structures and deck houses are rigidly connected to the main Hull.		
	4.7	Draw and describe the various ways of connecting framing, bilge keel, and tweed deck.		
	4.8	Describe the arrangement of bulk head framing and plating.		
	4.9	With sketches, describe the constructional details of stern, bow thrusters,, bilge keel and fenders.		
	4.10	Describe damage control arrangement in ship construction.		
	4.11	State the various types of loads that the foundation of machinery has to withstand.		

WEEK	General Objectives 5.0: Understand the rules and regulations concerning the design and construction of steel hull		
14-15	**RULES AND REGULATIONS** 5.1 Explain the rules and regulations of classification societies regarding the design and construction of ships. 5.2 State load line regulation concerning cargo to be carried.	DITTO	DITTO

ASSESSMENT: 40% Continuous Assessment (Arrangement & Tests every 5 weeks minimum)
60% Examination

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: NAVAL ARCHITECTURE		**Course Code: MAR 303**	**Contact Hours: 6**
Course Specification:			
WEEK	**General Objective 1.0: Know the general definitions**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1-3	DEFINITIONS 1.1 Define terms associated with Naval Architecture 1.2 Define form co-efficients 1.3 Calculate immersed planes using wetted surface area formulae 1.4 Calculate areas, volumes, centroids and center of pressure using Simpson's and trapezoidal rule	Explain and have students solve problems	Teaching Aids - O/H Projector - Multimedia Projector - Transparencies, CDs, Diskettes, ect.

WEEK	General Objectives 2.0: Understand transverse and longitudinal stability		
4-9	**TRANSVERSE AND LONGITUDINAL STABILITY** 2.1 Explain and calculate the centre of gravity, centre of buoyancy and metal centric height of a ship 2.2 Perform inclining experiment and calculate parameters in 2.1 above. 2.3 Calculate the shift in centre of gravity of a ship due to addition and removal of mass 2.4 Explain GZ curves and cross curve of stability. 2.5 Explain the effect of free liquid surface and sub-division of tanks on stability 2.6 Determine the effect of suspended mass on the stability of a ship. 2.7 List practical requirements to ensure stability at sea. 2.8 Determine the longitudinal BM and GM 2.9 Explain and calculate the centre of floatation 2.10 Determine stability at large angles of heel.	Demonstrate, explain and have students carry out experiments and solve problems	Tow Tank and stability equipment. Ship models

WEEK	General Objectives 3.0: Understand draught and trim		
10-12	DRAUGHT AND TRIM 3.1 Define the terms draught and trim 3.2 Calculate change in draught and trim due to adding, and removal of fuel, combustion of fuel, ballasting, addition & removal of cargo due to change in sea water density. 3.3 Calculate change in draught and trim using the loss of buoyancy and added mass methods. 3.4 Calculate change in draught and trim due to bilging of compartments.	Explain and have students solve problems	Teaching Aids as in 1.1.
WEEK	**General Objectives 4.0: Understand ship resistance**		

13-15	4.1 Explain the difference between frictional and residuary resistance of a ship 4.2 Derive Admiralty and fuel co-efficient and calculate problems on same. 4.3 Explain the law of corresponding speeds. 4.4 State Froude's law of comparison 4.5 Solve problems on the prediction of full-scale resistance from model experiments. 4.6 Solve problems involving the use of effective power, Delivered Power, Quasi Propulsive Co-efficient.	DITTO	DITTO

ASSESSMENT: 40% Continuous Assessment (Assignments & Tests every 5 weeks minimum)
60% Examination

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MARINE ENGINEERING		
COURSE: PROJECT	**Course Code: MAR 499**	**Contact Hours: 6**

Course Specification:			
WEEK	**General Objective:** 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.		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1-15	**Suggested Project topics** 1. Condition monitoring as a 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 work and supervise and advise throughout duration of project work, beginning in semester 3 and ending semester 4	Materials/systems for projects

NOTE: 3 contact hours in semester 3 but no credit units, 3 contact hours in semester 4 and 6 credit units assessed at end of project. ASSESSMENT: Oral Defence 45% - By a panel; Written Report 40%-External Moderator; Supervisor's Assessment 15% - By project Supervisor

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MARINE ENGINEERING			
Course: Heat and Mass Transfer		**Course Code: MAR 401**	**Contact Hours: 4Hours**
Course Specification: Theoretical			
WEEK	**General Objective :1.0: Know the physic of thermal energy transfer**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1-2	**Physics of Heat Transfer** 1.1 Define heat transfer. 1.2 State the basic laws of heat transfer (e.g. Fourier, etc. the First Law of Thermodynamics). 1.3 State the combined modes of heat transfer	Explain and have students solve problems	Teaching Aids - O/H Projector - Multimedia Projector - Transfer apparatus - CDs, Transparencies, Diskettes, etc.
General Objectives 2.0 Know heat transfer by conduction			
3-5	**Conduction** 2.1 Describe heat transfer by conduction. 2.2 Define the co-efficient of Thermal conductivity and explain heat conduction through thin and thick walls. 2.3 Describe heat transfer through composite wall and solve problems. 2.4 Derive Fourier's equation using the energy conservation approach. 2.5 Give analysis of steady flow and unsteady flow. 2.6 Derive the fundamental equation for steady flow in two dimensional and unsteady flow of one	Explain and have students solve problems	Teaching Aids as in 1.1.

	dimensional conduction. 2.7 Solve problems on 2.6 2.8 Solve problems on transient heat flow.		
	General Objectives 3.0 Know heat transfer by convection		
6-8	3.1 Explain free and forced convection in ducts and exterior surfaces 3.2 State the basic equations of heat transfer by convection and solve problems 3.3 Using dimensionless and similarity approach, derive Reynolds, Prandtl Raleigh and Freud's numbers 3.4 Explain the Buckingham – Pi Theorem 3.5 Describe the process of ebullition. 3.6 Evaluate heat transfer co-efficient using empirical equations and graphs.	Explain and have students solve problems	Teaching Aids as in 1.1.
	General Objectives 4.0: Know heat transfer by radiation		
9-11	4.1 Describe heat transfer by radiation. 4.2 Explain the electromagnetic spectrum. 4.3 Explain Thermal Radiation Spectrum. 4.4 Define Emissivity, Reflectivity and absorbity. 4.5 Describe Emissive power. 4.6 Describe the differences between Real and Ideal surfaces. 4.7 Define Kirchoff's Law and	Explain and have students solve problems	Teaching Aids as in 1.1.

	Stephen Boltzman's Law. 4.8 Explain the direct exchange between black and grey surfaces. 4.9 Explain solar radiation.		
	General Objectives 5.0 Understand the construction and principles of operations of heat exchangers		
12-13	5.1 Explain the difference between laminar and turbulent flows. 5.2 With the aid of diagrams describe the basic types of Heat Exchangers 5.3 Describe Shell-and Tube Heat Exchangers. 5.4 Describe the plate heat exchangers. 5.5 Give constructional details and applications of heat exchangers on board ships. 5.6 Give analysis and design of simple heat exchangers using Logarithmic Mean Temperature difference (LMTD).	Explain and have students solve problems	Teaching Aids as in 1.1. Sample heat exchangers.
	General Objectives 6.0 Understand mass transfer		
	6.1 Define Mass Transfer 6.2 Explain diffusion in 2 component systems 6.3 Define diffusivity, molar flux and concentration 6.4 State the Fick's First Law 6.5 Explain the Mass Transfer Co-efficient 6.6 Explain the mass transfer in 2-phase fluid systems 6.7 Explain heat – mass transfer	Explain and have students solve problems	Teaching Aids as in 1.1.

	analogy using Schmidt and Sherwood numbers 6.8 Give practical applications of Mass Transfer 6.9 Explain the mass transfer by molecular diffusion and convection 6.10 Describe flow in heat exchangers, involving fluids of constant specific heat and how this is used in the design of tubing in heat exchangers. 6.11 State the surface and overall co-efficient used in relation to heat exchanger design.		

ASSESSMENT: 40% - Continuous Assessment (Assignments & Test every 5 weeks minimum).
60% - Examination

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MARINE ENGINEERING			
Course: Maritime Law & Industrial Relations		**Course Code: MAR 406**	**Contact Hours: 2**
Course Specification: Theoretical			
WEEK	**General Objective: 1.0: Understand the fundamental laws of carriage of goods by sea**		
	Specific Learning Outcome:	**Teachers Activities**	**Resources**
1-4	**<u>Carriage of Goods by Sea</u>** 1.1 Discuss Shipping Law in Nigeria e.g. the merchant Shipping Act 1962 and the National Shipping Policy (Decree 10) 1986, etc. 1.2 Explain concepts of offer, acceptance and consideration of contracts 1.3 Define a common carrier, charter party 1.4 Discuss the I.M.O and International Conventions and Regulations 1.5 Explain contract of affreightment 1.6 List the different kinds of contract for the sale of goods to be carried by sea. 1.7 State the duties of the buyer in C.I.F. contract 1.8 Identify the remedies for breach in CIF contract 1.9 Discuss the breach of contract by the buyer 1.10 Describe and identify export and import licences used in CIF	Explain, Discuss	Teaching Aids - O/H Projector - Multimedia Projector etc.

	contracts 1.11 State the likely consequences of deterioration of goods in transit 1.12 Explain FOB contract 1.13 Discuss the International Maritime Dangerous Goods Cargo Code (IMDG Code) 1.14 Design documentary letters of credit 1.15 List other international maritime regulatory organizations and agencies		
	General Objectives 2.0: Know general principles of insurance		
5-7	**<u>Principles of Insurance</u>** 2.1 Explain the basic principles of Insurance Law. 2.2 Identify the major types of Insurance law. 2.3 Explain assignment under Insurance Policy.	Explain, Discuss	Teaching Aids as in 1.1
	General Objectives 3.0: Understand marine insurance		
8-11	**<u>Marine Insurance</u>** 3.1 Give a brief history of marine insurance 3.2 Identify marine Insurance as a contract of indemnity 3.3 List the subject matters of marine Insurance 3.4 List the persons who have an insurable interest 3.5 Distinguish between voyage policy	Explain, Discuss	Teaching Aids as in 1.1

	and time policy 3.6 Explain gaming and wagering 3.7 Explain warranties expressed or implied 3.8 Describe assignment of policy 3.9 Discuss losses in marine Insurance 3.10 Explain measure of indemnity 3.11 Outline return of premium 3.12 Define mutual assurance.		
	General Objectives 4.0: Know basic laws and status of industrial relations		
12-15	**<u>Industrial Relations</u>** 4.1 Define trade unionism, collective bargaining and joint consultation 4.2 Identify status of trade unions 4.3 Define trade union membership 4.4 Explain labour laws and industrial relations in Nigeria 4.5 State the effect of consultation on morale and discipline 4.6 Explain suggestion schemes, joint industrial councils and wage councils 4.7 Define and enumerate the duties of employer's associations 4.8 Discuss trade dispute 4.9 Explain picketing, collective agreements, and disclosure of information 4.10 Discuss workers compensation Acts, industrial disputes statutes 4.11 Explain breach of contract	Explain, Discuss	Teaching Aids as in 1.1

	4.12 Discuss advisory, conciliation, and arbitration services. 4.13 Identify limitations on statutory protection. 4.14 Discuss international management of trade union affairs.		

ASSESSMENT: 40% - Continuous Assessment (Assignments and Tests every 5 weeks minimum)
60% - Examination

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MARINE ENGINEERING			
Course: Thermodynamic Properties of Fluids		**Course Code: MAR 403**	**Contact Hours: 5**
Course specification: Theoretical and Practical			
WEEK	**General objective 1.0: understand the thermodynamic properties of fluids**		
	Specific Learning Outcome:	**Teachers Activities**	**Resources**
1-5	**<u>Thermodynamics Properties</u>** 1.1 List the eight thermodynamics properties of a system e.g. pressure, temperature, internal energy, etc. 1.2 Identify the directly and indirectly measurable thermodynamic properties 1.3 Explain Helmboltz functions 'f' and Gibbs function 'g' 1.4 Express the above two functions in terms of other properties 1.5 Name the thermodynamics potential 1.6 Express the first law of thermodynamics in the differential equation form 1.7 Express mathematically the entropy of a closed system undergoing reversible processes. 1.8 Combine the above two expressions in 1.6 and 1.7 1.9 Show from the above explanation the relations for the following: (i) Internal energy	Explain and have students solve problems	Teaching Aids - O/H projector - Multimedia projector - Transparencies, CDs Diskettes, etc.

	(ii) Enthalpy (iii) Helmboltz function (iv) Gibbs function and hence derive (v) Maxwell's relations 1.10 Define the co-efficient of expansion and compressibility and obtain relationship for the two 1.11 Define the specific heats at constant pressure and constant volume and express them mathematically 1.12 Develop an expression relating the co-efficient of expansion and compressibility 1.13 Explain the different idealized processes that a fluid can undergo such as: (i) constant volume process; (ii) constant pressure process; (iii) Constant temperature process. 1.14 Develop expressions for the change in internal energy of a closed system if it undergoes the above processes 1.15 Familiarise with the different thermodynamic charts and use them to solve problems 1.16 Explain availability and Gibbs functions		

	1.17 Explain the availability in a closed system 1.18 Explain the Gibbs functions and steady flow systems 1.19 Explain availability and steady flow open systems.		
	General objective 2.0: understand the response of thermodynamic system when fluid properties vary		
6-8	**Transfer Rate in Fluid Systems** 2.1 Explain the units of temperature and the international practical scale 2.2 Show mathematically that temperature can be defined as a linear function of a thermometric property of a substance 2.3 Express the above linear function in at least two different properties 2.4 Draw the graphs of T-V, T-P and P-V for a fluid undergoing a process 2.5 Describe the PVT surface for water 2.6 Read property values of fluids at saturation, super-heated and sub-heated temperatures 2.7 Use information in 2.6 to deduce work and heat transfer rates in fluid systems 2.8 Identify the properties of a perfect gas and express mathematically the equation of state and other property relations	Explain and have students solve problems	Teaching Aids as in 1.1

	2.9 Explain the kinetic theory of gases 2.10 Explain properties of real gases 2.11 Derive expressions relating various properties of real gases		
	General Objective 3.0: Understand non-flow processes		
9-11	**Non-Flow Processes** 3.1 Explain a constant volume process 3.2 Express the non-flow energy equation (NFEE) for a constant volume process 3.3 Derive expressions for heat and work transfer and change in entropy for a constant volume process 3.4 Sketch the process on P-V and T-S diagrams 3.5 Explain a constant pressure process 3.6 Deduce the NFEE for a constant pressure process 3.7 Develop expressions for heat and work transfers and change in entropy during a constant pressure process 3.8 Plot a constant pressure process on P-V and T-S diagrams 3.9 Explain a polytrophic process 3.10 Deduce NFEE for a polytrophic process 3.11 Derive Expressions for heat and	Explain and have students solve problems	Teaching Aids as in 1.1

	work transfers and change in entropy for a polytrophic process 3.12 Show the process on P-V and T-S diagrams 3.13 Explain a reversible adiabatic process 3.14 Deduce the NFEE for a reversible adiabatic process 3.15 Derive expressions for heat and work transfer and change in entropy for an adiabatic process 3.16 Show a reversible adiabatic process on P-V and T-S diagrams 3.17 Explain an isothermal process 3.18 Deduce the NFEE for an isothermal process 3.19 Derive expressions for heat and work transfers and change in entropy for an isothermal process 3.20 Sketch an isothermal process on P-V and T-S diagrams 3.21 Solve problems for perfect gases and vapours from all the processes mentioned above.		
	General Objective 4.0: Understand flow process		
12-15	**Flow Processes** 4.1 Explain the functions of a boiler and a condenser with simple sketches 4.2 State the assumptions made to obtain the SFEE for boiler and	Explain and have students solve problems	Teaching Aids as in 1.1 Demonstration turbine Turbine test sets calorimeters, etc.

	condenser 4.3 Apply the steady flow energy equation (SFEE) for boiler and condenser 4.4 Solve problems involving steady flow in boilers and condensers 4.5 Conduct a boiler test and determine boiler efficiency 4.6 Determine the rate of heat removal in a condenser 4.7 Describe a nozzle and diffuser and their functions with simple sketches 4.8 Develop the SFEE for nozzles and diffusers 4.9 Conduct test in nozzles and determine nozzles efficiency 4.10 State the assumptions made in 4.5 4.11 Solve problems on steady isentropic and non isentropic flows in nozzles and diffusers 4.12 Explain the functions of a turbine and a compressor 4.13 Develop the SFEE for turbine and compressor 4.14 Conduct test on a compressor and evaluate its various efficiencies 4.15 Solve problems of work and heat transfers in turbines and compressors 4.16 State the relevant assumptions in		

	4.8 4.17 Conduct load test on steam turbine and check the various parameters 4.18 Describe a throttling process 4.19 State the conditions under which a throttling process takes place e.g. partially opened water valve/top expansion valve in refrigeration 4.20 Identify at least two practical processes in which throttling takes place 4.21 Obtain the SFEE for a throttling process 4.22 Use a throttling calorimeter to determine the dryness fraction of wet vapour 4.23 Describe a throttling calorimeter with a sketch and its mode of operation 4.24 Solve problems on the throttling calorimeter and determine dryness fraction 4.25 Solve problems involving the calculations such as: (i) Velocity of flow of a gas in a pipe (ii) Change in enthalpy during flow process in other devices.		

ASSESSMENT: 40% - Continuous Assessment (Assignments & Tests every 5 weeks minimum)

60% - Examination.

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MARINE ENGINEERING			
Course: Ship Propulsion		**Course Code: MAR 402**	**Contact Hours: 4**
Course Specification:			
WEEK	**General Objective 1.0: Know the Principles of Propulsion Devices**		
	Specific Learning Outcome:	**Teachers Activities**	**Resources**
1	**Propulsion Devices** 1.1 Explain the principle of the screw propeller 1.2 Explain the principles of jet propulsion 1.3 Explain the principles of hydrofoil 1.4 Explain the principles of operation of hover-craft 1.5 Explain the fundamental principles of ship electric propulsion 1.6 Outline the power system configuration of 1.5 above.	Explain and have students solve problems	Teaching Aids - O/H Projectors - Multimedia Projector - Photographs - CDs, Diskettes, transparencies, etc
	General Objective 2.0: Know the Factors Affecting Propulsion		
2-3	**Factors Affecting Propulsion** 2.1 Determine the wave bending moment of the ship 2.2 Explain the term “Permissible Stresses” 2.3 Determine the permissible still water bending moments and shear force with appropriate formulae 2.4 List the effects of stern design to propulsion – (transom stern, cruiser stern and asymmetric stern)	Explain and have students solve problems	Teaching Aids

	2.5 Explain the following: Yawing, Pounding, Slamming, Rolling, Pitching, and Heaving.		
	General Objective 3.0: Know Propulsion Improvement Devices		
4	3.1 Enumerate the various propulsion improvement devices 3.2 Explain bow and stern Thrusters 3.3 Describe bulbous bow and stern bulb 3.4 Explain flume tanks.	Explain and have students solve problems	Teaching Aids
	General Objective 4.0 Understand the Shafting System of a Ship		
5-6	**Shafting** 4.1 List the components of shafting system and explain their functions 4.2 Explain reduction gearing 4.3 List the functions of intermediate shaft 4.4 Describe the following components: Thrust block, Plummer block and Stern tubes 4.5 Explain the constructional details of stern tubes 4.6 List the types of stern tubes 4.7 Describe the shaft turning and locking devices 4.8 Explain the safety precaution for a damaged shaft sections in a multiple section shafting arrangement. 4.9 Analyse the various gear transmission devices	Explain and have students solve problems	Teaching Aids

	4.10 List the various clutches employed in propulsion 4.11 List the types of couplings and their principles of operations.		
	General Objective 5.0: Understand the Geometry of Screw Propeller		
7-9	**Propeller** 5.1 List the various types of screw propellers 5.2 Describe the geometry of screw propellers 5.3 State the momentum of theory of the screw, axial and tangential losses 5.4 Derive the propulsive co-efficient of screw propellers 5.5 Enumerate the influences of after body on the wake distribution 5.6 Carry out model tests and establish laws of comparison 5.7 List the hydrodynamic characteristics of screw propeller 5.8 Define cavitations in relation to screw propeller 5.9 Determine the performance curve of the propeller in different load conditions 5.10 List the materials used in the manufacture of propellers and give reasons for the choice of these materials. 5.11 Distinguish between true slip and	Demonstrate, Explain and have students practice and solve problems	Ship models Tow tank Teaching Aids as in 1.1

	apparent slip. 5.12 List the various design symbols associated with the following: Propeller thrust co-efficient, shaft power, impact moment, speed of slip, wake factor and co-efficient of static friction. 5.13 Calculate the blade thickness for propellers. 5.14 Draw the screw propeller indicating the curves of swept area and maximum blade thickness. 5.15 Explain blade element theory, lift and drag on aerofoil sections. 5.16 Explain the matching of propulsion system with the propeller curve. 5.17 Explain the typical triangle of velocities introducing slip and angle of incidence. 5.18 Describe the pilgrim nut and its principle of operation. 5.19 Enumerate the safety precautions in carrying out 5.18 above.		
General Objective 6.0: Understand The Operational And Constructional Details Of Controllable Pitch Propeller			
10-11	**<u>Controllable Pitch Propeller</u>** 6.1 Explain the vital documentations needed prior to the installation of a controllable pitch propeller on a ship. 6.2 List the hydraulic control equipment	Explain and have students solve problems	Teaching Aids as in 1.1. Sample propeller

	6.3 Describe the pitch changing mechanism and solve for the impact momentum (IM) 6.4 Explain the tapered mounting operation and solve for the temperature at which the propeller is mounted 6.5 Carry out the static balancing and testing of a finished propeller and blades.		
	General Objective: 7.0 Understand the Principles of Steering a Ship With Rudders		
12-13	**Rudder** 7.1 Explain the use of rudder in relation to a ship 7.2 List the types of rudders 7.3 Determine the forces on a rudder from the laws of fluid friction 7.4 Determine the torque on the rudder stock 7.5 Calculate the angle of heel due to the force on the rudder.	Explain and have students solve problems Demonstrate	Teaching Aids as in 1.1. Tour tank & ship models
	General Objective 8.0: Know the Operational Details of Stability Fins		
14-15	**Stability Fins** 8.1 List the types of stability fins in use 8.2 Explain the operation of a stability fin 8.3 Explain the checks carried out before starting the stability fin 8.4 Explain the safety precaution in stability fin while underway in	Explain and have students solve problems	Teaching Aids

	narrow channels or harbours.		

ASSESSMENT: 40% - Continuous Assessment (Assignments & Tests every 5 weeks minimum)
60% - Examination

	Specific Learning Outcome:	**Teachers Activities**	**Resources**

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MARINE ENGINEERING			
Course: Marine Auxiliary Machinery	**Course Code: MAR 301**	**Contact Hours 6**	
Course Specification: Theory and Practical			
WEEK	**General Objective 1.0: Understand the various auxiliary systems & machines in the ship**		
1	1.1 List the classification of pumps 1.2 State the characteristics of the two classes of pumps. 1.3 Explain briefly the following: capacity heat\, suction head, power of the engine, and efficiency, and solve problems. 1.4 Derive the performance curves of the two classes of pumps. 1.5 Give examples of the following classes of pumps: positive displacement, & rotor-dynamic pumps. 1.6 Carry out maintenance work on the pumps. 1.7 Explain cavitations in pumps.	Demonstrate, explain, solve problems and have students practice same	Pumps of various types Tools Teaching aids - O/H Projector - Multimedia Projector - CDs, Diskettes, etc - Video Tapes and Players.
	General Objective 2.0: **Understand the principles of operation of air compressors and rotary blowers**		
2-3	2.1 List the constructional detail and working principle of rotary blowers. 2.2 List the uses of rotary blowers. 2.3 Plot the volumetric efficiency curves of the compressors from the actual tests. 2.4 List the classification of air compressors. 2.5 Explain the various methods of compressors compounding. 2.6 Explain the working principles of single and double acting compressor, single and multi-stage compressors. 2.7 Device actual capacity and volumetric efficiency. 2.8 Solve problems related to 2.6 & 2.7 above. 2.9 Calculate the compression ratio. 2.10 Plot the indicator diagram for reciprocating	Ditto	Compressor Evaporator Tools Teaching aids as in 1.1

	compressor. 2.11 Solve for work required per cycle when the gas is compressed adiabatically and isothermally. 2.12 List the constructional details and working principles of the turbo compressor. 2.13 Describe the diffuser. 2.14 Explain the working principle of axial flow compressor. 2.15 Draw the velocity diagram for the inlet and outlet blade tips of an axial flow compressor. 2.16 Distinguish between axial and radial flow compressor. 2.17 Determine the actual compression on T-Q diagram.		
	General Objective 3.0: Understand Distilling Plants		
4-5	3.1 List and explain the various types of distilling plants. 3.2 List the components of a distilling plant 3.3 Carry out the starting, running and shutting down of various distilling plants. 3.5 Explain the following: brine density control, priming, blow down routine, prevention of scale formation and replenishment of citric acid. 3.6 Carry out periodic maintenance of a distilling plant. 3.7 Explain the maintenance of citric acid injection equipment. 3.8 Enumerate the type of condensers, and their constructional details. 3.9 Describe the parallel- flow, the contra flow and the ejector type of a jet condenser. 3.10 Explain the following: effects of vacuum, effect of air cooling.	Ditto	Compressor Evaporator Tools Teaching aids as in 1.1

	3.11 From test of a new condenser, plot the heat transmission curve and the coefficient K. 3.12 Explain the use of fresh water generation on board. 3.13 List the types of fresh water generators. 3.14 sketch the layout of a typical fresh water generator piping system.		
	General Objective 4.0: Understand The Principle Of Centrifugal Oil Separator		
6-7	4.1 Explain the operational principle of centrifugal separator. 4.2 List the component parts of centrifugal separator. 4.3 Carry out the starting and running of separator. 4.4 Carry out the cleaning of the centrifuge. 4.5 List the importance of cleanliness and purity of lubricants. 4.6 Explain the rated service capacity of the separator. 4.7 Explain the operating principle of oily water separator. 4.8 List the types of oily water separators. 4.9 Explain the uses of oily water separator. 4.10 List the different types of filters. 4.11 Explain the working principle of self cleaning filters. 4.12 Describe the working principle of auto cleaning filters. 4.13 List the various filter elements.	Ditto	Centrifugal separator Tools, Filters Teaching aids, as in 1.1

	General Objective 5.0: Understand The Constructional And Operational details Of Sewage Treatment Plant		
8	5.1 List the component parts of sewage treatment plant. 5.2 Carry out the blowing down sequence of the black water tank. 5.3 Carry out maintenance operation on the vacuum pump. 5.4 Trace the fault of a non vacuum build up along the system lines. 5.5 Carry out the discharge operation of Grey water tank.	Ditto	Sewage Plant
	General Objective 6.0: Know The Various Laboratory Tests On Fluid Flow Through Pipes		
9	6.1 Carry out fresh water tests for salinity, alkalinity and acidity. 6.2 Carry out lubrication oil test for carbon content, dilution, viscosity, etc. 6.3 Test for fuel contamination and emulsion. 6.4 Enumerate the periodicity of inspection of various ship power plants. 6.5 Draw up a suitable maintenance schedule for the ship power plants.	Ditto	Oil test kit Viscometer Boiler Water Test Kit
	General Objectives 7.0: Know The Constructional & Operational Details Of Steam Boilers		
10-12	7.1 Describe a boiler 7.2 List the various types of boilers 7.3 Enumerate the various components of a boiler and the appropriate materials used in manufacturing them. 7.4 Sketch boiler mountings and explain their functions.	Ditto	Boiler, boiler gauge glasses, burners photographs (of boilers)

	7.5 Explain with the aid of a diagram, the boiler closed feed system. 7.6 Explain “priming” and “water hammer”. 7.7 Carry out the boiler feed water treatment. 7.8 Explain procedure for: opening up, cleaning and blowing down of boiler. 7.9 Sketch and label steam boiler furnace of any type of boiler. 7.10 Identify the basic material for refractory surfaces. 7.11 Describe the combustion in a marine boiler. 7.12 List the various types of burners and registers employed in marine boilers. 7.13 Carry out boiler retubing operations. 7.14 Explain boiler preservation during every aspect of boiler shut down including the periodicity. 7.15 State the requirements of classification societies concerning survey periods of marine boilers (main and auxiliary). 7.16 Describe with sketches the burners such as pressure spill and rotary cup burners. 7.17 Sketch and explain the waste heat recovery systems. 7.18 Describe the sequential operation of steam cock, water cock and drain cock of gauge glasses. 7.19 Describe and practice the sequence for cock attached directly to boiler. 7.20 Describe and practice sequence for cocks attached to pipes of comparatively large diameter. 7.21 Describe and practice the sequence for gauge in open communication through piping with steam and water		

	drums. 7.22 Describe how to overhaul gauge-glass cocks and the fitting of new glass and cones. 7.23 Describe the steam trap.		
	General Objective 8.0: Understand The Operating Principles Of Steering Gear		
13	8.1 List the types of steering gear. 8.2 Sketch and explain the telemotor transmitter and receiver. 8.3 Explain how creep test is carried out on a steering gear system. 8.4 Explain the operating principle of, and constructional details of ram type hydraulic steering gear, rotary vane steering gears, and mechanical type steering gear. 8.5 Describe the hunting gear and mention its uses. 8.6 List the pump types for steering gears. 8.7 Explain the charging of steering gear. 8.8 Carry out steering gear breakdown drills. 8.9 List the rules and regulations of classification societies concerning steering gear.	Ditto	Steering gears Photographs (of team gears) Video of breakdown drill.
	General Objective 9.0 Know The Application Of Fire Protection Equipment		
14	9.1 Explain the theory of fire. 9.2 List the various portable fire fighting appliances and name the type of fire each appliance is used on. 9.3 Describe the engine room CO_2 Total Flooding system. 9.4 Describe inert gas installation on board. 9.5 Describe the engine room fixed Halon installation. 9.6 Describe the sprinklers system of fire fighting.	Explain	Teaching aids as in 1.1

	General Objective 10.0: Understand The Piping System, Valves And Fittings.		
15	10.1 Explain reasons why fluid carrying pipes are seam-less. 10.2 List various types of valves. 10.3 Sketch and describe non-return valves, Screw lift valve, globe valve, gate valve etc. 10.4 List the types of pipe connections and explain their constructional details, i.e. fully penetrating butt-weld, with or without provision for the root, socket welds and screwed socket.	Ditto	Ditto

ASSESSMENT: 40% Continuous Assessment (Assignments & Test every 5 weeks minimum)
60% Examination

	Specific Learning Outcome:	Teachers Activities	Resources

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MARINE ENGINEERING			
COURSE: ELECTROTECHNOLOGY	**Course Code: MAR 305**		**Contact Hours 6**
Course Specification: Theoretical and Practical			
WEEK	**General Objective:1.0: UNDERSTAND ALTERNATING CURRENT**		
	Specific Learning Outcome	**Teachers Activities**	**Resources**
1.	1.1 Explain the production of an alternating waveform.	Demonstrate, explain and sketch and have	Oscilloscope, signal generator

	1.2 Describe how alternating currents are rectified. 1.3 Define frequency, amplitude, and instantaneous and maximum values. 1.4 Carry out practical demonstrations to show the relationship between frequency and number of poles and speed of a machine. 1.5 Define R.M.S .value, average value and form factor. 1.6 Show how an alternating quantity can be represented by phasor diagram to give instantaneous and R.M.S Values.	the students practice	Teaching aids
	General Objective 2.0: UNDERSTAND ELECTROSTATICS		
2.	2.1 2.1 State Columb's. law 2.2 Apply 2.1 to determine the force on a point charge placed in an external field. 2.3 Determine the intensity of electric field. 2.4 Explain flux density. 2.5 Derive relevant laws relating to static electric fields, e.g. i] Gaus Law ii] Divergence theorem. 2.6 Apply the laws in 2.5 to solve problems involving electric flux density, potential difference electromotive force and capacitance. 2.7 Deduce an expression for the energy stored in an electric field. 2.8 Apply 2.7 above to calculate the energy in an electric field.	Explain and have students solve problems	Teaching aids
	General Objective 3.0: UNDERSTAND THE PERFORMANCE OF A/C MACHINES		
3-4	3.1 Describe the construction of a synchronous machine. 3.2 Sketch the flux and emf waves in synchronous machines.	Sketch and explain and have students practice same	DITTO And samples of motors

	3.3 Explain armature reaction and leakage fluxes and reactances. 3.4 Explain synchronous reactances and synchronous impedance. 3.5 Sketch the equivalent circuit for a synchronous machine operator as a motor or generator. 3.6 Sketch phasor diagrams for a synchronous machine operating as a motor or generator. 3.7 Explain open circuit and short circuit characteristics of a synchronous machine. 3.8 Explain steady-state operating characteristics of a synchronous machine. 3.9 Describe the construction of an induction machine. 3.10 Explain the principle of operation of an induction machine. 3.11 Define synchronous speed, motor speed and slip. 3.12 Explain the equivalent circuit for an induction machine 3.13 explain the torque/slip characteristics of an induction motor. 3.14 Explain the various methods of cooling electric machines.		
	General Objectives 4.0: KNOW THE CONSTRUCTION OF D.C. MACHINES		
5.	4.1 Describe a shunt-wound generator. 4.2 Describe a compound wound generator. 4.3 Describe a separately excited generator. 4.4 Carry out practicals on 4.1, 4.2 and 4.3. 4.5 Describe the use of equalising bar. 4.6 Explain the load-sharing methods in D.C. machine 4.7 Give practical application of Ward Leonard in speed control system. 4.8 Describe the steering gear follow up system. 4.9 Explain the suitability of D.C. motors for various types of work. 4.10 Describe the faults that can occur in D.C. machines and how they can be remedied (e.g. overheating,	Demonstrate, sketch and explain and have students practice same Demonstrate changing the windings of a dc machine from shunt to compound and from separately wound to shunt or compound and vice versa.	D.C. Motors Model of Ward Leonard system Model of steering gear follow-up system megger or Digital Display meter (DDM)

	mechanical and electrical defects). 4.11 Carry out tests on D.C. machines using the megger.		
	General Objective 5.0: UNDERSTAND THE PRINCIPLE OF OPERATION AND USES OF SYNCHRONOUS MOTORS		
6.	5.1 Describe the various methods of starting a synchronous motor. 5.2 Explain the operation of a synchronous motor on an infinite Bus-bar. 5.3 Explain the use of a synchronous motor with static capacitor for power factor correction. 5.4 Compare a synchronous condenser with static capacitor for power factor correction. 5.5 Compare the synchronous motor with other types of electric motors in practical applications.	Explain	Teaching aids as in 1.1
	General Objectives 6.0: UNDERSTAND THE PERFORMANCE OF SYNCHRONOUS MACHINE CONNECTED TO ELECTRICAL POWER SYSTEM		
7-8	6.1 describe the characteristic of an infinite bus-bar 6.2 Describe the behaviour of a synchronous generator supplying as isolated load. 6.3 Explain the need for the synchronization of two or more machines. 6.4 State the conditions to be satisfied when connecting a machine to an infinite bus-bar. 6.5 Describe methods of synchronizing machines using; a) Dark lamp method b) Bright lamp method c) Rotary synchroscope. 6.6 Explain current locus diagram of a synchronous machine. 6.7 Solve problems involving the current locus of a synchronous machine. 6.8 Explain the V-curves diagram of a synchronous machine. 6.9 Solve problems involving the V-curves in 6.8. 6.10 Explain the effect of variation of excitation of	Sketch and explain and have students practice same	Samples of cylindrical rotor and salient pole rotor machines Teaching aids as in 1.1.

	synchronous generator connected to an infinite bus-bar. 6.11 Draw phasor diagram to illustrate 6.10 above. 6.12 Derive equation for synchronising power and torque for: i) cylindrical rotor ii) salient pole rotor. 6.13 Draw the torque handle and power angle characteristics. 6.14 Compute load sharing with the prime mover inputs known. 6.15 Describe method of voltage and frequency control of a synchronous machine. 6.16 Explain method of cooling a synchronous generator.		
	General Objective 7.0: UNDERSTAND INDUCTION MOTORS ANDMACHINES		
9-10	7.1 Describe with a diagram, the construction of induction machine. 7.2 Distinguish between: i) Squirrel cage induction motor and ii) Wound rotor induction motor. 7.3 Explain the principle of operation in induction machine. 7.4 Define synchronous speed, rotor speed and slip. 7.5 Derive the expressions for synchronous speed, rotor speed and slip. 7.6 Show that the equivalent circuit for an induction machine at stand-still (S=1) takes the form of a transformer with secondary short-circuit. 7.7 Explain the dependence of rotor on slip parameters. 7.8 Draw the equivalent circuit for one phase with all quantities referred to the starters. 7.9 Explain the equivalent circuit parameter of an induction machine. 7.10 Draw the equivalent circuit of induction machine using Therminin's theorem.	DITTO	Teaching aids as in 1.1.

	7.11 Derive expression for the following: i) rotor copper loss ii) load input to the rotor iii) gross mechanical output. 7.12 Construct phasor diagram for the equivalent circuit in 7.8 above. 7.13 Determine the equivalent circuit parameters from the no-load test and locked rotor test.		

	7.14 Derive expression for torque using the machine parameters. 7.15 Explain the torque/speed characteristics. 7.16 Draw the current locus and circle diagram from given parameters. 7.17 Solve problems using circuit diagram. 7.18 State the need for starters for starting induction motor. 7.19 Explain methods of starting induction motors. 7.20 Solve problems on the starting of induction motors. 7.21 Illustrate with diagrams the connection of a universal motor. 7.22 Explain with the aid of a diagram the torque/speed characteristics of the motor in 7.19 above. 7.23 Solve problems involving induction machines. 7.24 Determine experimentally the efficiency of an induction motor.		

	General Objective 8.0: KNOW THE PRINCIPLE OF OPERATION & CONSTRUCTION OF TRANSFORMERS		
11-12	8.1 Explain the working principle of the transformer. 8.2 Develop the emf equation of a transformer. 8.3 Describe the different types of transformer cores and windings. 8.4 Explain resultant flux, magnetising inductance, leakage fluxes and leakage inductances. 8.5 Explain the phasor diagrams for transformer on no-load and on-load conditions. 8.6 Explain the equivalent circuit of a transformer. 8.7 Identify the limitations of the equivalent circuit and the approximate equivalent circuit. 8.8 Use the open-circuit test and the short-circuit test to determine the equivalent circuit parameters 8.9 Show with the aid of sketches the possible arrangement of three phase transformer windings. 8.10 Explain the purpose of the tertiary windings in three phase	Demonstrate, sketch, explain and have students practice same	Transformers (single & 3-ph) Voltmeter, Ammeter, watt meter Teaching aids, etc.

	transformers. 8.11 Explain the parallel operation of three phase transformers. 8.12 Derive expression for load sharing of transformers connected in parallel 8.13 Describe methods of testing transformers namely: routing test during life span of the transformer. 8.14 Explain the effects of temperature rise on transformers. 8.15 Describe methods of cooling transformers. 8.16 Explain the limitations of each method. 8.17 Explain the source of vibration and noise in transformers. 8.18 Solve related problems involving 8.2, 8.4 and 8.12. 8.19 Determine by experiments: (i) voltage regulation of a transformer (ii) efficiency of a transformer		
	General Objective 9.0: UNDERSTAND SINGLE PHASE MOTOR AND THE PRINCIPLE OF OPERATION OF MOTOR STARTER		
13	9.1 Describe the general common types of single phase motors. 9.2 Describe the starting methods of single phase motors. 9.3 Describe an automatic starter showing variation of starting current with time. 9.4 Describe the control systems for series motors. 9.5 Carry out practical demonstrations on starters. 9.6 Carry out practical demonstration to show the relationship between frequency, number of poles and speed of a machine.	DITTO	Single phase motor Single phase starters Teaching aids as in 1.1.

	General Objective 10.0: UNDERSTAND ALTERNATORS		
14	10.0 Describe the construction of a salient pole alternator. 10.2 Describe a cylindrical rotor machine. 10.3 Describe the construction of distributed winding machine. 10.4 Describe a brush less machine. 10.5 Dismantles and re-assemble the item mentioned in 10.3. 10.6 State the emf equations and solve problems. 10.7 Carry out practical demonstrations of load sharing and synchronising. 10.8 Describe automatic voltage regulators.	DITTO	Brush-less machine Distributed winding machine, Tool Box

	General Objective 11.0: KNOW DISTRIBUTION SYSTEM		
15	11.1 Explain the meaning of voltage drop. 11.2 Illustrate single and double feed distributors on board a ship, 11.3 Carry out practicals on the running of a D.C. 2-wire and D.C. 3-wire systems. 11.4 Explain the A.C. single-phase. 11.5 Describe the three phase, 3-wire and 3- phase, 4-wire distribution methods. 11.6 Describe star and delta (mesh) connections for supply and loads. 11.7 Illustrate phase and line relationships and power.	DITTO	Conductors Teaching Aids as in 1.1. Terminal box of a motor of alternator.

ASSESSMENT: 40% continuous Assessment (Assignments on Test every 5 weeks minimum) 60% examination

LIST OF MINIMUM EQUIPMENT FOR HND 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 machine 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.	Callipers (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

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

4	Marking out table	1
5	Power hacksaw	1
6	Flat rough file (300mm)	30
7	Round rough file (300mm)	30
8	Square rough file (300mm)	30
9	Flat smooth file 250mm)	30
10	Half round rough file (150mm)	30
11	Triangular rough file (150mm)	30
12	Try-square	30
13	Dividers	30
14	Steel rule	30
15	Wallets of warding file	10 sets
16	Scribers	16
17	Vee block and clamp	2
18	Scribing block	2
19	Centre punches	30
20	Cold chisels (set)	10 sets
21	Scrapers (set)	5
22	Guilotine	2
23	Vernier Caliper	10
24	Hacksaw frame	30
25	Stock and dies (set) metric	3 sets
26	Taps and wrenches (set) metric	3 set
27	Hand drill	2
28	Centre drills	Lot
29	Tap extractor (set)	2 sets
30	Screw extractor (set)	4
31	Screw gauges (assorted)	2 sets
32	Screw driver (set)	4 sets
33	Hammers (assorted weight)	30
34	Wire brush	5

35	Micrometer (assorted)	5
36	Fire extinguisher, water and sand buckets	4 each
37	Feeler gauges	10
38	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 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 WORKSHOP

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
17	Quecching bath	2
18	Thermocouples	2
19	Pickup tongs (assorted)	10
20	Combined portable thermocouple pyrometer	1
21	Hammers (assorted)	6 each
22	Wire brush	2
23	Pedestal grinder	2
24	Hacksaw frame and blades	10
25	Eye Goggles	10
26	Face shield	10
27	Heat resistant gloves	10 pairs
28	Knee leggings (foundry)	10 pairs
29	Leather apron	10 pairs
30	Safety boots (fire resistant)	10
31	Moulding bench	10
32	Bottom board	20
33	Moulding flask	20
34	Moulding sand shovel	20
35	Watering can	5
36	Wheel-barrow	4
37	Rammers (various types)	20
38	Moulding trowels (various sizes)	20
39	Strike-off-bars	20
40	Gate cutter or spoon	20
41	Sprue pins	20
42	Vent rods	20

43	Bellows	10
44	Lifters	10
45	Bold sponges	10
46	Draw pins	100
47	Bench vice	12
48	Hand vice	6
49	Cutting pliers	6
50	Combination pliers	20
51	Half round bastard file	20
52	Flat file second cut	20
53	Triangular file	20
54	Round file	20
55	Sand mixing machine	1
56	Moulding machine	5
57	Continuous mixer machine dispenser	1
58	Core boxes	10
59	G. Clamps	20
60	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 calliper	5
31	Outside calliper	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	Clinometers	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 centres	2
57	Block level	4
58	Measuring ball	2 sets
59	Measuring cylinder	2 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	Straight 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 calliper	3
67	Vernier height gauge (75mm-100mm)	4
68	Vernier calliper	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 gauge	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	Bernoulli 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	Rota-meter	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 anemometer	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	Un-calibrated mercury in glass thermometer 10° to 110 °c	20
3	Resistance thermometer	1
4	Bench mounted air-cooled 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 interface	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

NATIONAL DIPLOMA AND HIGHER NATIONAL DIPLOMA

Guidelines for textbook writers

The following guidelines are suggestions from the Engineering Committees to the writers of the textbooks for the new curricula. They are intended to supplement the detailed syllabuses which have been produced, and which define the content and level of the courses.

Authors should bear in mind that the curriculum has been designed to give the students a broad understanding of applications in industry and commerce, and this is reflected in the curriculum objectives.

- One book should be produced for each syllabus
- Page size should be A4
- The front size should be 12 point for normal text and 14 point where emphasis is needed
- Line spacing should be set to 1.5 lines
- Headings and subheadings should be emboldened
- Photographs, diagrams and charts should be used extensively throughout the book, and these items must be up-to-date
- In all cases, the material must be related to industry and commerce, using real life examples wherever possible so that the book is not just a theory book. It must help the students to see the subject in the context of the 'real word'
- The philosophy of the courses is one of an integrated approach to theory and practice, and as such, the books should reflect this by not making an artificial divide between theory and practice.
- Illustrations should be labelled and numbered.
- Examples should be drawn from Nigeria wherever possible, so that the information is set in a country context.
- Each chapter should end with student self-assessment questions (SAG) so that students can check their own master of the subject
- Accurate instructions should be given for any practical work having first conducted the practical to check that the instructions do indeed work
- The books must have a proper index or table of contents, a list of references and an introduction based on the overall course philosophy and aims of the syllabus.
- Symbols and units must be listed and a unified approach used throughout the book

- In case of queries regarding the contents of the books and the depth of information, the author must contact the relevant curriculum committee via the National Board for Technical Education
- The final draft version of the books should be submitted to Nigerian members of the curriculum working groups for their comments regarding the content in relation to the desired syllabus.

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